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**SYSTEMATIC LITERATURE REVIEW: THE USE OF  
VIRTUAL REALITY AS A MEDIUM OF KNOWLEDGE  
TRANSFER IN HERITAGE PRESERVATION**

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**Abstract:**

The increasing application of Virtual Reality (VR) technology in heritage preservation has evolved from static documentation towards immersive and interactive knowledge experiences. Despite this growing adoption, the role of VR as a structured medium for heritage knowledge transfer remains insufficiently synthesised in the existing literature. This study investigates the use of VR for heritage knowledge transfer, its effectiveness compared to conventional methods, and its main benefits. A Systematic Literature Review analysed 41 articles published between 2019 and 2025. VR is applied through digital reconstruction, interactive applications, and storytelling-based education. It improves learning outcomes and user engagement, but its impact on long-term knowledge retention is mixed. VR offers four main benefits: immersive learning, skill development, personalised learning, and tacit knowledge transfer. Rather than functioning as isolated advantages, these dimensions operate as interrelated mechanisms that collectively support experiential and structured heritage knowledge transfer. VR is significant as both a pedagogical medium and a heritage conservation tool, but challenges such as cost, infrastructure, and standardisation need to be addressed. Future research should explore hybrid strategies integrating technical, pedagogical, and sociocultural dimensions to maximise the sustainability of heritage knowledge transfer.

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**Keyword:**

Virtual Reality, Knowledge Transfer, Heritage, Preservation



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## Introduction

The preservation of cultural heritage has become a significant focus globally, particularly in light of the challenges faced by globalisation, climate change, and rapid urban development. Cultural heritage, including both tangible and intangible elements, serves as a historical record and underpins identity, collective memory, and the ongoing preservation of community values across generations (UNESCO 2024; Wijesuriya 2022). However, without effective preservation strategies, many heritage assets face a critical risk of disappearance (Weiland et al. 2021).

A critical challenge in heritage preservation lies in the knowledge transfer. Unlike tangible artefacts that can be documented or exhibited, the knowledge inherent in architectural expertise, carpentry techniques, construction methods, and cultural practices is far more challenging to convey and preserve. This knowledge is generally informal, transmitted orally or through practical experience by practitioners, and is rarely systematically documented (Champion and Rahaman 2019; Eun-Jee Song 2020). Consequently, the passing of older generations results in the loss of undocumented knowledge (Lukito 2025). In this regard, advances in digital technology have introduced new dimensions to heritage preservation efforts. Among these technologies, VR offers significant opportunities due to its capacity to generate immersive and interactive experiences (Bekele et al. 2021; Zhao and Kim 2024). VR allows users to examine heritage through visualisation and to virtually experience spaces, construction techniques, and cultural practices. Thus, VR serves both as a documentation tool and as an effective pedagogical medium for transferring heritage knowledge (Xu et al. 2025).

Although there is a growing body of research on VR in the cultural heritage context, much of the existing literature focuses primarily on technological developments, digital reconstruction accuracy and user engagements. Previous reviews have concentrated on the role of VR in general education or on the digitisation of artefacts (Cecotti 2022; Tsakoumaki et al. 2023) As a result, discussions surrounding VR tend to be dispersed across technical, experiential, and exhibition focussed domains. This scenario does not indicate a lack of VR application in heritage preservation. Rather, the literature remains fragmented in scope, with limited synthesis integrating VR approaches, effectiveness, and benefits within the specific context of heritage knowledge transfer. This methodological and conceptual gap highlights the absence of a comprehensive review that critically explores how VR functions as a medium for knowledge transfer in heritage preservation.

Therefore, a Systematic Literature Review (SLR) was conducted to understand the effects of VR as a tool in transferring knowledge in heritage preservation. This study gathers and analyses previous studies that apply VR in heritage preservation between 2019 and 2025 to answer several research questions.

## Literature Review

Before the emergence of immersive technology, the transmission of heritage knowledge relied on conventional methods such as drawing, photography, and field notes. Although effective in documenting physical forms, these methods are significantly limited in their ability to capture deep cultural experiences, techniques, and meanings (Gherardini and Sirocchi 2022; de Kramer 2020). Two-dimensional representations are constrained and may overlook significant contextual information (Cáceres-Criado et al. 2023). These limitations have prompted the exploration of emerging technologies. Virtual Reality (VR) then emerged offering users immersive and interactive experiences that simulate real-life situations. In a heritage context, virtual reality is used for the reconstruction of archaeological sites and historical structures, thus allowing the assessment of heritage value by various parties (Cáceres-Criado et al. 2023). Beyond documentation, virtual reality enhances the museum experience by increasing immersion and presence. Studies indicate that virtual reality makes visits more meaningful compared to the conventional exhibitions (Clini et al. 2018; Kontopanagou, Tsipis, and Komianos 2021). Innovations like the “phygital” exhibition show that VR can enhance accessibility and boost community engagement (Giovannini and Bono 2023). In terms of interaction, VR integrates hand-motion tracking and haptic technology to enhance the realism of the experience (Choi et al. 2024). Natural movements and tactile devices have been shown to improve users' understanding of artefacts, however, challenges remain, regarding cost and technical accuracy (Song 2020). In addition, VR is increasingly integrated with technologies such as LiDAR, HBIM, and 3D scanning to generate more precise documentation (Bekele 2021). This method not only supports preservation but also establishes a collaborative platform among researchers, conservators, and the community (Bekele et al. 2021; Cai and Ch'ng 2025; Giovannini and Bono 2023). In summary, current literature shows a transition from static documentation to immersive experiences that encompass methods, context, and interactions, which are important for the sustainable transfer of heritage knowledge. This study reviews the empirical application of VR for this objective, focusing on experience design, evaluation methodologies, and learning outcomes or knowledge transfer. From a conceptual standpoint, the growing emphasis on immersive and interactive engagement in VR applications can be understood through the lens of Experiential Learning Theory (Kolb 2000). The theory proposes that knowledge is constructed through concrete experience, reflective observation, conceptual understanding, and active experimentation. In heritage contexts, VR simulates experiential interaction with cultural assets, allowing users to move beyond passive observation towards embodied and contextual engagement. Anchoring this review within an experiential learning perspective provides a clear theoretical basis for interpreting how VR supports experiential, cognitive, and tacit dimensions of heritage knowledge transfer.

