Virtual Heritage Dissemination and Immersive Learning

Subjects: Architecture And Design

Contributor: Jesse Rafeiro, Ana Tomé, Maria Nazário

Lost architectural heritage refers to buildings, structures, or other physical features of the built environment that have been damaged or altered over time to such an extent that they are irretrievable through physical experience alone. This loss can occur for many reasons like neglect, disaster, demolition, or renovation works. Such heritage is commonly known to us through sparse sources of multiple and varied layers of the past that are often uncertain and contradictory. Each lost artifact uncovers cultural, social, and spiritual significances embedded within dynamic relations that are ambiguous from a contemporary mindset.

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1. Virtual Heritage Dissemination

The use of digital platforms by cultural institutions like museums and other learning institutions has grown in recent years, creating numerous ways of disseminating knowledge about heritage assets online, either in databases, archives, virtual tours, or other immersive learning experiences made possible by augmented reality (AR) and virtual reality (VR) technologies. Such practices have intensified following the COVID-19 pandemic, which forced many cultural institutions to redefine and reimagine forms of public engagement and storytelling, with many virtual formats replacing physical visits [1][2][3]. Google Arts & Culture is a well-known example which provides online access to numerous virtual experiences made through partnerships with significant museums and other public institutions globally [4]. Already, the results of studies suggest these trends are no temporary phenomenon or crisis response. Virtual travel is likely to continue in a post-pandemic world due to a growing sense of eco-anxiety and concerns over the sustainability of physical travel [5][6].

Although the term evokes many possible definitions, immersive experiences typically refer to virtual experiences made navigable online through a smart device, computer screen, or VR headsets which replicate a guided visit to a physical place. Often, immersive experiences can take the form of a virtual tour providing a sequentially designed walkthrough within which the virtual visitor is pointed to culturally significant objects, architectural details, or other aspects, akin to the experience of an in-person visit. Descriptions of these may be enhanced through the convergence of other media, beyond what is possible in a physical visit, for example, with the inclusion of videos, explanatory digital models, images, text, or other content. This enables visitors to view and interact with a simulated environment that facilitates learning about both tangible (physical artifacts) and intangible (cultural and historical context, documented practices of life) aspects of a place [7][8][9].

The inclusion of intangible history in virtual heritage is particularly relevant in consideration of a more inclusive and sustainable understanding of heritage today [10]. Since the 1970s, international documents defining the criteria of heritage protection began incorporating not only the tangible protection of objects but increasingly intangible aspects of heritage [11]. Examples of intangible heritage in the context of architecture could include building techniques, uses of spaces, ritual practices, ceremonies, events, oral histories, or other invisible cultural meanings associated with an object or place. The significance of this trend has increased within the last two decades, contributing to what has been referred to as a new paradigm which recognizes the importance of transmitting memory and traditions to future generations [12]. Within this context, digital modelling processes, like HBIM, have been touted for their contribution to the sustainability of intangible cultural memory as employed not only in the documentation and management of heritage but also as a means of visualization and cultural learning [13][14][15][16]. This process often leverages the dissemination of virtual heritage to draw attention to physical sites.

Several case studies highlight the diversity of approaches that researchers have taken to relate physical and virtual places. The case of the Canadian Parliament buildings is one example where physical visits have been substituted by virtual ones during a lengthy rehabilitation campaign which will close doors to the public for at least two decades [17][18]. In this case, the virtual experience temporarily takes over the physical experience to continue the dissemination of the

popular destination. A virtual tour of the Castle in Corsano, Italy, uses virtual reality to permit access to a physically inaccessible place, allowing first-hand experience of the tangible and intangible history of the place [19]. Here, the virtual experience contributes to the site's valorization in hopes of an eventual reopening of the site. In Romania, a series of wooden churches were incorporated into a virtual learning experience to connect visitors to fragile heritage sites to promote their cultural significance and protection [20]. This approach seeks to leverage digital surveying data for public engagement and conservation assessment. Virtual experiences have also proven effective for remote learning within higher education contexts to enhance architecture students' understandings of heritage, as is the case of the Pantheon in Rome [21]. In this course, the virtual experience enhances textbook learning by allowing students to explore a site first-hand while eliminating the need for costly international travel. Far from being an exhaustive list, these are some examples which use digital content to permit the continual access and sustainability of architectural heritage and its intangible values and practices.

