

RESEARCH ARTICLE OPEN ACCESS

Augmented Heritage: Unlocking Government Museums via Augmented Reality

Kriti Singh^{1*}, Dr. Akriti Jaiswal²

¹Research Scholar (Department of Commerce, University of Lucknow, India)

²Assistant Professor (Department of Commerce, University of Lucknow, India)

*Corresponding author's Email: sing.kriti15@gmail.com

Abstract

Museums worldwide are shifting from static, object-centred exhibition models toward interactive, technology-enabled experiences that support deeper visitor engagement and learning. Augmented reality (AR) has emerged as one of the most promising tools for this transformation, allowing digital content to be layered onto physical heritage artefacts without compromising their authenticity. In India, government museums hold vast and culturally significant collections, yet many continue to rely on traditional, low-interaction exhibition practices that fall short of the expectations of digitally connected audiences. While the literature on AR in museums is growing, existing research remains fragmented, typically examining single outcomes such as engagement, satisfaction, or learning in isolation, with little attempt to integrate these into a unified value perspective, particularly for government-run institutions. This conceptual paper addresses that gap by proposing the Augmented Heritage Value (AHV) framework, which characterises the incremental value AR contributes to a heritage encounter across three interrelated dimensions: Educational, Informational, and Experiential value. Adopting a descriptive, qualitative research design, the study synthesises twelve peer-reviewed sources spanning empirical quantitative studies, a bibliometric field-level analysis, case-based AR deployments, and a qualitative documentary account of Indian museums, using narrative and thematic synthesis to triangulate each AHV dimension across independent bodies of evidence. The paper then applies the framework to the context of Indian government museums, reframing documented constraints such as limited digitization, uneven regional access, and a shortage of trained personnel as opportunity areas for sequencing future AR investment. The AHV framework offers both a theoretical contribution, a unifying construct for a currently disjointed field, and a practical tool for museum practitioners and policymakers seeking to guide AR adoption in resource-constrained government settings.

Keywords: Augmented Reality; Augmented Heritage Value (AHV); Cultural Heritage; Government Museums; Digital Transformation; Visitor Experience.

This article is published under the Creative Commons Attribution License, allowing use, distribution, and reproduction in any form, as long as the original work is properly acknowledged.



© 2026 The Author(s). Prabandhan Vimarsh, MBA (Finance & Accounting), Department of Commerce, University of Lucknow.

For more details, visit <https://creativecommons.org/licenses/by-nc/4.0/>.

1. Introduction

Over the last few decades, museums have undergone a remarkable transformation in terms of how their users interact with and engage with artefacts, and how they are used to facilitate the teaching of historical content and skills, and cultural preservation, public engagement and experiential learning (Hooper-Greenhill, 2007; Black, 2012; Falk & Dierking, 2016). While museums are still places where historical items are kept, modern museums are also powerful teaching and learning machines which encourage visitors to participate and share their knowledge with the public (Parry, 2007; ICOM, 2022). The shift reflects the change of expectations upon the visitors: their experience in the museum is not limited to observation, but is more of an engagement, immersion and participation in cultural heritage. In this aspect, the museum is an organization for learning and entertainment. As museums have become more experience-driven and cultural, immersive technologies that can support the meaningful and personalized learning of visitors are becoming more important (Falk & Dierking, 2016; Black, 2012; Xiao et al., 2026). India's heritage is one of the largest and most diverse in the world and many public and government institutes in India contain archaeological remains, manuscripts, sculptures, paintings, textiles, coins, ethnographic collections and other more valuable cultural relics. In addition to education, promoting cultural identity, facilitating intercultural dialogue, and advancing cultural tourism, Indian museums have a crucial role to play in safeguarding these collections.

But in spite of their great cultural importance, many government museums still practice traditional museum exhibition approaches, which are built around static exhibition practices, labels and minimum interaction with visitors. The solutions are often less successful than those required by digitally connected audiences who are accustomed to personalised, interactive and technologydriven cultural experiences (Black, 2012; Falk & Dierking, 2016; Yoon & Elinich, 2012). Computer technologies have revolutionized the museum world across the globe. Museums have been transformed by documentation, virtual exhibitions, artificial intelligence (AI), Virtual Reality (VR) and most of all Augmented Reality (AR) in terms of the interpretation, preservation and dissemination of cultural heritage (Trunfio et al., 2022; Damala et al., 2019; Parry, 2007). Digital technologies are rapidly evolving and are transforming our daily lives as well as human-technology interaction (HTI) between the real and the virtual world, particularly in the tourism industry with experiences as the core of business (Serravalle et al., 2019; Trunfio et al., 2022; Li & Xiao, 2021). Of these innovations, AR has come out as one of the most promising technologies

as it adds digital content to physical environments while maintaining the authenticity of the actual artefact (Azuma, 1997; Javornik, 2016). When implemented in a museum context, AR can be used to immerse people in the story and objects of the past, combining 3D visualizations, multimedia resources, narration and context, and enabling an interactive learning element, including animation.

In the tourism sector, augmented reality (AR) has come a long way, particularly in the cultural heritage tourism field, where it has revolutionized traditional sightseeing by adding an interactive and immersive element (Xiao et al., 2026). Academic publications of AR technologies for the creation of immersive heritage experiences are growing in number, reflecting the increasing impact of AR in the museum context. Recent investigations have shown that AR can create greater engagement, learning, retention, emotional connection, satisfaction with the museum and intention to return to the museum (Yim et al., 2017; Poushneh & Vasquez-Parraga, 2017; tom Dieck & Jung, 2018; Rhee & Lee, 2021; Whang et al., 2021; Lavoye et al., 2023; Lin & Huang, 2024; Ngo et al., 2025). Moreover, AR can have both educative and entertaining functions to provide immersive experiences that can be enjoyed by a wide range of visitor groups (Jung et al., 2016; tom Dieck & Jung, 2017). These aspects of the AR experience – visual appeal, usability, content richness, and personalization – are of key importance to AR visitors, and appear to have a positive impact on the engagement of AR visitors and the overall museum experience (Lee et al., 2015; Chung et al., 2018; Jung & tom Dieck, 2017). The Augmented Reality (AR) technology is becoming an exciting way to enhance the experience of people visiting museums and other buildings of public interest, having come to the fore with the growing digitalization of government and public museums. In addition to technological innovation, the effectiveness of AR relies on the ability to provide viewers with aesthetically pleasing, easy to use, informative, and customizable experience that facilitates the deeper involvement with cultural heritage (Lee et al., 2015; Jung et al., 2016; tom Dieck & Jung, 2017; Chung et al., 2018).