## Research Methodology

### *Systematic Literature Review*

This study applies a Systematic Literature Review (SLR) methodology to comprehensively investigate the application of Virtual Reality (VR) technology as a medium for knowledge transfer in heritage preservation. This approach was used because systematic literature reviews allow the collection, evaluation, and synthesis of existing research findings in a transparent and structured manner of VR technology. The review process was guided by systematic review principles aligned with PRISMA (Preferred Reporting Items for Systematics Review and Meta Analysis) to ensure transparency in article identification, screening, eligibility assessment, and

inclusion. Although this study does not perform meta-analysis, the PRISMA flow logic was applied to structure the review stages systematically.

### ***Research Question***

The systematic research questions are presented as shown in Table 1 to maintain the focus of the study and to guide the review process. This ensures that data extraction can be carried out systematically and appropriately.

**Table 1: Research Questions**

| No | Research Question  | Purpose  |
|----|--|--|
| 1  | How is the VR approach used as a medium in transferring knowledge in heritage preservation?        | To find out the approach used by VR as knowledge transfer in heritage preservation                 |
| 2  | Is VR more efficient than conventional methods in transferring knowledge in heritage preservation? | To identify how effective VR is compared to conventional methods in heritage preservation          |
| 3  | What are the benefits of using VR in transfer knowledge for heritage preservation?                 | To find out the benefits of using VR as the medium of knowledge transfer in heritage preservation. |

Source: (Author, 2025)

### ***Research Findings***

The search process was conducted using the Scopus indexing database which is acknowledged as a peer-reviewed academic resource. Scopus was selected to ensure quality control and academic rigour in identifying relevant publications. To complement the indexing search, supplementary search was performed via the ScienceDirect platform to retrieve full-text articles published by Elsevier that were relevant to VR application in heritage preservation.

The search terms employed comprised combinations of: “Virtual Reality” OR “VR” OR “Immersive Technology” AND “Heritage Preservation” OR “Cultural Heritage” OR “Knowledge Transfer”. The study concentrated on the timeframe from 2019 to 2025 to guarantee that the examined research was current and aligned with the rapid development.

Table 2 presents the search results:

**Table 2: Search Results**

| No    | Source         | Number of articles |
|-------|----------------|--------------------|
| 1     | Scopus         | 64                 |
| 2     | Science Direct | 203                |
| Total |                | 267                |

Source: (Author, 2025)

### ***Inclusion and Exclusion Criteria***

To ensure methodological rigour, inclusion and exclusion were established prior to the screening process as shown in table 3.

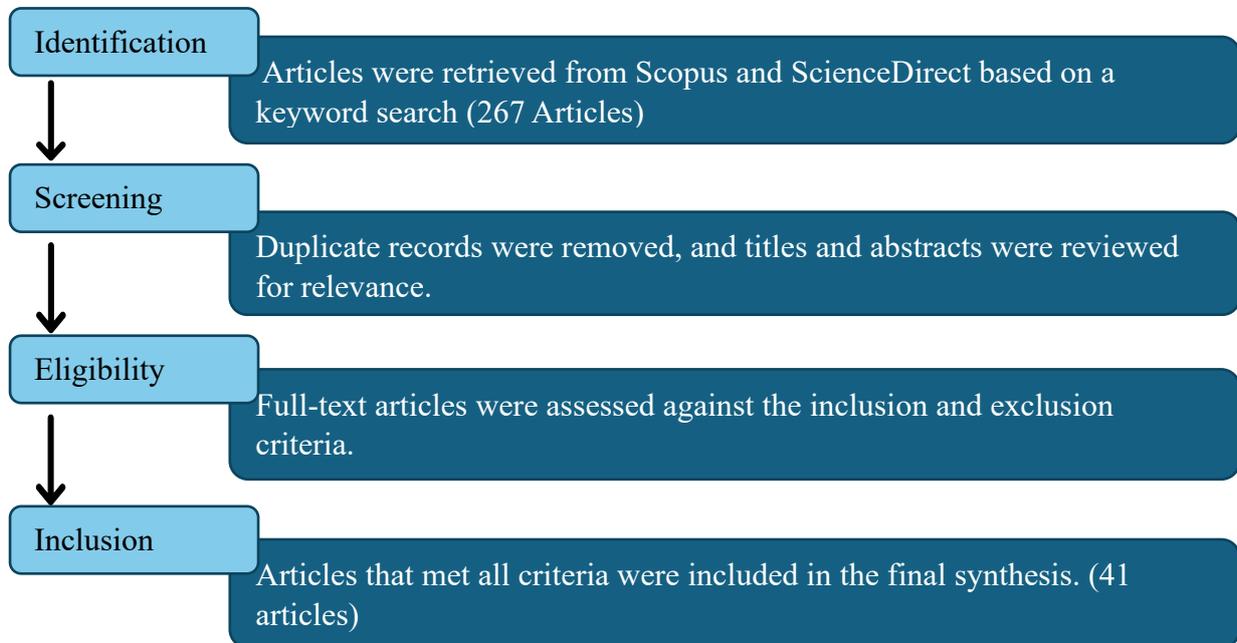
**Table 3. Inclusion and Exclusion Criteria**