Despite the increasing adoption of virtual experiences for such purposes, there are many questions as to how these experiences impact our relationship to physical places and their histories. Namely, what kind of relationship should a virtual experience have to the physical place which it represents? Is the digital meant to replace the physical or can the two experiences be mutually beneficial for learning about the past? How do researchers define authenticity in such cases, and is it even possible to do so in an age of mass simulation [22]? These questions are especially pertinent in cases which seek to replicate experiences of an existing, already publicly accessible place.

2. Authenticity in Virtual Reconstruction Research

The visualization of lost architectural heritage through virtual reconstruction research instigates a complex relationship between the physical and virtual that raises questions of authenticity. Virtual reconstruction typically uses digital modelling from diverse datasets to visualize places which no longer exist or have been modified so greatly over time as to make physical visits alone ineffectual to achieve a tangible understanding. According to the Principles of Seville, virtual reconstruction may occur at a single point or multiple points in history and is to be grounded in studies conducted by experts in fields such as architecture, archaeology, and history. It should be substantiated by physical evidence, historical texts, and comparisons with similar places or objects [23] (p. 3).

Such models are often important forms of public engagement about heritage, yet, some have criticized that virtual environments can create an even greater distance between the present and past. Despite all efforts to recreate authentic virtual environments with high visual and auditory fidelity, there are still many limitations that give us a sense of "immateriality and sterilization" as a result of the absence of patina and traces of life, as well as the haptic limitations that such environments have been unable to overcome in existing technologies [24] (p. 51). In contrast, the notion that high visual fidelity is important for authenticity has also encountered increasing scrutiny in recent years. Despite the advancements in contemporary 3D reality capture technologies, which can produce increasingly refined and geometrically precise representations, such attributes do not inherently ensure authenticity. The temptation to conflate authenticity with accuracy might be better avoided altogether, each having their own distinct roles [25][26].

Additionally, some criticism has emerged about international guidelines such as the London Charter and Seville Principles for having exhibited an excessive preoccupation with recreating the original as the primary determinant of cultural authenticity [26]. Instead, researchers have suggested that any definition of authenticity is itself based on evolving, often highly subjective criteria depending on different individual or collective opinions, cultural contexts, societal changes, and differing value systems that are impossible to define in a universal way [26][27][28]. Authenticity for many researchers, therefore, is not only about faithful representations of the past but also a much more dynamic process including (1) how these pasts are constructed, (2) the development of a virtual heritage project itself, and (3) the living experiences of those who are intended to find meaning in it [27]. This understanding of authenticity shares UNESCO's reformulation of criteria for listing objects and sites as world heritage that was advanced in the Nara Conference of 1994 [29]. Here, value judgements and criteria of authenticity differ greatly across cultural perspectives, which makes it impossible to base authenticity on fixed criteria. Instead, a commitment to authenticity implies the necessity to evaluate and assess heritage properties within their respective, often complex or contradictory, cultural contexts.