However, more recently, AR-based game narratives and immersive digital narratives have been identified as effective strategies to promote exploration, engagement, emotional engagement and personalized heritage experience in museums and cultural sites (Xiao et al., 2026). AR can offer great heritage preservation and interpretation opportunities as well as be used to engage visitors. It helps to virtual re-construct the damaged monuments, to reconstruct missing artefacts, to simulate the historical context and to present the collections that cannot be damaged (Zhang, Y. et al., 2024). Accordingly, AR can be a helpful tool to solve the problem of balancing heritage

conservation and interpretive approaches that are important and acceptable to visitors, helping museums to enhance their visitors' experience while teaching the original collections (Javornik, 2016; Zhang Y. et al., 2024). All these characteristics have given rise to the possibility of using AR as a technology to enhance the digital transformation of museums and, in turn, the accessibility of cultural heritage. Noting this potential, the Government of India has launched a number of initiatives that seek to upgrade museums with digital innovation. The Ministry of Culture has encouraged the digitization of museums and the creation of the National Portal and Digital Repository for Museums of India (JATAN), and other institutions, such as the Pradhan Mantri Sangrahalaya, the Indian Museum Kolkata, the National Council of Science Museums, and several emerging state museums, have integrated immersive technologies, digital storytelling, virtual exhibitions and AR (augmented reality) interpretation to enhance visitor engagement and heritage communication (Ministry of Culture, 2024; Museums of India, 2024; Rege, 2025). The developments are just an example of increasing institutional adoption and interest in using digital technologies as a tool for our museum management and are a pointer to the possibility of growing the developments of AR in the Government museum ecosystem of India.

In this dynamic environment, this research is based on the idea of Augmented Heritage and the value proposition it entails. The Augmented Heritage is the digitally enriched interpretation and communication of cultural heritage, which includes the use of Augmented Reality in the interpretation and communication of physical heritage assets. Through the combination of contextual digital information, 3-D visualizations, historical reconstruction, multimedia content, and interactive storytelling, AR enriches visitors' understanding, engagement, and learning while maintaining the authenticity of the original heritage. Augmented Reality does not supplant cultural heritage, but rather serves as an interpretative and communicative tool that enhances the links between cultural heritage, museums and their audiences, thus creating more immersive, accessible and meaningful cultural experiences (Casella & Coelho, 2013; Challenor & Ma, 2019; Damala et al., 2019; Ramtohul, 2024). The interpretative power of digital layering has already been demonstrated in the Indian government's efforts to digitise and make accessible more than one lakh historical antiquities at ten national museums, including the JATAN: Virtual Museum Builder and the National Portal and Digital Repository for Museums of India (Museums of India, 2024). Based on the concept of Augmented Heritage (Casella & Coelho, 2013) and the multidimensional value perspective of Augmented Reality in cultural heritage proposed by tom Dieck and Jung (2017),

this study will develop the idea of Augmented Heritage Value (AHV) as the multidimensional value produced by using Augmented Reality for cultural heritage interpretation, interactive storytelling, visitor participation, accessibility, and contextual communication to enhance the cultural heritage experience and generate educational, experiential and informational value.

In contrast to the majority of previous research studies that focused on individual outcomes of visitors, Augmented Heritage Value takes a holistic approach to AR by acknowledging its role as a strategic tool for value creation, in terms of strengthening the communication of heritage, improving the attractiveness and accessibility of museums, cultural sustainability and the digital transformation of government museums (tom Dieck & Jung, 2017; Damala et al., 2019; Trunfio et al., 2022; Ramtohl, 2024). Augmented Heritage Value (AHV) is the multidimensional value gained when Augmented Reality enables cultural heritage to be richer in interpretive, educational, experiential, institutional and societal outcomes in relation to the transformation of cultural heritage into increased communication, interaction, accessibility and participation. Inspired by the concept of Augmented Heritage (Casella & Coelho, 2013) and taking the concept of stakeholder value of tom Dieck and Jung (2017) a step further, AHV introduces Augmented Reality as more than just an immersive technology but as an instrument for sustainable value creation for visitors, museums and society.

While the study of Augmented Reality in museums is growing increasingly, the field is still somewhat disjointed and mainly linked to the museum visitors, with existing research focused on particular outcomes such as engagement, satisfaction, immersion, learning and revisit intention. With a few notable exceptions, very little has been done to address the various aspects of AR's impact on the museum visitor's experience - heritage interpretation, interactive storytelling, visitor interaction, digital accessibility, institutional efficiency, and cultural sustainability as a unified, integrated process, especially in the case of government museums. The current body of literature usually focuses on one of these dimensions, thereby resulting in a limited concept of the value of AR to the public museum's mission as a whole, instead of a coherent understanding of its value. Furthermore, the pressure on making museums accessible and engaging for the public was felt also at the institutional level, which is evident in the institutional practice of museum digitisation, but at the same time, present there is a conceptual void, there is no theoretically oriented connection between the policy-level experience of museum digitization and the strategic role AR can play in government institutions of cultural heritage. To fill this gap, the present study proposes to enrich

the Augmented Heritage Value (AHV) framework, which aims not only to define AR as a tool for enhancing the visitor experience, but also as a value-creation mechanism for government museums by increasing their institutional capacity, public value, and sustainable digital transformation.

2. Literature Review

Over the last few decades, museums have undergone a remarkable transformation in terms of how their users interact with and engage with artefacts, and how they are used to facilitate the teaching of historical content and skills, cultural preservation, public engagement and experiential learning (Hooper-Greenhill, 2007; Black, 2012; Falk & Dierking, 2016). Museums are still institutions where historical items are stored, but modern museums are also institutions of great teaching and learning power which invite visitors to participate in the institution, and to share their knowledge with others (Parry, 2007; ICOM, 2022). It is a sign of the evolving expectations of visitors to museums, where they want to observe but also engage, immerse and participate in cultural heritage activities. Museums in this context have turned into learning, and entertainment too, making immersive technologies even more relevant to engage in meaningful and personalised experiences for visitors (Falk & Dierking, 2016; Black, 2012; Xiao et al., 2026). Li et al. (2023) found that the themes of research on immersive museum technology include engagement and accessibility and cultural heritage, while Upasani et al. (2023) reported on the increasing implementation of ARVR-MR in various fields, including 3D reconstruction, gaming and education.

The studies suggest the growing prospects of immersive technologies to transform museum experience and communication on cultural heritage. The heritage of India is one of the largest and richest in the world and there are various public and government institutions that have archaeological remains, manuscripts, sculptures, paintings, textiles, coins, ethnographic collections and other valuable cultural relics. In addition to education, promoting cultural identity, facilitating intercultural dialogue and advancing cultural tourism, Indian museums have a crucial role to play in safeguarding these collections. Many government museums, however, still use traditional methods of exhibiting that are based on static exhibits, labelling and minimal interaction with the public. These may not be the most appropriate strategies for digitally connected audiences who have come to expect culturally personalised, interactive and tech-savvy experiences (Black, 2012; Falk & Dierking, 2016; Yoon et al., 2012 ss). These new technologies applied to the documentation, virtual exhibitions, Artificial Intelligence (AI) and Virtual Reality (VR), and especially Augmented

Reality (AR) have revolutionized, in this new museum context, the interpretation, preservation and dissemination of cultural heritage (Trunfio et al., 2022; Damala et al., 2019; Parry, 2007).