| Criteria  |    |   |
|-----------|----|---|
| Inclusion | I1 | Peer-reviewed journal articles  |
|           | I2 | Articles related to the purpose of using VR as a medium for heritage preservation |
|           | I3 | Articles discussing effectiveness, benefits, or knowledge transfer                |
|           | I4 | Articles published between 2019-2025  |
|           | I5 | Articles are written in English   |
| Exclusion | E1 | Conference abstracts without full papers  |
|           | E2 | Non-peer-reviewed publication   |
|           | E3 | Articles not related to virtual reality as medium for heritage preservation       |
|           | E4 | Articles without full publication   |

Source: (Author, 2025)

### ***Screening and Filtering Process***

The articles obtained through the selection process followed four systematic stages adapted from the PRISMA protocol:



**Figure 1: Screening and Filtering Process Adapted from PRISMA Protocol**

Source: (Author, 2025)

### ***Data Extraction and Analysis***

Selected articles were analysed using thematic synthesis. The extracted data included VR approaches applied in heritage preservation, reported effectiveness compared to conventional methods and identified benefits and challenges. Thematic categorisation was conducted through an iterative reading process. Extracted data were repeatedly reviewed and compared to ensure consistency and alignment with the research questions. Initial codes were generated based on recurring concepts identified across multiple studies, and these codes were subsequently grouped into broader thematic categories.

The development of themes was guided by patterns emerging across multiple studies rather than isolated findings. To enhance analytical rigour, themes were defined to avoid conceptual overlap and to maintain clear distinctions between categories. The categorisation aligns with the SLR objectives to identify VR approaches, evaluate their effectiveness, and highlight the benefits and challenges within the context of heritage knowledge transfer.

Table 5 presents the 41 selected articles included in the final analysis. These papers comprise empirical studies, technical analyses, and systematic reviews that highlight the significance of virtual reality in various aspects of heritage preservation, including documentation, museum exhibitions, intangible heritage, user engagement, and technological integration.

**Table 5: List of Selected Articles**

| Author                           | Year | Aim of Study  | Challenges                            |
|----------------------------------|------|---|---------------------------------------|
| Champion and Rahaman             | 2019 | To examine sustainability of 3D VR heritage models              | Lack of sustainable funding           |
| Bekele et al                     | 2019 | To compare immersive VR with conventional learning              | Limited adoption, no standard methods |
| Kharroubi et al.                 | 2019 | To integrate massive point clouds into VR                       | Technical issues with large datasets  |
| Bekele                           | 2019 | To design walkable MR maps for heritage                         | Requires advanced infrastructure      |
| Obradović et al.                 | 2020 | To reconstruct Serbian Orthodox Cathedral via VR photogrammetry | High cost, fidelity limits            |
| Song                             | 2020 | To preserve intangible heritage (rituals & crafts) using VR     | Lack of formal integration            |
| (Scianna, Gaglio, and La Guardia | 2020 | To improve heritage interpretation using photogrammetry + VR    | Hardware demands, processing limits   |
| (Katifori et al. 2020)           | 2020 | To explore VR as storytelling for cultural heritage             | Technical support needs               |
| Hajirasouli et al.               | 2021 | To digitise endangered heritage using VR documentation          | Resource intensive                    |
| Vichnevetskaia                   | 2021 | To analyse the use of VR in heritage conservation               | Lack of long-term testing             |
| Chong et al.                     | 2021 | To assess usability of VR heritage applications                 | Lack of clear framework               |
| Bekele                           | 2021 | To explore cloud-based collaborative VR for cultural learning   | Cost & technical barriers             |
| Bekele et al.                    | 2021 | To evaluate multi-modal MR/VR case studies                      | Limited adoption in practice          |
| (Gabellone 2021)                 | 2021 | To reconstruct Diocletian's Baths with VR + 5G                  | Infrastructure costs                  |

**Table 5: List of Selected Articles**

| Author                     | Year | Aim of Study   | Challenges                                  |
|----------------------------|------|--|---|
| Olbrycht et al.            | 2025 | To enhance real-time underground built heritage visualisation      | Technical complexity, real-time constraints |
| Cecotti                    | 2022 | To apply fully immersive VR in heritage education & preservation   | Motion sickness, high cost                  |
| Gherardini and Sirocchi    | 2022 | To integrate 2D & 3D sources for VR reconstruction                 | Data inconsistency                          |
| De Paolis et al.           | 2022 | To design VR storytelling for Castle of Corsano                    | Limited scalability                         |
| Hajirasouli et al.         | 2022 | To develop VR-based digitisation framework for endangered heritage | Resource intensive, scalability issues      |
| Al-Aqbi et al.             | 2023 | To study the effect of memory in shaping virtual heritage          | Conceptual validation still limited         |
| Wijesuriya                 | 2023 | To explore multisensory VR in museums for engagement               | Motion sickness, integration issues         |
| Tsakoumaki et al.          | 2023 | To advance digitization methods for heritage (Delphi Museum)       | Implementation cost, technical expertise    |
| Abergel et al.             | 2023 | To present Aïoli VR 3D annotation cloud platform for heritage      | Requires infrastructure, expert input       |
| (Montusiewicz et al. 2023) | 2023 | To build mobile VR for Silk Road cultural heritage                 | Lower fidelity, hardware limitations        |
| Cáceres-Criado et al.      | 2023 | To propose framework for optimising accuracy in VR reconstructions | Limited adoption, validation issues         |
| Alemán                     | 2023 | To apply mesh retopology in VR heritage visualisation              | Needs technical expertise                   |
| Giovannini and Bono        | 2023 | To design “phygital” VR exhibitions for cultural engagement        | Curatorial adaptation, resource demands     |