For over a decade, the Principles of Seville has stood as the most authoritative guideline for definitions of authenticity in virtual heritage. They were formulated firstly in 2011 to extend the earlier London Charter's principles into the field of virtual archaeology. Overall, the principles equate authenticity to the scientific validation of hypotheses and degrees of accuracy based on available information. One criticism of the principles from what has been discussed above is that they implicitly bias a search for the original as the main goal of virtualization, with scientific categories that in reality cannot be fully upheld [26]. One of the most direct claims of the principles is: "Since archaeology is complex and not an exact and

irrefutable science, it must be openly committed to making alternative virtual interpretations provided they afford the same scientific validity. When that equality does not exist, only the main hypothesis will be endorsed" [23] (p. 6). Here, the judgment of equality rests on many factors like the interpreter's opinions, biases, and cultural background, as well as an understanding of the context in which the historic records used to create a hypothesis were produced. Morcillo et al. have suggested, therefore, that the definition of scientific validity be defined to incorporate "truthful and credible values for different versions of an object, different uses through time, different cultural contexts and memories, and maybe even future projections of meanings" [26] (p. 41). In this way, research transparency in virtual reconstruction would be paramount to disclosing claims or definitions of authenticity.

Another important international declaration on virtual heritage is the 2006 London Charter, which was born out of the research community of the late 1990s and early 2000s. Its authors saw a growing necessity to define guiding principles to justify the scientific nature and progress of the newly emerging field [30]. At that time, a sustainable solution to transparency in virtual heritage was particularly important due to the novelty that virtual tools introduced into the study of history. Thus, while authenticity is not a term employed or directly addressed by The London Charter, researchers who contributed to its formulation have since reflected on what it implies about authenticity [31]. For them, authenticity is referred to as the ability to scientifically evaluate and assess a visualization outcome [31]. This includes a formal representation of the reasoning process for generating a visualization outcome, along with the primary data used and its transformation process. In this context, transparency is meant to ensure the intellectual accountability of the research processes that led to produce the digital artifact, not guarantee the authenticity of the result [31]. Through an adequate means of communicating transparency, others can determine for themselves the validity of the work in question. That being said, researchers must be cognisant of the range of interpretations that potential visitors are able or willing to give to virtual heritage experiences.

An important aspect to consider within this scope is the concept of paradata. According to the London Charter, paradata refers to how a researcher understands and interprets the available data involved in a given virtual reconstruction project [30] (p. 13). Paradata should be included in any database of a virtual model of this kind to clarify the results of the work. Considering that there are numerous different interpretations of an artifact or historical data possible, paradata ensure the transparency of the research. They involve describing the steps taken in the interpretation and the reasoning process of reconstruction regardless of how they define such criteria. In this way, the documentation of paradata aims to provide other interested parties with a robust understanding of the various objectives and environments involved, as well as the dependability of certain visualization techniques used to achieve the results [32]. They are crucial for the transparency of the research narrative, showcasing how arguments were formed and offering insight into the visualization journey with all its inherent uncertainties and biases made visible [33].

3. Immersive Learning

Although it is always ideal to learn about architectural history in its genuine physical environment, a spatial understanding of the 16th-century Madre de Deus could only be achieved virtually due to the extensive spatial transformations that have obscured its history. By providing first-person immersive experiences, the use of VR can provide some semblance of access to a vanished past. Such immersive experiences can also become learning tools to transmit additional knowledge in the form of text or other media mapped onto three-dimensional experiences of a virtual world. In these ways, how might an immersive learning experience provide visitors with access to spaces lost to time, while transforming their interpretation of the existing place in ways that a physical visit cannot?

At present, there are numerous VR applications which generally appear in two popular forms: Desktop-VR and Headset-VR [34] (p. 962–965). Desktop-VR utilizes a standard computer monitor, mouse, and keyboard for visual display and interaction. It is the most cost-effective and simple option due to the widespread availability of personal computers and the minimal training involved for users to immediately engage in this content. As an alternative, Headset-VR employs a head-mounted display for specialized viewing. It provides a greater sense of immersion and, as many studies have shown, achieves better memory performance [35] (p. 1218). Despite this, research has struggled to comprehensively understand how effective these environments are for learning since there are still a lot of unknowns, different disciplinary knowledge at play, and because the research often yields contradictory results [35] (pp. 1213–124). Regardless, many educators and researchers have posited numerous advantages of this kind of learning for closing the gap between theory and practice in diverse examples of science and technology training, though less focus has been given to learning in the humanities [36] and heritage [37] in general.