The added benefit of these technologies is AR, which integrates a digital display into a physical environment, while preserving the reality of the real artefact (Azuma, 1997; Javornik, 2016). In museums, AR can enhance the learning experience by providing 3D visualisations, multimedia, narration and contextual information to immerse visitors in the stories and objects of the past, thus fostering interactive learning. The growing body of research indicates that AR can enhance engagement, learning, emotional connection, satisfaction and intention to revisit museums (Yim et al., 2017; Poushneh & Vasquez-Parraga, 2017; tom Dieck & Jung, 2018; Rhee & Lee, 2021; Whang et al., 2021; Lavoye et al., 2023; Lin & Huang, 2024; Ngo et al., 2025). In addition to education and entertainment, AR can be used to create immersive experiences for various audiences of visitors (Jung et al., 2016; tom Dieck & Jung, 2017). Boboc et al. (2022) and Li et al. (2023) also show that three factors, namely, engagement, accessibility, visualisation, usability, usefulness and enjoyment are critical parts of immersive museum experiences.

In addition, the learning and knowledge seeking behaviour of visitors to AR have been explored. From the literature, Chen and Lai (2021) concluded that AR can enhance learning motivation and effectiveness of the visitors, especially in terms of attraction, relevance, logical clarity, curiosity and knowledge-seeking. The results suggest that AR can make museum activities more active learning activities, and also point out the need to assess the museum education's educational effectiveness in using AR. Additionally, Chen et al. (2024) identified that AR novelty, aesthetics, educational value, authenticity and interactivity positively impacts visitors' satisfaction and behavioral intentions. The results indicate that the success of AR is not just a result of the technology itself, but the content that is displayed to the visitors. The results indicate that the effectiveness of AR is not only due to the technology itself but also due to the quality, relevance, and authenticity of the content that is presented to visitors.

The experiential aspect of AR has been further emphasized in an approach of storytelling, personalization and visitors' participation. Panhale et al. (2023) defined AR as an augmented environment that allows for storytelling, personalization, participation and guided interaction to co-create the visitor's experience. It indicates that visitors can be active instead of passive recipients, in the interpretation of heritage. Xiao et al. (2026) elaborated on the narrative aspect of the immersive heritage experience, and emphasized gamified AR narratives, multisensory

interaction and emotional engagement as key components that promote immersion, engagement and heritage learning. Likewise, Zhang et al. (2024) showed how 3D visualization, virtual restoration and active audience participation techniques can be applied to heritage exhibits. Also, Casella & Coelho (2013) pointed out the increasing adoption of mobile AR applications to support museum communication and education, stressing the role of content and user interface design.

These studies suggest that AR effectiveness is tightly linked with the design of digital content and its embedding in the physical museum environment. Immersive technologies are not just about engagement, but also about accessibility and preservation and broader museum roles. In the systematic review of empirical studies, Düzenli et al. (2026) identified several potential benefits of the AR/VR/MR/XR for the heritage preservation, heritage visualization, heritage immersion, heritage experiential learning, and heritage accessibility. Similarly, Mahesha and Babu (2025) noted the role of AI-powered technologies in enhancing the ways that exhibits are interpreted, preserved, accessible and engage visitors. The developments show the possibilities of immersive technologies not only for the visitor experience, but also for the educational and interpretive, preservation and public roles of museums. Meanwhile, the literature reveals that many of the studies are only partial and specific to a certain technology, a museum, the collections, or the outcome of the visit, and that research in this field is ongoing.

The use of AR in the Indian context also highlights its increasing significance in the field of museum interpretation and cultural preservation. Rege (2025) emphasized the application of immersive storytelling, 3D reconstruction and multisensory interaction in Indian heritage sites and museums, indicating their potential to make cultural heritage more accessible and engaging. In the case of the Kempegowda Museum, Rao (2024) showcased how AR/VR, interactive exhibits, and experiential narratives can breathe new life into the traditional museum setting, maintaining historical authenticity. Sharma and Jamwal (2026) also considered Indian museums as "living museums of public history and education and public engagement" and how digitization and technological innovation could enhance heritage education and public engagement in Indian museums. They are also reflected in institutional efforts towards museum digitisation and digital access to cultural collections. The literature collectively suggests a shift towards more dynamic and interactive, experiential, and technologically advanced methods of heritage interpretation from a focus on objects within a museum setting.

3. Conceptual Framework

3.1 Defining Augmented Heritage Value (AHV)

When augmented reality (AR) technology is used to enrich the value of a heritage artifact, monument or museum experience beyond its intrinsic value, it is called Augmented Heritage Value (AHV). In simple terms, AR adds an additional layer of meaning, understanding, engagement, and accessibility to a heritage object when the digital content is overlaid onto it, which is what AHV is. AHV does not view AR as a singular, standard improvement, but understands that the added value is manifested in various ways depending on the exhibition and the audience. An AR application could greatly enhance the factual knowledge about an artifact that a visitor already has, but not increase its experience of engagement or emotional significance, or it could increase the engagement and emotional impact of a visit without adding much factual information. This is why AHV separates out the positive value of AR into various definable dimensions, instead of considering it as a single undifferentiated value. The value measured by AHV is not the value of the museum visit overall, but the value added by AR to a traditional museum visit. A static exhibit is valuable in itself; AHV is a discussion about what AR can bring to the base of that. The three dimensions put forward to operationalize this incremental value are: educational, informational, experiential value.

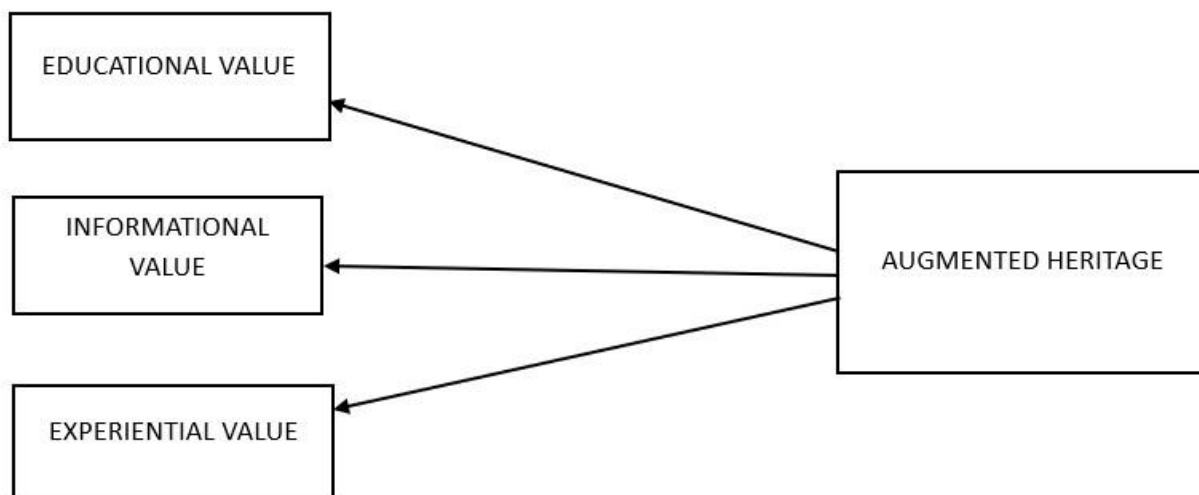


Figure 1 Conceptual Model

Source: Developed by the author, based on Casella and Coelho (2013) and tom Dieck and Jung (2017), and informed by Chen et al. (2024), Cheng et al. (2025), and Han et al. (2021)

The different dimensions represent different mechanisms by which AR changes the way the user interacts with the heritage content and collectively constitute a composite lens to assess the role of AR in museum practice. The framework is intentionally conceptual, not psychometric, because it states what AR adds, where, but not how much.