**Table 5: List of Selected Articles**

| Author                               | Year | Aim of Study  | Challenges                                |
|--------------------------------------|------|---|---|
| Zhou                                 | 2024 | To develop mobile VR exhibitions for wider accessibility            | Lower fidelity vs. desktop VR             |
| H. Wang et al.                       | 2024 | To explore gamification in VR heritage exhibitions                  | Lack of uniform framework                 |
| (Izaguirre, Ferrari, and Acuto 2024) | 2024 | To reconstruct Andes archaeology using VR approaches                | Large datasets required                   |
| Al shawabkeh and Arar                | 2024 | To apply VR + Unreal Engine for transparent heritage reconstruction | Technical resource demands                |
| Lukito                               | 2024 | To restore murals using VR applications                             | Fidelity limits                           |
| Tribhuvan and Binnaser               | 2024 | To digitise Ajanta caves using VR technology                        | Resource requirements                     |
| Rodríguez-Moreno                     | 2024 | To visualise uncertainty in VR-based reconstructions                | Needs further validation                  |
| (Ikonomi and Papa 2024)              | 2024 | To explore immersive VR in ethnographic museums (Berati case)       | Tourism/interpretation challenges         |
| Z. Zhang                             | 2025 | To apply VR preservation to strengthen authenticity                 | Archival/data management issues           |
| Abukarki                             | 2025 | To survey VR applications in architecture and heritage spaces       | No empirical data                         |
| Lukito                               | 2025 | To document Wae Rebo houses using VR + 3D scanning                  | Technical barriers                        |
| Shen, Aziz, and Lv                   | 2025 | To apply 360° VR panoramas for heritage perception                  | Limited knowledge depth                   |
| Nunes et al.                         | 2025 | To design MR/VR exhibitions for curatorial co-creation              | Technical support needs                   |
| Lu et al.                            | 2025 | To integrate AR, VR, and the Metaverse in museums                   | Rapid tech evolution, implementation gaps |

**Table 5: List of Selected Articles**

| Author          | Year | Aim of Study   | Challenges                      |
|-----------------|------|--|---------------------------------|
| Bajena et al.   | 2025 | To apply speculative VR reconstructions for heritage       | Risks of overinterpretation     |
| Jadon and Patil | 2025 | To reconstruct Mansingh Palace using VR                    | Requires validation             |
| Cai and Ch'ng   | 2025 | To empower communities via participatory VR reconstruction | Stakeholder dependency          |
| S. Wang         | 2025 | To reconstruct lost cultural landscapes with VR            | Methodological limits           |
| Merchán et al.  | 2025 | To apply VR as didactic tool for teaching history          | Context-specific, small samples |

Source: (Author, 2025)

## Result and Discussion

### *VR as an Approach for Heritage Preservation*

Analysis shows that there are three main approaches to utilising VR in the transfer of heritage knowledge. Digital reconstruction and preventive preservation as illustrated in Table 6, represent the first approach which emphasises documentation and reconstruction using photogrammetry, LiDAR and HBIM. The primary advantage of this technology is that it provides high technical accuracy and supports long-term preservation plans.

**Table 6: Approach Of VR In Preservation Heritage**

| Approach of VR                                   | Example Studies  |
|--|--|
| Digital Reconstruction & Preventive Preservation | Alemán 2023; Bekele 2019; Cáceres-Criado et al. 2023; Champion and Rahaman 2019; Gabellone 2021; Gherardini and Sirocchi 2022; Hajirasouli et al. 2021; Izaguirre, Ferrari, and Acuto 2024; Kharroubi et al. 2019; Li et al. 2025; Lukito 2025; Obradović et al. 2020; Olbrycht et al. 2025; Rodríguez-Moreno 2024; Scianna, Gaglio, and La Guardia 2020; Al shawabkeh and Arar 2024; Shen, Aziz, and Lv 2025; Tribhuvan and Binnaser 2024; Wang 2025; Zhang and Huang 2025; Zhou 2024 |
| Interactive & Immersive                          | (Abergel et al. 2023; Bekele 2021; Bekele et al. 2021; Cecotti 2022; Chong et al. 2021; Giovannini and Bono 2023; Ikonomi and Papa 2024; Lu et al. 2025; Montusiewicz et al. 2023; Nunes et al. 2025; Tsakoumaki et al. 2023; Vichnevetskaia 2021; Wijesuriya 2022)  |

**Table 6: Approach Of VR In Preservation Heritage**

| Approach of VR             | Example Studies   |
|----------------------------|---|
| Educational & Storytelling | Al-Aqbi, Al-Yousif, and Al-Nuaimi 2023; Bajena et al. 2025; Cai and Ch'ng 2025; Hajahmadi et al. 2024; Jadon and Patil 2025; Merchán et al. 2025; De Paolis et al. 2022; Song 2020; H. Wang et al. 2024 |
| Source: (Author, 2025)     |   |

The interactive and immersive approach is widely used in museum exhibitions, mobile applications, and gesture and haptic technologies to increase visitor engagement. Compared to traditional exhibitions, VR provides a more immersive and interactive experience, making knowledge transfer more meaningful. Finally, the educational and storytelling approach focuses on pedagogical ideals through cultural narratives, rituals and crafts. Virtual reality serves not only as a preservation tool but also as a more engaging learning medium compared to text or video records. Its benefit lies in its ability to convey underlying cultural meanings more authentically.