Within the experience of architectural heritage, however, one could speculate on various benefits across existing research. Some suggest that learning can take place simply through the emulation of a genuine context, as long as it is

able to induce a sense of presence [38]. Furthermore, while reading increases cognitive efforts due to the necessary filtering and interpretation of symbols in text, immersive experiences can reduce the strain of interpretation by presenting information directly [39]. This is clearly an advantage to learning about architecture. This is supported by existing research in psychology that indicates active interaction in virtual spaces yields higher mnemonic benefits than passively watching instructional videos, indicating a positive correlation between the spatial interactions in VR and learning outcomes [40][41]. Furthermore, immersive experiences can help trigger episodic memory, which in turn enhances the retention of meaningful, personalized learning experiences [42]. Episodic memory is a type of long-term memory that involves the conscious recollection of past experiences, including spatial context, time, place, and associated emotions, among other factors that allow us to re-experience events of the past [43]. It has important implications for learning because it can help individuals remember the context in which certain information was acquired, allowing personal connections to form between different experience and subject matter [43]. What is important for learning in immersive virtual experiences is that they leverage our innate episodic memory by providing interactions to create lasting, transformative knowledge [42]. Researchers suggest that an effective immersive learning experience should therefore aim to elevate a user's levels of perception and cognition through the creation of interactive spatiotemporal connections of objects and spaces [44][45][46].

Aside from the learning benefits, there are other aspects related to the connection between the virtual and physical that should be mentioned. VR has been increasingly relevant for addressing accessibility to heritage [47] while re-situating learning in experiential contexts to create a sense of presence [48] in places that are otherwise impossible, difficult, too costly, or unethical to visit [49]. Virtual experiences might similarly aid in enhancing a visitors' eventual physical experience of a place, providing insights and context. Studies in the tourism industry provide some reassurance to this hypothesis. Usually, users of virtual experiences respond that they offer helpful complements and background information to eventual physical experiences of a site, rather than understanding them as replacements of such visits [50][51]. Others suggest that positive interactions in virtual experiences may encourage visitors to visit a physical site [52]. Thus, virtual experiences have the capacity to positively transform our encounters with physical places, introducing new forms of knowledge that the limitations of physical visits cannot.