3.1.1 Educational Value

The value of education is AR's ability to produce learning outcomes for museum visitors, such as increased understanding, knowledge retention, and academic success, rather than the quality of the information it conveys. In a heritage museum context, AR glasses significantly improved the learning outcomes and satisfaction of visitors when used, with technical novelty, user trust and situational aesthetics determined as key factors influencing the educational value of the AR experience (Chen et al., 2024). In the study of AR-based museum learning by Cheng et al. (2025) at Wuhan Natural History Museum, it was found that learning motivation has a positive impact on academic performance, whereas immersive and imaginative experiences of AR-based museum learning are intervening variables affecting academic performance, rather than information being presented alone. This is important for AHV because it suggests that educational value is a downstream psychological and behavioural outcome, which can be achieved by motivating and immersing the visitor with AR delivered content, rather than by making information for the display a "direct or automatic" consequence of AR. Boboc et al. (2022) also place this dimension in the context of the wider field, indicating that education is one of the most common research trends in AR applications for cultural heritage from 2012 to 2021, alongside 3D reconstruction, digital heritage and virtual museums.

3.1.2 Informational Value

Informational value is the quality, richness, and reliability of the content AR brings to the visitor regardless of whether or not it is a measurable learning outcome. Cheng et al. (2025) directly operationalized this distinction, demonstrating that the information quality has a positive effect on visitors' immersion and imagination, and that the information richness has an independent effect on academic achievement, with information quality acting as a mediator between information richness and academic achievement, rather than being the actual outcome of information. This aligns with the Information System Success Model, which establishes quality of information, along with system quality and service quality, as a fundamental factor that contributes to user satisfaction

and user intention to use a technology system. In the AR museum context, informational value relates to questions of accuracy, completeness and timeliness of the content of the interactive overlay on the artifact, and the extent to which AR enhances or improves the information already displayed within the physical exhibit, without regard to post-AR learning gains. For government museums, and by extension many others, this separation is more real: a successful AR deployment might provide high-quality, accurate, well-curated information (high informational value), without necessarily meaning a measurable improvement in the learning outcomes of the visitors (educational value) - these two values are distinct and must be designed independently of each other.

3.1.3 Experiential Value

Experiential value is the sensory, hedonic and affective aspects of the AR experience for the visitor, beyond the interactive or participatory components of engagement. Han et al. (2021) offer the basic definition of this construct, which explores AR experiential value at heritage sites where the artifacts and monuments can only be viewed indirectly by the visitor because of physical restrictions (e.g., controlled information boards, rope-laying). Their study conceptualizes AR experiential value as multi-dimensional, including visual appeal, entertainment, enjoyment, and escapism, and shows that the experiential aspects are important in influencing visitors' destination related behaviour including satisfaction and the willingness to support heritage conservation. This places experiential value not just as an “added value” of the AR experience, but as a contributor to the downstream attitude of the visitor to the heritage site. This experiential element is especially relevant in the context of heritage, given that restriction of the senses is a frequent occurrence: fragile exhibits, roped off monuments and glassed-in glass cases often limit the sensory qualities of an unaugmented visit. Han et al. (2021) point to this as an example of AR working as a compensation strategy in this context, providing visual richness, novelty, and escapism that a distance-viewed artifact alone cannot provide. Similarly, Zhang, H.-J. et al. (2024) concluded that perceived value positively mediated the relationship between AR service quality and the intention to adopt AR services in museums, highlighting the importance of the experiential quality of an AR encounter and not the technology itself. This aspect of AHV is particularly relevant in government museums where display cases, roped barriers and "do not touch" signage are not out of the ordinary. AR's ability to provide visual salience, novelty and some escapism overcomes these inescapable

physical limitations to provide a pathway to a more meaningful visitor experience which does not involve changing any conservation protocol.

4. Objectives of the Study

1. To propose a new concept of Augmented Heritage Value (AHV) that will be used to conceptualize the contribution of AR to heritage museums in terms of multiple dimensions.
2. To explore each dimension, through a review of the AR–heritage literature, conceptual and empirical.
3. To explore the applicability of the AHV framework to the context of Indian government museums.

5. Research Methodology

5.1 Research Design

This study is designed to be descriptive with qualitative approach and will be applied to conceptual research. The goal of the paper is not to test hypotheses with primary data, but to propose and develop the Augmented Heritage Value (AHV) framework, therefore a descriptive design is suitable and appropriate: it is suitable because it is necessary to describe, synthesize, interpret existing studies on the application of AR in the field of heritage and museum, from which a new theoretical construct can be developed. Of the fourteen sources examined in this paper, fourteen were empirical studies using quantitative methods (such as structural equation modelling, survey instruments, or PLS-SEM analysis) with a specific focus on testing some hypotheses. The present paper does not replicate or extend any of these empirical models, but rather uses the sum of the results from all the studies to be synthesized descriptively, looking for patterns that are common to all of the studies, but have not been reflected in any single one. This places the design of the paper in a logical sequence before the framework can be operationalized and tested, following the conceptual-paper approach to developing a framework from a body of evidence before the framework is then tested and operationalized.

5.2 Research Approach

The paper adopts a conceptual-analytical approach that reviews, compares and synthesizes the existing empirical and conceptual literature in the field of AR applications in cultural heritage, museum studies and heritage tourism to identify the value dimensions that are common across the different applications. This paper is informed by the core sources of information, which come in three different methodological forms and provide different components to the framework:

Empirical (quantitative) studies included: Chen et al. (2024) tested a specific hypothesized relationship of AR service quality → perceived value → adoption intention with a sample of visitors ranging from 254 to 324 respondents; Han et al. (2021) tested the hypothesized relationship between information quality and immersion with academic achievement; Zhang, H.-J. et al. (2024) tested the hypothesized relationship between information quality and immersion with academic achievement; Cheng et al. (2025) tested the hypothesized relationship between AR service quality and perceived value with the adoption intention; Xu et al. (2025) tested the hypothesized relationship between information quality and immersion with the academic achievement. The nine-year time frame (2012–2021) included 1,201 documents in the Scopus and Web of Science databases, which were analyzed by Boboc et al. (2022) to identify recurring research trends in the field, the following: education, user experience, gamification, and 3D reconstruction. This source provides evidence for "field-level validation," which validates the dimension that is suggested in AHV as a consistent pattern in a substantial volume of published research. Although not theoretical models, Hammady et al. (2018), Pauls and Karsakov (2021), Zhang, Y. et al. (2024), and Barneche-Naya and HernándezIbáñez (2026) each present specific AR deployments: Museum Eye at the Grand Egyptian Museum, an AR calligraphy application, the Terracotta Army Restoration Hospital, inclusive VR design for older visitors.

