



RIVISTA DI DISEGNO
UNIVERSITÀ DEGLI
STUDI DI FIRENZE

Special Issue | N. 1 | 2026
LE MECCANICHE DEL GAMING
THE MECHANICS OF GAMING

Citation: A. Ippolito, M. Di Giovine, *From Survey to Play: Serious Games and Interactive Narratives for Architectural Heritage*, in in *TRIBELON*, Special Issue, 2026, 1, pp. 36-43.

ISSN (stampa): 3035-143X

ISSN (online): 3035-1421

doi: <https://doi.org/10.36253/tribelon-4006>

Received: March, 2026

Accepted: May, 2026

Published: September, 2026

Copyright: 2026 Ippolito A., Di Giovine M., this is an open access peer-reviewed article published by Firenze University Press (<http://www.riviste.fupress.net/index.php/tribelon>) and distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Competing Interests: The Author(s) declare(s) no conflict of interest.

Journal Website: riviste.fupress.net/tribelon

FROM SURVEY TO PLAY: SERIOUS GAMES AND INTERACTIVE NARRATIVES FOR ARCHITECTURAL HERITAGE

ALFONSO IPPOLITO, MATILDE DI GIOVINE

Sapienza University of Rome

Corresponding author: alfonso.ippolito@uniroma1.it

This paper investigates the potential of serious games and interactive narratives as tools for the communication and valorisation of architectural heritage. Starting from architectural survey methods as a rigorous scientific foundation, this research explores strategies for translating complex metric and historical data into accessible and engaging digital experiences aimed at younger audiences. The proposed methodology combines survey techniques, data processing, and selective simplification with narrative design principles based on semiotics and existing game studies. Particular attention is given to the role of storytelling and mission-based mechanics in fostering learning through play. The approach is tested through a case study focused on the Basilica of Santa Maria Maggiore in Rome, whose historical stratification and architectural complexity make it an ideal example to experiment on. The survey data are translated into digital models and integrated into an interactive digital environment, while the narrative framework is defined according to Greimas' actantial model.

The results highlight how interactive storytelling, grounded in accurate architectural representation, can enhance users' understanding of heritage while maintaining scientific reliability. The study contributes to the ongoing debate on digital heritage communication by proposing a transferable workflow that connects architectural survey, narrative construction, and game-based learning.

Keywords: Serious game, architectural heritage, digital survey, interactive narrative, digital model.

Introduction

Digital technologies have profoundly transformed the documentation, interpretation, and communication of architectural heritage, progressively shifting digital heritage practices from static forms of representation toward interactive and experiential environments. Within this framework, architectural knowledge is no longer transmitted exclusively through descriptive or visual outputs, but increasingly mediated through digital systems that enable exploration, interaction, and narrative engagement¹.

In this evolving context, users are no longer passive recipients of cultural content, but are increasingly involved as active participants in its construction and interpretation. As observed by Jenkins, contemporary digital culture is characterised by a convergence of media

platforms and participatory practices, in which audiences act as co-authors in the production and circulation of meaning². This participatory dynamic reshapes the ways in which cultural heritage is communicated, favouring interactive experiences that go beyond traditional static models of representation.

Against this backdrop, serious games have emerged as relevant tools for heritage communication, particularly in educational contexts. By combining spatial exploration, interaction inputs, and goal-oriented progression, they support learning-through-play and active engagement³. Yet a methodological gap persists: architectural survey data – rich in metric precision and layered historical information – are difficult to translate into interactive experiences that remain scientifically reliable while being accessible to non-specialist audiences⁴.

¹ Parrinello, *Documentation and valorization of Holy Land cultural heritage*; Cameron, Kenderdine (eds.), *Theorizing Digital Cultural Heritage: A Critical Discourse*.

² Jenkins, *Convergence Culture: Where Old and New Media Collide*, p. 3.

³ Mortara et al., *Learning cultural heritage by serious games*, cit., pp. 318-325.

⁴ Ferdani, *Ricostruzioni virtuali dal sito archeologico al videogioco*, pp. 136-149.

⁵ Bonacini, Giaccone, *Gamification and cultural institutions in cultural heritage promotion: a successful example from Italy*, pp. 3-22.

⁶ Champion, *Critical Gaming: Interactive History and Virtual Heritage*, pp. 21-29.

⁷ Luigini, Pancioli, *Ambienti digitali per l'educazione all'arte e al patrimonio*.

⁸ Zhou et al., *Cognitive load-based multi-level annotation model for knowledge acquisition in heritage games*, art. 559.

⁹ Liamruk et al., *Development and evaluation of an augmented reality serious game to enhance 21st century skills*, art. 13492.

¹⁰ Palombini, *Narrazione e semiotica nei videogames*, pp. 70-73.

This paper addresses this gap by proposing a methodological framework that integrates architectural survey, data processing, narrative design, and serious game mechanics. The approach is tested through a case study on the Basilica of Santa Maria Maggiore in Rome, exploring the potential of narrative-driven digital environments for architectural heritage communication.