References

1. Burke, V.; Jørgensen, D.; Jørgensen, F.A. Museums at Home: Digital Initiatives in Response to COVID-19. Nor. Museumstidsskrift 2020, 6, 117–123.
2. Akhtar, N.; Khan, N.; Mahroof Khan, M.; Ashraf, S.; Hashmi, M.S.; Khan, M.M.; Hishan, S.S. Post-COVID-19 Tourism: Will Digital Tourism Replace Mass Tourism? Sustainability 2021, 13, 5352.
3. Ginzarly, M.; Jordan Srour, F. Cultural Heritage through the Lens of COVID-19. Poetics 2022, 92, 101622.
4. Google Arts & Culture. Available online: https://artsandculture.google.com/ (accessed on 14 January 2024).
5. Talwar, S.; Kaur, P.; Nunkoo, R.; Dhir, A. Digitalization and Sustainability: Virtual Reality Tourism in a Post Pandemic World. J. Sustain. Tour. 2022, 31, 2564–2591.
6. Talwar, S.; Kaur, P.; Escobar, O.; Lan, S. Virtual Reality Tourism to Satisfy Wanderlust without Wandering: An Unconventional Innovation to Promote Sustainability. J. Bus. Res. 2022, 152, 128–143.
7. Mah, O.B.P.; Yan, Y.; Tan, J.S.Y.; Tan, Y.-X.; Tay, G.Q.Y.; Chiam, D.J.; Wang, Y.-C.; Dean, K.; Feng, C.-C. Generating a Virtual Tour for the Preservation of the (in)Tangible Cultural Heritage of Tampines Chinese Temple in Singapore. J. Cult. Herit. 2019, 39, 202–211.
8. Kyrlitsias, C.; Christofi, M.; Michael-Grigoriou, D.; Banakou, D.; Ioannou, A. A Virtual Tour of a Hardly Accessible Archaeological Site: The Effect of Immersive Virtual Reality on User Experience, Learning and Attitude Change. Front. Comput. Sci. 2020, 2, 23.
9. Okanovic, V.; Ivkovic-Kihic, I.; Boskovic, D.; Mijatovic, B.; Prazina, I.; Skaljo, E.; Rizvic, S. Interaction in eXtended Reality Applications for Cultural Heritage. Appl. Sci. 2022, 12, 1241.
10. UNESCO. Text of the Convention for the Safeguarding of the Intangible Cultural Heritage. Available online: https://ich.unesco.org/en/convention (accessed on 5 December 2023).
11. Vecco, M. A definition of cultural heritage: From the tangible to the intangible. J. Cult. Herit. 2010, 11, 321–324.
12. Araoz, G.F. Preserving heritage places under a new paradigm. J. Cult. Herit. Manag. Sustain. Dev. 2011, 1, 55–60.
13. Hajirasouli, A.; Banihashemi, S.; Kumarasuriyar, A.; Talebi, S.; Tabadkani, A. Virtual Reality-Based Digitisation for Endangered Heritage Sites: Theoretical Framework and Application. J. Cult. Herit. 2021, 49, 140–151.