The sources provides an illustration of the concrete mechanisms that enable the abstract dimensions of AHV to come to life in the museum, rather than them remaining purely theoretical; the use of real-life examples from the museum instead of theoretical ones. Sharma and Jamwal (2026) conducted a qualitative documentary analysis research on Indian museums, particularly, highlighting the issues of limited digitization, unequal access to museums in different regions, and inadequate infrastructure of trained museum personnel. This source provides the "contextual grounding" that is required for the application of the AHV framework specifically to Indian government museums in the subsequent sections that do not deal with the conceptual framework.

5.3 Method of Analysis

The sources were analyzed with a narrative and thematic synthesis approach, which is divided into three stages:

- The findings, hypothesized relationships and outcomes of the papers were extracted and tabulated based on the value mechanism of the paper (e.g., what findings of the paper were on information quality vs informational value, learning motivation vs educational value, and academic achievement vs informational value).
- The result of the independent studies was grouped together and seen thematically by convergence. The relevance of the Educational Value dimension of AHV is substantiated by the research results that AR enhances learning for visitors (Chen et al., 2024), that the quality of the information is the mediating factor between immersion and academic achievement (Cheng et al., 2025), and that one of the recurring field-wide trends is education (Boboc et al., 2022). The other two dimensions of AHV (Informational and Experiential value) were created in a similar way, using a triangulation across independent studies for each dimension, without depending solely on any one study to determine a dimension of AHV.
- Results were then organized into themes and combined into the three dimensions of AHV, the Indian-context source (Sharma & Jamwal, 2026) connecting the three dimensions to the context of government museums that follows, and the case-based sources (Hammady et al., 2018; Pauls & Karsakov, 2021; Zhang, Y. et al., 2024) explicitly illustrating each dimension.

The analytical approach adopted is similar to that adopted in the other descriptive studies of museums which are based on historical or documentary method. The documentary evidence is examined critically, the interpretation is done within the context of the material, and a comparative analysis between the materials and the interpretation is made, as opposed to testing against statistical evidence (Sharma & Jamwal, 2026).

5.4 Data Sources

The study includes twelve peer-reviewed journal articles (appearing in journals included in the Scopus and Web of Science categories of Heritage Science, Applied Sciences, Sustainability, Frontiers in Psychology, PLOS ONE, SAGE Open, Journal of Quality Assurance in Hospitality & Tourism, Procedia Computer Science, International Journal of Arts, Humanities and Social Studies, Journal of Business of Tourism, and Science for Sustainable Tourism), one Springer conference proceedings volume and one Springer book chapter. Empirically, the studies cover museum environments in China (Liangzhu Museum, Wuhan Natural History Museum, Sanxingdui Museum, Terracotta Army Museum) as well as wider cross-national bibliometric samples, and the two most recent (Barneche-Naya & Hernández-Ibáñez, 2026; Sharma & Jamwal, 2026) expand the evidence base to accessibility-focused and Indian-specific settings. The geography and methodology enables the resulting AHV framework to be developed on the back of converging international evidence rather than one national or institutional context, and is then purposefully used in the little-studied context of a government museum in India.

6. Results

6.1 Overview

Reading the twelve sources together, rather than separately, surfaces three recurring value mechanisms that correspond to the dimensions defined in the conceptual framework: Educational, Informational, and Experiential value.

6.2 Educational Value

Chen et al. (2024) and Cheng et al. (2025) both associate AR service quality with perceived value and adoption intention, suggesting that the pedagogical value visitors perceive in AR is a key driver of adoption, not merely a by-product of it. Han et al. (2021), Zhang, H.-J. et al. (2024), and Xu et al. (2025) examine the same dimension through academic performance and consistently find that immersion alone does not produce learning gains: information quality mediates the relationship. Boboc et al. (2022) corroborates this at the field level, identifying education as one of the most recurrent themes across 1,201 documents published between 2012 and 2021.

6.3 Informational Value

The same three information-quality studies (Han et al., 2021; Zhang, H.-J. et al., 2024; Xu et al., 2025) support a second, related dimension: AR platforms that prioritise content accuracy and clarity outperform those built around immersive spectacle alone. Pauls and Karsakov (2021) illustrates this concretely with an AR calligraphy application that overlays contextual and procedural information onto artefacts rather than purely visual effects.

6.4 Experiential Value

He and Wang (2025) traces a similar AR service quality–perceived value–adoption intention pathway to Chen et al. (2024), but with emphasis on experiential satisfaction. Boboc et al. (2022) identifies gamification as a recurring field-wide trend. Case-based evidence from Hammady et al. (2018) (Museum Eye at the Grand Egyptian Museum) and Zhang, Y. et al. (2024) (the Terracotta Army Restoration Hospital) shows that the AR medium alone is not sufficient to generate experiential value - it depends on deliberate content design.

6.5 Cross-Cutting Synthesis

Each of the three dimensions is independently supported by at least two sources, so no dimension rests on a single study. The quantitative studies (Chen et al., 2024; Han et al., 2021; Zhang, H.-J. et al., 2024; Cheng et al., 2025; Xu et al., 2025; He & Wang, 2025) consistently model value constructs as antecedents of adoption intention, suggesting that all three dimensions ultimately feed into sustained visitor engagement. The case-based sources (Hammady et al., 2018; Pauls & Karsakov, 2021; Zhang, Y. et al., 2024) confirm that each dimension has already been operationalized in a real deployment, giving the framework practical as well as theoretical standing.

6.6 Contextualizing AHV for Indian Government Museums

Sharma and Jamwal (2026) document limited digitization, uneven regional access, and a shortage of trained personnel in Indian museums. Framed constructively, these are starting conditions rather than disqualifying deficits: limited digitization constrains Informational value, since AR content quality depends on digitised source material, while the personnel shortage constrains both Educational and Experiential value, as these dimensions depend on well-designed, trust-building AR content that requires trained staff to deploy and maintain. The AHV framework thus offers a way to sequence AR investment against the dimension most constrained by an institution's current

infrastructure. It is worth noting that Sharma and Jamwal (2026) also raise regional access as a distinct constraint; this points toward Accessibility as a candidate dimension for future extension of the AHV framework, discussed further under Future Research Directions, rather than a dimension addressed within the present three-dimension model.



Figure 2 Deve Gowda gallery / Political Journey exhibit

It shows the interactive gallery display on shri H.D. DEVE GOWDA's political journey obtained from Pradhanmantri Sangrahalaya, by Ministry of Culture, Government of India.