***Is The Use of VR Much More Efficient Than Conventional Learning Methods?***

Studies point out that virtual reality offers greater effectiveness compared to conventional approaches. Three dominant themes concerning the effects of VR on knowledge transfer were identified, namely enhanced knowledge outcomes, engagement and motivation, and mixed results on knowledge retention. Table 7 lists studies that demonstrate the effectiveness of VR use in knowledge transfer of heritage preservation.

**Table 7: Effects Of VR On Transfer Knowledge in Heritage Preservation**

| Theme                                | Representative Studies  |
|--------------------------------------|---|
| Enhanced Transfer knowledge Outcomes | (Bekele et al. 2021; Cecotti 2022; Champion and Rahaman 2019; Giovannini and Bono 2023; Obradović et al. 2020; De Paolis et al. 2022; Scianna, Gaglio, and La Guardia 2020; Z. Zhang 2024; Zhao and Kim 2024)                                       |
| Engagement and Motivation            | (Abergel et al. 2023; Cai and Ch'ng 2025; Giovannini and Bono 2023; Hajirasouli et al. 2021; Lu et al. 2025; Merchán et al. 2025; Montusiewicz et al. 2023; Nunes et al. 2025; Eun-Jee Song 2020; Tribhuvan and Binnaser 2024; H. Wang et al. 2024) |
| Mixed Knowledge Retention            | (Bekele 2021; Bekele et al. 2021; Chong et al. 2021; Shen, Aziz, and Lv 2025; Vichnevetskaia 2021; Wijesuriya 2022)   |
| Source: (Author, 2025)               |   |

In summary, findings from the reviewed studies show that VR is significantly effective in improving learning outcomes and increasing engagement, but its impact on data retention is less conclusive. Several studies indicate that immersive VR environments enhance experiential understanding and immediate recall due to heightened levels of user engagement and perceived presence within the virtual setting. However, other studies suggest that long-term knowledge retention is influenced by specific moderating factors, including instructional design, duration of exposure, and the extent to which VR is pedagogically integrated, rather than immersion alone. These variations demonstrate that VR, as a technological medium, does not inherently guarantee sustained knowledge retention. Instead, its long-term effectiveness appears is contingent upon structured pedagogical support, repeated interaction, and contextual reinforcement within the learning process.

***Benefits Of Using VR As Medium of Knowledge Transfer in Heritage Preservation.***

The literature review finds that the application of VR technology in education and heritage preservation provides various benefits, categorised under four primary themes: immersive learning, skill development, personalised learning, and the transfer of tacit knowledge as illustrated in table 8 below:

**Table 8: Benefits of using VR**

| Theme                    | Representative Studies  |
|--------------------------|---|
| Immersive Learning       | Cecotti 2022; Clini et al. 2018; Dogan and Kan 2020; Giovannini and Bono 2023; Ikonomi and Papa 2024; Johansson and Roupé 2024; Kontopanagou, Tsipis, and Komianos 2021; Lucas 2018; Obradović et al. 2020; E.-J. Song 2020; B. Zhang et al. 2025 |
| Skill Development        | Champion and Rahaman 2019; Gabellone 2021; De Paolis et al. 2022  |
| Personalised Learning    | Cai and Ch’ng 2025; Scianna, Gaglio, and La Guardia 2020; K. Wang 2024  |
| Tacit Knowledge Transfer | Bajena et al. 2025; Hajirasouli et al. 2021; E.-J. Song 2020  |

Source: (Author, 2025)

The findings indicate that VR provides comprehensive benefits across cognitive, emotional, and psychomotor aspects. Despite ongoing challenges related to cost, infrastructure, and standardisation, the potential of virtual reality as a medium for learning and heritage preservation is significant. Consequently, the integration of VR in education and heritage conservation is seen as an important strategy to enhance pedagogical effectiveness, knowledge transfer, and cultural sustainability.

## Conclusion

Based on the findings of this SLR study, VR applications in heritage preservation can be divided into three categories: digital reconstruction, interactive and immersive experiences, and storytelling-based education. Although VR demonstrates effectiveness in documentation, visualisation, and user engagement, existing research lacks in terms of systematic pedagogical integration. In terms of effectiveness, VR has been found to enhance learning outcomes and motivation, but its impact on long-term knowledge retention is inconsistent. This suggests that VR is more suitable to serve as a supplementary tool to traditional approaches rather than as a standalone medium. The most important benefits of VR include immersive learning, skill development, personalised learning, and tacit knowledge transfer. However, these findings are currently limited to specific case-based studies and lack a comprehensive conceptual framework.