14. Fadli, F.; AlSaeed, M. Digitizing Vanishing Architectural Heritage; The Design and Development of Qatar Historic Buildings Information Modeling Platform. Sustainability 2019, 11, 2501.
15. Heesom, D.; Boden, P.; Hatfield, A.; Rooble, S.; Andrews, K.; Berwari, H. Developing a Collaborative HBIM to Integrate Tangible and Intangible Cultural Heritage. Int. J. Build. Pathol. Adapt. 2020, 39, 72–95.
16. Fai, S.; Graham, K.; Duckworth, T.; Wood, N.; Attar, R. Building information modelling and heritage documentation. In Proceedings of the 23rd International Symposium, International Scientific Committee for Documentation of Cultural Heritage (CIPA), Prague, Czech Republic, 12–19 July 2011; pp. 12–16. Available online: https://www.cipaheritagedocumentation.org/wp-content/uploads/2018/12/Fai-e.a.-Building-information-modelling-and-heritage-documentation.pdf (accessed on 29 January 2024).
17. Pybus, C.; Graham, K.; Doherty, J.; Arellano, N.; Fai, S. New Realities for Canada's Parliament: A Workflow for Preparing Heritage BIM for Game Engines and Virtual Reality. Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci. 2019, XLII–2/W15, 945–952.
18. DPT. Parliament—Parlement The Virtual Reality Experience. 11 May 2020. Available online: https://store.steampowered.com/app/1232920/Parliament__Parlement/ (accessed on 11 January 2024).
19. De Paolis, L.T.; Chiarello, S.; Gatto, C.; Liaci, S.; De Luca, V. Virtual Reality for the Enhancement of Cultural Tangible and Intangible Heritage: The Case Study of the Castle of Corsano. Digit. Appl. Archaeol. Cult. Herit. 2022, 27, e00238.
20. Caciora, T.; Herman, G.V.; Ilieș, A.; Baias, Ș.; Ilieș, D.C.; Josan, I.; Hodor, N. The Use of Virtual Reality to Promote Sustainable Tourism: A Case Study of Wooden Churches Historical Monuments from Romania. Remote Sens. 2021, 13, 1758.
21. Chan, C.-S.; Bogdanovic, J.; Kalivarapu, V. Applying Immersive Virtual Reality for Remote Teaching Architectural History. Educ. Inf. Technol. 2021, 27, 4365–4397.
22. Baudrillard, J. Simulacra and Simulation; Glaser, S., Translator; University of Michigan Press: Ann Arbor, MI, USA, 1994.
23. The Seville Principles. International Principles of Virtual Archaeology. 2017. Available online: https://icomos.es/wp-content/uploads/2020/06/Seville-Principles-IN-ES-FR.pdf (accessed on 5 December 2023).
24. Jeffrey, S. Digital heritage objects, authorship, ownership and engagement. In Authenticity and Cultural Heritage in the Age of 3D Digital Reproductions; Di Giuseppantonio Di Franco, P., Galeazzi, F., Vassallo, V., Eds.; McDonald Institute for Archaeological Research: Cambridge, UK, 2018; pp. 49–56.
25. Jensen, P. Evaluating authenticity: The authenticity of 3D models in archaeological Field documentation. In Authenticity and Cultural Heritage in the Age of 3D Digital Reproductions; Di Giuseppantonio Di Franco, P., Galeazzi, F., Vassallo, V., Eds.; McDonald Institute for Archaeological Research: Cambridge, UK, 2018; pp. 57–72.
26. Morcillo, J.M.; Schaaf, F.; Schneider, R.H.; Robertson-von Trotha, C.Y. Authenticity through VR-Based Documentation of Cultural Heritage. A Theoretical Approach Based on Conservation and Documentation Practices. Virtual Archaeol. Rev. 2017, 8, 35.
27. Champion, E.M. (Ed.) Preserving authenticity in virtual heritage. In Virtual Heritage: A Guide; Ubiquity Press: London, UK, 2021; pp. 129–137.
28. Galeazzi, F. 3-D Virtual Replicas and Simulations of the Past: "Real" or "Fake" Representations? Curr. Anthropol. 2018, 59, 268–286.
29. ICOMOS (International Council on Monuments and Sites). The Nara Document on Authenticity. ICOMOS/ICCROM/UNESCO: Nara. 1994. Available online: https://www.icomos.org/en/charters-and-texts/179-articles-en-francais/ressources/charters-and-standards/386-the-nara-document-on-authenticity-1994 (accessed on 17 January 2024).
30. London Charter. London Charter for the Computer-Based Visualisation of Cultural Heritage. 2012. Available online: http://www.londoncharter.org/introduction.html (accessed on 5 December 2023).
31. Sorin, H.; Niccolucci, F. Digital Authenticity and the London Charter. In Authenticity and Cultural Heritage in the Age of 3D Digital Reproductions; Di Giuseppantonio Di Franco, P., Galeazzi, F., Vassallo, V., Eds.; McDonald Institute for Archaeological Research: Cambridge, UK, 2018; pp. 37–44.
32. Bentkowska-Kafel, A.; Denard, H. Introduction. In Paradata and Transparency in Virtual Heritage; Ashgate Publishing Company: Famham, UK, 2012; pp. 1–4.
33. Baker, D. Defining Paradata in Heritage Visualization. In Paradata and Transparency in Virtual Heritage; Ashgate Publishing Company: Famham, UK, 2012; pp. 163–175.