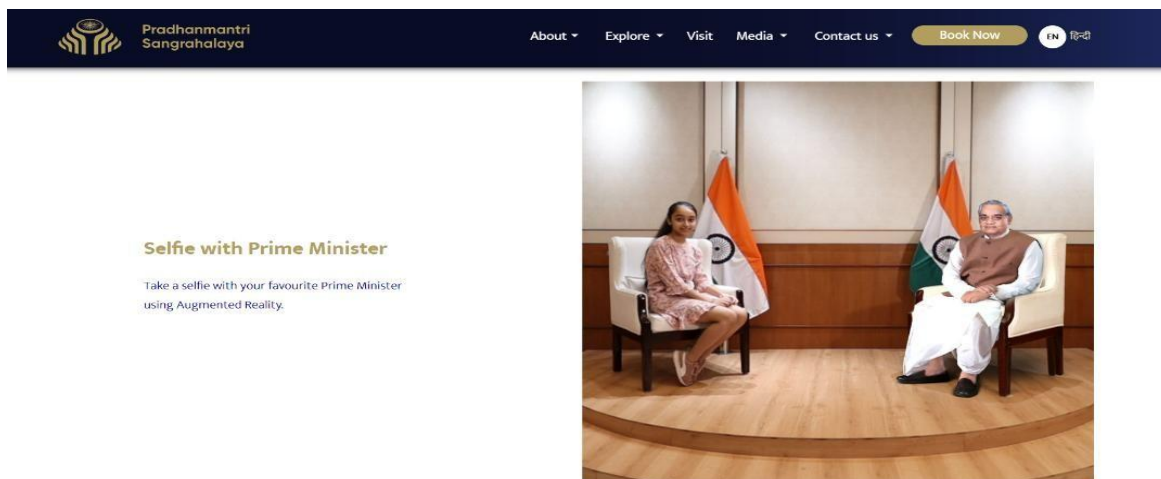


Figure 2: Selfie with Prime Minister – AR feature

Selfie with Prime Minister Augmented Reality experience at Pradhanmantri Sangrahalaya obtained from Pradhanmantri Sangrahalaya, by Ministry of Culture, Government of India.

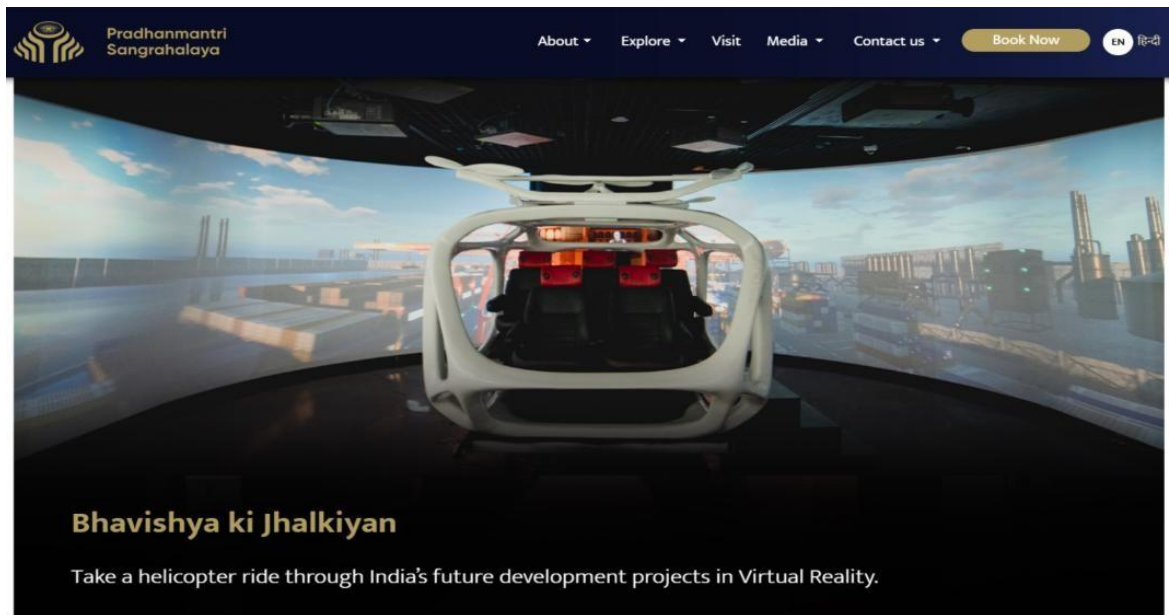


Figure 3: Bhavishya ki Jhalkiyan – VR helicopter ride

Bhavishya ki Jhalkiyan virtual reality helicopter experience showcasing India's development projects obtained from Pradhanmantri Sangrahalaya, by Ministry of Culture, Government of India.

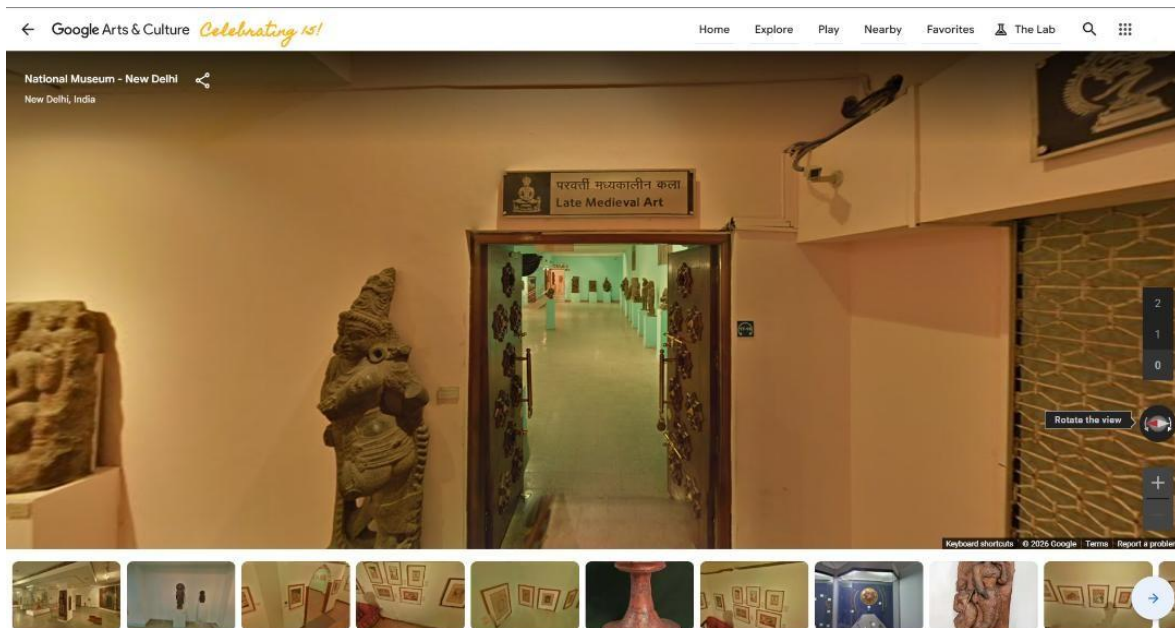


Figure 4: National Museum, New Delhi – Google Arts & Culture

Virtual street-view tour of the National Museum, New Delhi. From Google Arts & Culture, by Google LLC.

7. Implications

7.1 Theoretical Implications

Prior work models AR adoption through isolated constructs, service quality, immersion, information quality, each tested against a single outcome in a single setting (Chen et al., 2024; Cheng et al., 2025; He & Wang, 2025; Han et al., 2021; Zhang, H.-J. et al., 2024; Xu et al., 2025). By triangulating these alongside Boboc et al. (2022), Hammady et al. (2018), Pauls and Karsakov (2021), and Zhang, Y. et al. (2024), this paper proposes that these constructs are better understood as three dimensions of one underlying AHV construct, offering the field a unifying vocabulary rather than a growing list of context-specific variables. It also positions AHV as a mediating construct between AR quality and adoption intention for future adoption models.