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## References

- Abergel, Violette, Adeline Manuel, Anthony Pamart, Isabelle Cao, and Livio De Luca. 2023. "Aïoli: A Reality-Based 3D Annotation Cloud Platform for the Collaborative Documentation of Cultural Heritage Artefacts." *Digital Applications in Archaeology and Cultural Heritage* 30. doi:10.1016/j.daach.2023.e00285.
- Abukarki, H.J. 2025. "Beyond Preservation: A Survey of the Role of Virtual Reality in Experiencing and Understanding Historical Architectural Spaces." *Buildings* 15(9). doi:10.3390/buildings15091531.
- Al-Aqbi, S.J., I.J. Al-Yousif, and S.F. Al-Nuaimi. 2023. "The Effect of Memory in Shaping Virtual Heritage." In *Proceedings International Conference on Developments in Esystems Engineering Dese*, , 379–84. doi:10.1109/DeSE60595.2023.10469234.
- Alemán, M.D.D. 2023. "Mesh Retopology Applied to 3D Models of Cultural Heritage for Interactive Visualization Enhancement in Virtual Reality and Augmented Reality | Retopologia de Malha Aplicada a Modelos 3D de Património Cultural Para Melhorar a Visualização Interativa Em Rea." *Ge Conservacion* 24(1): 87–98. doi:10.37558/GEC.V24I1.1147.
- Al shawabkeh, Rami, and Mai Arar. 2024. "Virtual Reality as a Tool to Enhance the Efficiency and Reliability of the Virtual Reconstruction Process for Heritage/Archaeological Sites: The Case of Umm Al-Jimal in Jordan." *Digital Applications in Archaeology and Cultural Heritage* 33. doi:10.1016/j.daach.2024.e00325.
- Bajena, I.P., F.I. Apollonio, K. Argasiński, F. Fallavollita, R. Foschi, J. Franczuk, K. Koszewski, P. Kuroczyński, and J. Lutteroth. 2025. 15190 LNCS Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics *Documentation and Publication of Hypothetical Virtual 3D Reconstructions in the CoVHer Project*. doi:10.1007/978-3-031-78590-0\_10.
- Bekele, M.K. 2019. "Walkable Mixed Reality Map as Interaction Interface for Virtual Heritage." *Digital Applications in Archaeology and Cultural Heritage* 15. doi:10.1016/j.daach.2019.e00127.
- Bekele, M.K. 2021. "Clouds-Based Collaborative and Multi-Modal Mixed Reality for Virtual Heritage." *Heritage* 4(3): 1447–59. doi:10.3390/heritage4030080.
- Bekele, M.K., E. Champion, D.A. McMeekin, and H. Rahaman. 2021. "The Influence of Collaborative and Multi-Modal Mixed Reality: Cultural Learning in Virtual Heritage." *Multimodal Technologies and Interaction* 5(12). doi:10.3390/mti5120079.
- Cáceres-Criado, I., D.F. García-Molina, F.J. Mesas-Carrascosa, and P. Triviño-Tarradas. 2023. "New Approach for Optimizing the Interpretation and Representation of the Degree of Historical-Archaeological Evidence in the Virtual Reconstructions." *Virtual Reality* 27(2): 967–83. doi:10.1007/s10055-022-00707-6.
- Cai, S., and E. Ch'ng. 2025. "From Memory to Model: Engaging Communities in the Virtual Reconstruction of Their Heritage." *Journal of Cultural Heritage Management and Sustainable Development*. doi:10.1108/JCHMSD-04-2025-0086.
- Cecotti, Hubert. 2022. "Cultural Heritage in Fully Immersive Virtual Reality." *Virtual Worlds* 1(1): 82–102. doi:10.3390/virtualworlds1010006.
- Champion, E., and H. Rahaman. 2019. "3D Digital Heritage Models as Sustainable Scholarly Resources." *Sustainability Switzerland* 11(8). doi:10.3390/su11082425.
- Choi, J.W., J. Jin Park, E. Kim, and H. Jong Jun. 2024. "USER-CENTERED DESIGN (UCD) BASED WEB VR FOR THE VALUE OF CULTURAL HERITAGE." In *Proceedings of the International Conference on Computer Aided Architectural Design Research in Asia*, , 303–12.