34. Furht, B. (Ed.) Encyclopedia of Multimedia, 2nd ed.; Springer Science & Business Media: New York, NY, 2008; pp. 962–965.
35. Smith, S.A. Virtual Reality in Episodic Memory Research: A Review. Psychon. Bull. Rev. 2019, 26, 1213–1237.
36. Kuhail, M.A.; ElSayary, A.; Farooq, S.; Alghamdi, A. Exploring Immersive Learning Experiences: A Survey. Informatics 2022, 9, 75.
37. Valencia Arnica, Y.K.; Ccasani Rodriguez, J.L.; Rucano Paucar, F.H.; Talavera-Mendoza, F. The Status of Didactic Models for Heritage Education: A Systematic Review. Heritage 2023, 6, 7611–7623.
38. Dengel, A.; Magdefrau, J. Immersive Learning Explored: Subjective and Objective Factors Influencing Learning Outcomes in Immersive Educational Virtual Environments. In Proceedings of the 2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE), Wollongong, Australia, 4–7 December 2018; IEEE: Piscataway, NJ, USA, 2018; pp. 608–615. Available online: https://ieeexplore.ieee.org/abstract/document/8615281?casa_token=cQvXP9Jod_8AAAAA:ex2-U71djNCkDU7Ef7LdKFCI6HVPBs8J3B3r5WUOWaHIITESfhEJQg9r6fmII5gzm6uilogi2Pw (accessed on 17 January 2024).
39. Elmqaddem, N. Augmented Reality and Virtual Reality in Education. Myth or Reality? Int. J. Emerg. Technol. Learn. 2019, 14, 234–241.
40. Hahm, J.; Lee, K.; Lim, S.-L.; Kim, S.-Y.; Kim, H.-T.; Lee, J.-H. Effects of Active Navigation on Object Recognition in Virtual Environments. CyberPsychol. Behav. 2007, 10, 305–308.
41. Sauzéon, H.; Arvind Pala, P.; Larrue, F.; Wallet, G.; Déjos, M.; Zheng, X.; Guitton, P.; N'Kaoua, B. The Use of Virtual Reality for Episodic Memory Assessment. Exp. Psychol. 2012, 59, 99–108.
42. Mystakidis, S.; Lympouridis, V. Immersive Learning. Encyclopedia 2023, 3, 396–405.
43. Gillund, G. Episodic Memory. Encycl. Hum. Behav. 2012, 68–72.
44. Sylaiou, S.; Mania, K.; Paliokas, I.; Pujol-Tost, L.; Killintzis, V.; Liarokapis, F. Exploring the educational impact of diverse technologies in online virtual museums. Int. J. Arts Technol. 2017, 10, 58–84.
45. Styliani, S.; Fotis, L.; Kostas, K.; Petros, P. Virtual Museums, a Survey and Some Issues for Consideration. J. Cult. Herit. 2009, 10, 520–528.
46. Pietroni, E.; Ferdani, D. Virtual Restoration and Virtual Reconstruction in Cultural Heritage: Terminology, Methodologies, Visual Representation Techniques and Cognitive Models. Information 2021, 12, 167.
47. Marasco, A.; Balbi, B. Designing accessible experiences for heritage visitors through virtual reality. E-Rev. Tour. Res. 2019, 17, 426–443. Available online: https://ertr-ojs-tamu.tdl.org/ertr/article/view/526 (accessed on 29 January 2024).
48. Asad, M.M.; Naz, A.; Churi, P.; Tahanzadeh, M.M. Virtual Reality as Pedagogical Tool to Enhance Experiential Learning: A Systematic Literature Review. Educ. Res. Int. 2021, 2021, 7061623.
49. Schott, C.; Marshall, S. Virtual Reality and Situated Experiential Education: A Conceptualization and Exploratory Trial. J. Comput. Assist. Learn. 2018, 34, 843–852.
50. Losada, N.; Jorge, F.; Teixeira, M.S.; Melo, M.; Bessa, M. Could Virtual Reality Substitute the 'Real' Experience? Evidence from a UNESCO World Heritage Site in Northern Portugal. Adv. Tour. Technol. Syst. 2020, 209, 153–161.
51. El-Said, O.; Aziz, H. Virtual Tours a Means to an End: An Analysis of Virtual Tours' Role in Tourism Recovery Post COVID-19. J. Travel Res. 2021, 61, 528–548.
52. Tarek, S. Smart Access to the Past: Studying Digital Applications for Interaction with Cultural Heritage. In Proceedings of the 6th International Conference of Contemporary Affairs in Architecture and Urbanism, Alanya, Turkey, 14–16 June 2023.