7.2 Practical and Policy Implications

For museums generally, the framework offers a diagnostic tool: select AR design choices, content quality for Educational/Informational value, gamification and content design for experiential value, based on the dimension being targeted. For Indian government museums, given the infrastructural constraints documented by Sharma and Jamwal (2026), the framework suggests prioritizing digitization and content-quality investment first, since this underpins Informational value, before layering Experiential features. At the policy level, bodies such as the Ministry of Culture could use the framework to evaluate AR-related funding proposals against defined value outcomes rather than generic modernization targets.

8. Future Research Directions

- Empirical validation: Develop and test an AHV measurement scale to confirm whether the three dimensions load as distinct factors, building on the quantitative traditions of Chen et al. (2024), Cheng et al. (2025), and He and Wang (2025).
- Indian context: Collect primary data (visitor surveys, staff interviews, institutional case studies) from Indian government museums, since the Indian evidence here rests on a single qualitative source (Sharma & Jamwal, 2026).

- Longitudinal and comparative designs: Track how AHV dimensions evolve with repeated visitor exposure, or compare outcomes across government versus private/international museums.
- Extending the framework: Test whether Accessibility and Preservation/Reconstructive value, raised by Barneche-Naya and Hernández-Ibáñez (2026), Sharma and Jamwal (2026), Hammady et al. (2018), and Zhang, Y. et al. (2024), warrant inclusion as additional AHV dimensions beyond the present three.
- Personnel and capacity-building: Examine training models or partnerships that reduce Indian government museums' dependence on external AR vendors, addressing the shortage identified by Sharma and Jamwal (2026).

9. Conclusion

This paper synthesized twelve sources on AR in cultural heritage into the Augmented Heritage Value (AHV) framework, comprising three dimensions: Educational, Informational, and Experiential value, each supported by at least two independent sources. Applied to Indian government museums, the framework reframes documented constraints, limited digitization, uneven access, personnel shortages, as a basis for sequencing future AR investment rather than as barriers. The paper's contribution is conceptual: it offers AHV as a structured starting point for future empirical testing, positioning Indian government museums as a substantive, largely untapped setting for AR research and application.

REFERENCES

- Azuma, R. T. (1997). *A survey of augmented reality*. Presence: Teleoperators and Virtual Environments, 6(4), 355–385. <https://doi.org/10.1162/pres.1997.6.4.355>.
- Bachiller, C., Monzo, J. M., & Rey, B. (2023). Augmented and virtual reality to enhance the didactical experience of technological heritage museums. *Applied Sciences*, 13(6), Article 3539. <https://doi.org/10.3390/app13063539>
- Barneche-Naya, V., & Hernández-Ibáñez, L. A. (2026). Inclusive museum experiences through immersive virtual reality: Enhancing accessibility and outreach for older audiences. In B. K. Smith, M. Borge, R. A. Sottilare, & J. Schwarz (Eds.), *HCI International 2025 – Late breaking papers (Lecture Notes in Computer Science, Vol. 16344)*. Springer.
- Black, G. (2012). *Transforming museums in the twenty-first century*. Routledge. <https://doi.org/10.4324/9780203150061>
- Boboc, R. G., Băutu, E., Gîrbacia, F., Popovici, N., & Popovici, D.-M. (2022). Augmented reality in cultural heritage: An overview of the last decade of applications. *Applied Sciences*, 12(19), Article 9859. <https://doi.org/10.3390/app12199859>.
- Casella, G., & Coelho, M. (2013). *Augmented Heritage: Situating Augmented Reality Mobile Apps in Cultural Heritage Communication*. In *Proceedings of ARTECH 2013*.
- Challenor, J., & Ma, M. (2019). A review of augmented reality applications for history education and heritage visualisation. *Multimodal Technologies and Interaction*, 3(2), 39. <https://doi.org/10.3390/mti3020039>.
- Chen, C.-A., & Lai, H.-I. (2021). Application of augmented reality in museums – Factors influencing the learning motivation and effectiveness. *Science Progress*, 104(3_suppl), 1–16. <https://doi.org/10.1177/00368504211059045>.
- Chen, Y., Wang, X., Le, B., & Wang, L. (2024). Why people use augmented reality in heritage museums: A socio-technical perspective. *Heritage Science*, 12(1), Article 108. <https://doi.org/10.1186/s40494-02401217-1>.
- Cheng, A., Zhang, W., Feng, A., Wu, Y., & Li, W. (2025). Exploring psychological dimensions of augmented reality in education: A study on learning motivation and achievement in museums. *Frontiers in Psychology*, 16, Article 1514117. <https://doi.org/10.3389/fpsyg.2025.1514117>.
- Chung, N., Han, H., & Joun, Y. (2018). Tourists' intention to visit a destination: The role of augmented reality applications for a heritage site. *Computers in Human Behavior*, 50, 588–599.
- Damala, A., Marchal, I., & Houlier, P. (2007). Merging augmented reality based features in mobile multimedia museum guides. In *Proceedings of the XXI International Symposium CIPA 2007: AntiCIPAting the Future of the Cultural Past* (pp. 259-264)

- Falk, John & Dierking, Lynn. (2016). The Museum Experience Revisited. 10.4324/9781315417851.
- Hammady, R., Ma, M., & Powell, A. (2018). User experience of markerless augmented reality applications in cultural heritage museums: 'MuseumEye' as a case study. In Augmented reality, virtual reality, and computer graphics: 5th International Conference, AVR 2018, Proceedings, Part II (pp. 349–369). Springer.
- Han, S., Yoon, J.-H., & Kwon, J. (2021). Impact of experiential value of augmented reality: The context of heritage tourism. Sustainability, 13(8), Article 4147. <https://doi.org/10.3390/su13084147>.
- He, Y., & Wang, W. (2025). Factors influencing visitors' use of augmented reality technology in museum guided tours. PLOS ONE, 20(10), Article e0332688. <https://doi.org/10.1371/journal.pone.0332688>.
- Hooper-Greenhill, Eilean. (2007). Museums and Education: Purpose, Pedagogy, Performance. Museums and Education: Purpose, Pedagogy, Performance. 10.4324/9780203937525.
- Javornik, A. (2016). 'It's an illusion, but it looks real!': Consumer affective, cognitive and behavioural responses to augmented reality applications. Journal of Marketing Management, 32(9–10), 987–1011. <https://doi.org/10.1080/0267257X.2016.1174726>.
- T. Jung, M.C. tom Dieck, H. Lee, N. Chung, Effects of virtual reality and augmented reality on visitor experiences in Museum, Information and Communication Technologies in Tourism 2016, Springer International Publishing, 2016, pp. 621–635.
- Lavoye, A., et al. (2023). [Journal of Business Research article on AR and heritage]. <https://doi.org/10.1016/j.jbusres.2023.114247>.
- Lee, H., Jung, T. H., tom Dieck, M. C., & Chung, N. (2020). Experiencing immersive virtual reality in museums. Information & Management, 57(5), 103229. <https://doi.org/10.1016/j.im.2019.103229>.
- Li, X., et al. (2023). A bibliometric analysis of immersive technology in museum exhibitions: Exploring user experience. Frontiers in Virtual Reality, 4, Article 1240562. <https://doi.org/10.3389/frvir.2023.1240562>
- Li, W., & Xiao, J. X. (2021). User experience in digital museums: A case study of the Palace Museum in Beijing. In M. Rauterberg (Ed.), *Culture and computing: Interactive cultural heritage and arts* (pp. 436–448). Springer.
- Lin, Y., & Huang, C. (2024). Technology in Society. <https://doi.org/10.1016/j.techsoc.2024.102540>.
- Ministry of Culture, Government of India. (2024). Ministry of Culture. <https://culture.gov.in>.
- Museums of India. (2024). *National Portal and Digital Repository for Museums of India*. <https://www.museumsofindia.gov.in>.
- Ngo, T., et al. (2025). *Computers in Human Behavior Reports*. <https://doi.org/10.1016/j.chbr.2025.100648>
- Panhale, T., Bryce, D., & Tsoukoku, E. (2023). Augmented reality and experience co-creation in heritage settings. Journal of Marketing Management, 39(5–6), 470–497. <https://doi.org/10.1080/0267257X.2022.2120061>