- Chong, Hwei Teeng, Chen Kim Lim, Minhaz Farid Ahmed, Kian Lam Tan, and Mazlin Bin Mokhtar. 2021. "Virtual Reality Usability and Accessibility for Cultural Heritage Practices: Challenges Mapping and Recommendations." *Electronics (Switzerland)* 10(12). doi:10.3390/electronics10121430.
- Clini, P., L. Ruggeri, R. Angeloni, and M. Sasso. 2018. "Interactive Immersive Virtualmuseum: Digital Documentation for Virtual Interaction." In *International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences ISPRS Archives*, , 251–57. doi:10.5194/isprs-archives-XLII-2-251-2018.
- de Kramer, M. 2020. Springer Series on Cultural Computing *Relict–Interpolated–Extrapolated–Speculative: An Approach to Degrees of Accuracy in Virtual Heritage Reconstruction*. doi:10.1007/978-3-030-37191-3\_21.
- De Paolis, Lucio Tommaso, Sofia Chiarello, Carola Gatto, Silvia Liaci, and Valerio De Luca. 2022. "Virtual Reality for the Enhancement of Cultural Tangible and Intangible Heritage: The Case Study of the Castle of Corsano." *Digital Applications in Archaeology and Cultural Heritage* 27. doi:10.1016/j.daach.2022.e00238.
- Gabellone, F. 2021. "A Reconstructive Proposal of Diocletian's Baths for the 5g Experimentation in Rome." *Archeologia E Calcolatori*: 189–98. doi:10.19282/ac.31.2.2020.18.
- Gherardini, F., and S. Sirocchi. 2022. "Systematic Integration of 2D and 3D Sources for the Virtual Reconstruction of Lost Heritage Artefacts: The Equestrian Monument of Francesco III d'Este (1774–1796, Modena, Italy)." *Heritage Science* 10(1). doi:10.1186/s40494-022-00711-8.
- Giovannini, E.C., and J. Bono. 2023. "Creating Virtual Reality Using a Social Virtual Environment: Phygital Exhibition at the Museum Passion in Sordevolo." In *International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences ISPRS Archives*, , 669–76. doi:10.5194/isprs-Archives-XLVIII-M-2-2023-669-2023.
- Hajahmadi, Shirin, Irene Calvi, Eleonora Stacchiotti, Pasquale Cascarano, and Gustavo Marfia. 2024. "Heritage Elements and Artificial Intelligence as Storytelling Tools for Virtual Retail Environments." *Digital Applications in Archaeology and Cultural Heritage* 34. doi:10.1016/j.daach.2024.e00368.
- Hajirasouli, Aso, Saeed Banihashemi, Anoma Kumarasuriyar, Saeed Talebi, and Amir Tabadkani. 2021. "Virtual Reality-Based Digitisation for Endangered Heritage Sites: Theoretical Framework and Application." *Journal of Cultural Heritage* 49: 140–51. doi:10.1016/j.culher.2021.02.005.
- Ikonomi, J., and D. Papa. 2024. *Advances in Science Technology and Innovation Immersive Technologies in Virtual Heritage for an Innovative Tourist Experience the Case of the Berati Ethnographic Museum*. doi:10.1007/978-3-031-57385-9\_6.
- Izaguirre, Joaquín Ignacio, Alejandro Andrés Ferrari, and Félix Alejandro Acuto. 2024. "Exploring Cultural Heritage and Archaeological Research from a VR-Based Approach." *Digital Applications in Archaeology and Cultural Heritage* 32. doi:10.1016/j.daach.2024.e00318.
- Jadon, S.S., and A.S. Patil. 2025. "Digital Reconstruction of Mansingh Palace Using Historical Descriptions and Site Analysis." *Digital Applications in Archaeology and Cultural Heritage* 38. doi:10.1016/j.daach.2025.e00439.
- Katifori, Akrivi, Fay Tsitou, Myrsini Pichou, Vassilis Kourtis, Evangelos Papoulias, Yannis Ioannidis, and Maria Roussou. 2020. "Exploring the Potential of Visually-Rich Animated Digital Storytelling for Cultural Heritage." In , 325–45. doi:10.1007/978-3-030-37191-3\_17.

- Kharroubi, A., R. Hajji, R. Billen, and F. Poux. 2019. "Classification and Integration of Massive 3D Points Clouds in a Virtual Reality (VR) Environment." In *International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences ISPRS Archives*, , 165–71. doi:10.5194/isprs-archives-XLII-2-W17-165-2019.
- Kolb, D. 2000. "The Process of Experiential Learning." In *Strategic Learning in a Knowledge Economy*, Elsevier, 313–31. doi:10.1016/B978-0-7506-7223-8.50017-4.
- Kontopanagou, Katerina, Athanasios Tsipis, and Vasileios Komianos. 2021. "A Framework for Exploring Churches/Monuments/Museums of Byzantine Cultural Influence Exploiting Immersive Technologies in Real-Time Networked Environments." *Technologies* 9(3). doi:10.3390/technologies9030057.
- Li, Q., Z. Chen, T. Wu, C. Shen, Y. Yang, and X. Zhao. 2025. "Exploring the Effects of Narrative Augmented Reality in Cultural Heritage: A Study on Emotional Arousal, Intrinsic Motivation, Cognitive Load, and Learning." *International Journal of Human Computer Interaction*. doi:10.1080/10447318.2025.2504185.
- Lu, J., Y. Zhao, Y. Zheng, C. Chu, T. Zeng, and T. Li. 2025. "Bridging the Past and Future: The Integration of AR, VR, and the Metaverse in Museums." In *Digest of Technical Papers SID International Symposium*, , 968–72. doi:10.1002/sdtp.18975.
- Lukito, Yulia Nurliani H. 2025. "Documenting Vernacular Heritage with 3D Scanning Technology: The Case of Wae Rebo Village, Manggarai, Indonesia." *Digital Applications in Archaeology and Cultural Heritage* 37. doi:10.1016/j.daach.2025.e00416.
- Merchán, M.J., P. Merchán, E. Pérez, S. Salamanca, and M. Corrales-Serrano. 2025. "Virtual Reality as a Didactic Tool for Teaching History to Early Childhood Teachers in Training." *Interactive Technology and Smart Education*. doi:10.1108/ITSE-12-2024-0309.
- Montusiewicz, J., S. Skulimowski, M. Barszcz, and R. Kayumov. 2023. 634 LNNS Lecture Notes in Networks and Systems *Creating Mobile VR Visualisations of 3D Objects from the Area of the Silk Road*. doi:10.1007/978-3-031-26190-9\_105.
- Nunes, Tiago, Pedro Lourenço, Armanda Rodrigues, and Nuno Correia. 2025. "Building Mixed Reality Digital Versions of Cultural Visits/Exhibits." *Digital Applications in Archaeology and Cultural Heritage* 38. doi:10.1016/j.daach.2025.e00447.
- Obradović, M., I. Vasiljević, I. Durić, J. Kićanović, V. Stojaković, and R. Obradović. 2020. "Virtual Reality Models Based on Photogrammetric Surveys-a Case Study of the Iconostasis of the Serbian Orthodox Cathedral Church of Saint Nicholas in Sremski Karlovci (Serbia)." *Applied Sciences Switzerland* 10(8). doi:10.3390/APP10082743.
- Olbrycht, Robert, Alfonso Bahillo Martínez, Ernesto Marcheggiani, Müge Akkar Ercan, Pinar Karagöz, Karol Kropidłowski, and Giuseppe Pace. 2025. "Methods for Real-Time Underground Built Heritage Visualization Enhancement." *Journal of Cultural Heritage* 75: 1–10. doi:10.1016/j.culher.2025.07.006.
- Rodríguez-Moreno, C. 2024. 44 Springer Series in Design and Innovation *Depicting the Uncertain in Virtual Reconstructions of Architectural Heritage*. doi:10.1007/978-3-031-57579-2\_15.
- Scianna, A., G.F. Gaglio, and M. La Guardia. 2020. "DIGITAL PHOTOGRAMMETRY, TLS SURVEY and 3D MODELLING for VR and AR APPLICATIONS in CH." In *International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences ISPRS Archives*, , 901–9. doi:10.5194/isprs-archives-XLIII-B2-2020-901-2020.
- Shen, Huaheng, Nor Fadzila Aziz, and Xinyi Lv. 2025. "Using 360-Degree Panoramic Technology to Explore the Mechanisms Underlying the Influence of Landscape

- Features on Visual Landscape Quality in Traditional Villages.” *Ecological Informatics* 86. doi:10.1016/j.ecoinf.2025.103036.
- Song, E.-J. 2020. “A Study on Application Method of Virtual Reality for Preservation and Utilization of Intangible Cultural Properties.” *ASM Science Journal* 13(Specialiss): 59–67.
- Song, Eun-Jee. 2020. “A Study on Application Method of Virtual Reality for Preservation and Utilization of Intangible Cultural Properties.” *Akademi Sains Malaysia* 13: 59–67.
- Tribhuvan, Amrapali Prakash, and Aziz Abdullah Binnaser. 2024. “Exploring the Digital Heritage of Ajanta Caves through VR Technology.” *Digital Applications in Archaeology and Cultural Heritage* 35. doi:10.1016/j.daach.2024.e00381.
- Tsakoumaki, M. C., D. M. Lala, A. Tsaroucha, and A. Psalti. 2023. “Advanced Digitization Methods for the Protection and Dissemination of Cultural Heritage towards Digital Transformation: The Archaeological Museum of Delphi.” In *Procedia CIRP*, Elsevier B.V., 1056–60. doi:10.1016/j.procir.2023.06.181.
- Unesco. 2024. *Lhe Lhe/24/C2c/3 Paris, 30 May 2024 Original: English Convention For The Safeguarding Of The Intangible Cultural Heritage Twelfth Annual Coordination Meeting Of Category 2 Centres Active In The Field Of Intangible Cultural Heritage*.
- Vichnevetskaia, A. 2021. “Implications of the Use of Virtual Reality in Heritage Conservation.” In *International Conference on Virtual Rehabilitation Icvr*, , 215–22. doi:10.1109/ICVR51878.2021.9483868.
- Wang, H., Z. Gao, X. Zhang, J. Du, Y. Xu, and Z. Wang. 2024. “Gamifying Cultural Heritage: Exploring the Potential of Immersive Virtual Exhibitions.” *Telematics and Informatics Reports* 15. doi:10.1016/j.teler.2024.100150.
- Wang, Kaidong. 2024. 2023 Highlights in Science, Engineering and Technology CSIC *Research and Application of VR in Training and Learning*.
- Wang, S. 2025. “Virtual Reality Reconstructions of Lost Cultural Landscapes: Digital Heritage Preservation Methods.” *Geojournal* 90(4). doi:10.1007/s10708-025-11416-3.
- Weiland, S, T Hickmann, M Lederer, and S Schwindenhammer. 2021. “The 2030 Agenda for Sustainable Development: Transformative Change through the Sustainable Development Goals.” *Politics and Governance*: 90–95.
- Wijesuriya, Gamini. 2022. “2022 World Heritage\_50 Years and Moving Forward.” : 173–92.
- Xu, Chaoran, Cong Wu, Lifeng Tan, and Hanfang Liu. 2025. “The Application of HBIM in Chinese Architectural Heritage: Sustainability Assessment and Prospects.” doi:10.20944/preprints202503.0049.v1.
- Zhang, Zhi Hu, and Heng Chiang Huang. 2025. “Enhancing Sustainable Tourism Through Virtual Reality: The Role of Collectable Experiences in Well-Being and Meaning in Life.” *Sustainability (Switzerland)* 17(13). doi:10.3390/su17135809.
- Zhang, Zilong. 2024. 2024 Highlights in Science, Engineering and Technology AMMMP *Innovative Application and User Experience of Virtual Reality Technology in Human-Computer Interaction*.
- Zhao, Lulu, and Jae Woong Kim. 2024. “The Impact of Traditional Chinese Paper-Cutting in Digital Protection for Intangible Cultural Heritage under Virtual Reality Technology.” *Heliyon* 10(18). doi:10.1016/j.heliyon.2024.e38073.
- Zhou, X. 2024. 1215 LNEE Lecture Notes in Electrical Engineering *Intangible Cultural Heritage Art Exhibition System Based on Mobile Virtual Reality Technology*. doi:10.1007/978-981-97-4125-0\_23.