- Parry, R. (2007). *Recoding the museum: Digital heritage and the technologies of change*. Routledge.
<https://doi.org/10.4324/9780203347485>
- Pauls, A., & Karsakov, A. (2021). The concept of using augmented reality technology to present interactive calligraphic objects. *Procedia Computer Science*, 193, 366–373.
<https://doi.org/10.1016/j.procs.2021.10.042>
- Poushneh, A., & Vasquez-Parraga, A. Z. (2017). Discernible impact of augmented reality on retail customer experience, satisfaction and willingness to buy. *Journal of Retailing and Consumer Services*, 34, 229–234.
- Ramtohl, A., & Khedo, K. K. (2024). Augmented reality systems in the cultural heritage domains: A systematic review. *Digital Applications in Archaeology and Cultural Heritage*, 32, e00317.
<https://doi.org/10.1016/j.daach.2024.e00317>.
- Rao, B. S. (2024). Innovative approaches to cultural preservation: Integrating AR/VR technology in Kempegowda Museum: A case of Bengaluru. *International Journal for Multidisciplinary Research*, 6(2).
- Rege, S. (2025). Integrating technology and tradition in Indian historical sites and museums: A study of augmented reality curation. *Alochana Journal*, 14(5).
- Rhee, B., & Lee, J. (2021). Effects of augmented reality on consumer responses in museum and heritage experiences. *Sustainability*, 13(11), 6336. <https://doi.org/10.3390/su13116336>.
- Serravalle, F., Ferraris, A., Vrontis, D., Thrassou, A., & Christofi, M. (2019). Augmented reality in the tourism industry: A multi-stakeholder analysis of museums. *Tourism Management Perspectives*, 32, Article 100554. <https://doi.org/10.1016/j.tmp.2019.07.002>.
- Sharma, P., & Jamwal, R. S. (2026). Museums and public history: Transforming heritage education in India. *International Journal of Arts, Humanities and Social Studies*, 8(7), 22–29.
<https://doi.org/10.33545/26648652.2026.v8.i7a.513>.
- Tom Dieck, M. C., & Jung, T. (2017). Value of augmented reality at cultural heritage sites: A stakeholder approach. *Journal of Destination Marketing & Management*, 6(2), 110–117.
- M. Claudia tom Dieck & Timothy Jung, 2018. "A theoretical model of mobile augmented reality acceptance in urban heritage tourism," *Current Issues in Tourism*, Taylor & Francis Journals, vol. 21(2), pages 154-174, January.
- Trunfio, M., Campana, S., & Magnelli, A. (2020). Measuring the impact of functional and experiential mixed reality elements on a museum visit. *Current Issues in Tourism*, 23(16), 1990–2008.
<https://doi.org/10.1080/13683500.2019.1703914>.
- UNESCO. (2021). *Recommendation on the Ethics of Artificial Intelligence / Digital Heritage Resources*.
<https://www.unesco.org>.

- Upasani, N., Manna, A., & Ranjanikar, M. (2023). Augmented, virtual and mixed reality research in cultural heritage: A bibliometric study. *International Journal of Advanced Computer Science and Applications*, 14(1), 832–842. <https://doi.org/10.14569/IJACSA.2023.0140191>.
- Whang, H., Yong, S., & Ko, E. (2021). Pop-up augmented reality and consumer responses. *Journal of Business Research*. <https://doi.org/10.1016/j.jbusres.2021.04.057>.
- Xiao, L., Mokhtar, N. A., & Mat Sulaiman, M. K. A. (2026). From interaction to immersion: Gamified AR narratives and visitor typologies in heritage tourism engagement. *Advances in Intelligent Systems*, 7(1), 779–792. <https://doi.org/10.62754/ais.v7i1.915>.
- Xu, W., Ismail, M., Shahrudin, S., Quan, W., & Li, Y. (2025). Exploring tourists' intentions to adopt augmented reality in cultural heritage museums: Insights from a modified technology acceptance model. *SAGE Open*, 15(2). <https://doi.org/10.1177/21582440251339936>.
- Yim, M. Y. C., Chu, S. C., & Sauer, P. L. (2017). Is augmented reality technology an effective tool for ecommerce? An interactivity and vividness perspective. *Journal of Interactive Marketing*, 39, 89–103. <https://doi.org/10.1016/j.intmar.2017.04.001>.
- Yoon, S. A., Elinich, K., Wang, J., Steinmeier, C., & Tucker, S. (2012). Using augmented reality and knowledge-building scaffolds to improve learning in a science museum. *International Journal of Computer-Supported Collaborative Learning*, 7(4), 519–541. <https://doi.org/10.1007/s11412-012-9156-x>.
- Zhang, H.-J., Fang, C.-Y., & Lin, P. M.-C. (2024). AR service quality and adoption intention in museums: The mediating role of perceived value and the moderating effect of intracultural differences. *Journal of Quality Assurance in Hospitality & Tourism*, 27(3), 657–686. <https://doi.org/10.1080/1528008X.2024.2365874>.
- Zhang, Y., Abdul Aziz, F., Abu Bakar, N. A., Zhang, X., & Zhang, J. (2024). Exploring augmented reality integration for enhancing heritage museum exhibits: A focus on innovative display design. *International Journal of Academic Research in Business and Social Sciences*, 14(11), 2596–2611. <http://dx.doi.org/10.6007/IJARBS/v14-i11/23447>. <https://www.pmsangrahalaya.gov.in/gallery-block-2> <https://artsandculture.google.com/> <https://www.pmsangrahalaya.gov.in/> <https://artsandculture.google.com> <https://icom.museum> <https://www.nationalmuseumindia.gov.in/en/home>