Serious Games and Cultural Heritage: A Theoretical Framework

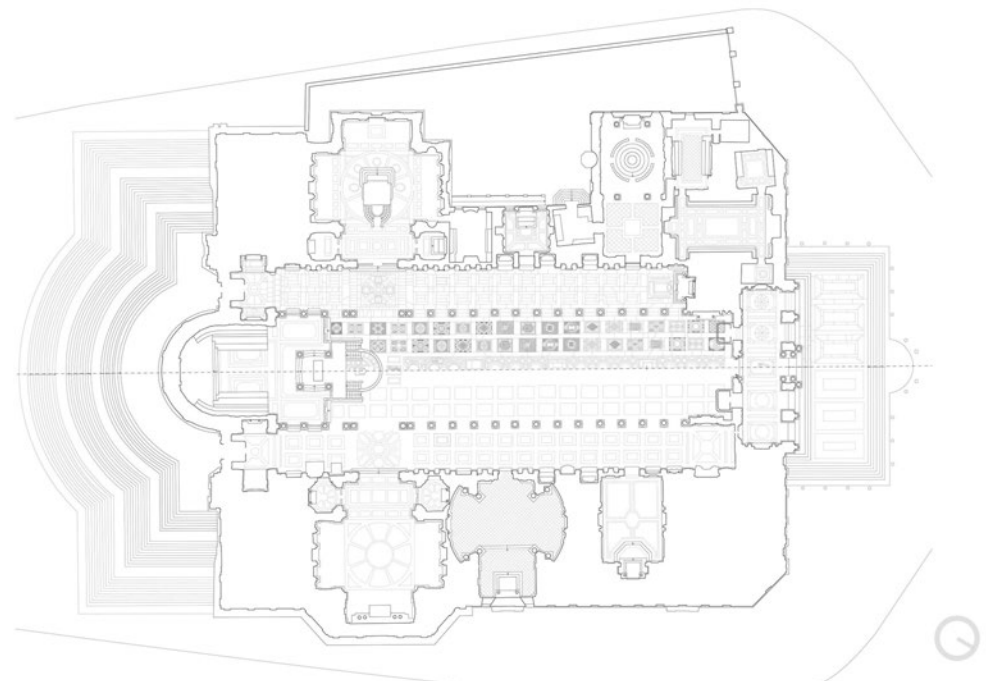
Serious games as cultural mediation tools

Serious games act as cultural mediation tools by combining educational objectives, rule-based interaction and spatial exploration to promote active engagement with historical and architectural content⁵.

Recent studies show that interaction can support experiential learning and the progressive construction of meaning where spatial complexity and historical depth challenge traditional communication tools⁶.

In digital heritage education, learning-through-play is increasingly framed as a way to sustain motivation and participation by coupling cultural content with interactive tasks and feedback. Within digital learning environments for heritage, engagement is not treated as an added “effect”, but as a condition that supports attention, curiosity, and the progressive construction of meaning through experience⁷.

At the same time, designing for younger audiences requires careful control of information density and task complexity: heritage content is intrinsically layered, and interactive experiences can easily overload users if interpretative cues and learning objectives are not calibrated. Recent empirical studies in heritage-oriented serious games show that structuring information in progressive levels and managing cognitive load can improve knowledge acquisition and retention⁸. Similar evidence emerges from an AR serious game evaluated with children and parents, where usability, feedback, and narrative clarity directly affect engagement and perceived learning impact⁹.



Narrative structures and interactive storytelling

Within cultural heritage serious games, narrative structures play a crucial role in organising content and guiding user interaction. By linking spatial actions to narrative goals, interactive storytelling supports the interpretation of architectural and historical information through experience rather than exposition¹⁰.

1 | Point cloud data obtained from laser scanning of the Basilica of Santa Maria Maggiore.

2 | 2D plan derived from the elaboration and interpretation of laser scanning and photogrammetry data of the Basilica of Santa Maria Maggiore.



3 | 2D elevation derived from the elaboration and interpretation of laser scanning and photogrammetry data of the Basilica of Santa Maria Maggiore.

Recent studies on interactive and spatial narratives highlight how narrative frameworks can enhance user orientation, agency, and comprehension in complex digital environments¹¹. In heritage contexts, narrative-driven interaction enables users to navigate layered information by connecting spaces, events, and actions into coherent experiential paths¹². This approach is particularly relevant for architectural heritage, where narrative structures help mediate spatial complexity and historical stratification without oversimplifying content.

In interactive environments, representation shifts from a purely descriptive function to a mediating process that structures access to spatial and historical information¹³.

This shift challenges traditional hierarchies between accuracy and communication, showing how survey-derived models can be adapted to interactive and narrative contexts without compromising scientific reliability and the interpretative role of drawing and modelling¹⁴.

Methodological Approach

Architectural survey as an interpretative foundation

Architectural survey constitutes the scientific foundation of the methodology

as both metric acquisition and critical reading. Survey data require interpretation, selection and synthesis to become meaningful representations; these analytical choices guide subsequent modelling and communication¹⁵.

Recent contributions in the field of architectural representation have emphasised the distinction between raw survey data – such as point clouds or dense numerical datasets – and the interpretative models derived from them. These models are not neutral transcriptions of reality, but critical constructs that organise spatial information according to geometric, semantic, and cognitive criteria. Understanding survey as an interpretative foundation allows architectural representation to mediate complexity while preserving scientific reliability¹⁶.

The workflow links integrated acquisition, point-cloud processing, 2D restitution, 3D modelling, selective simplification and real-time implementation. Each phase involves choices concerning geometry, semantic relevance, interoperability and communicative use¹⁷ (fig. 1).

From survey data to interactive digital environments

After data acquisition, survey outputs are processed with a focus on communication rather than exhaustive documentation.

¹¹ Ryan, *Narrative as Virtual Reality 2: Revisiting Immersion and Interactivity*.

¹² *Ibid.*; Rouse, *Game Design: Theory and Practice*, pp. 87-96.

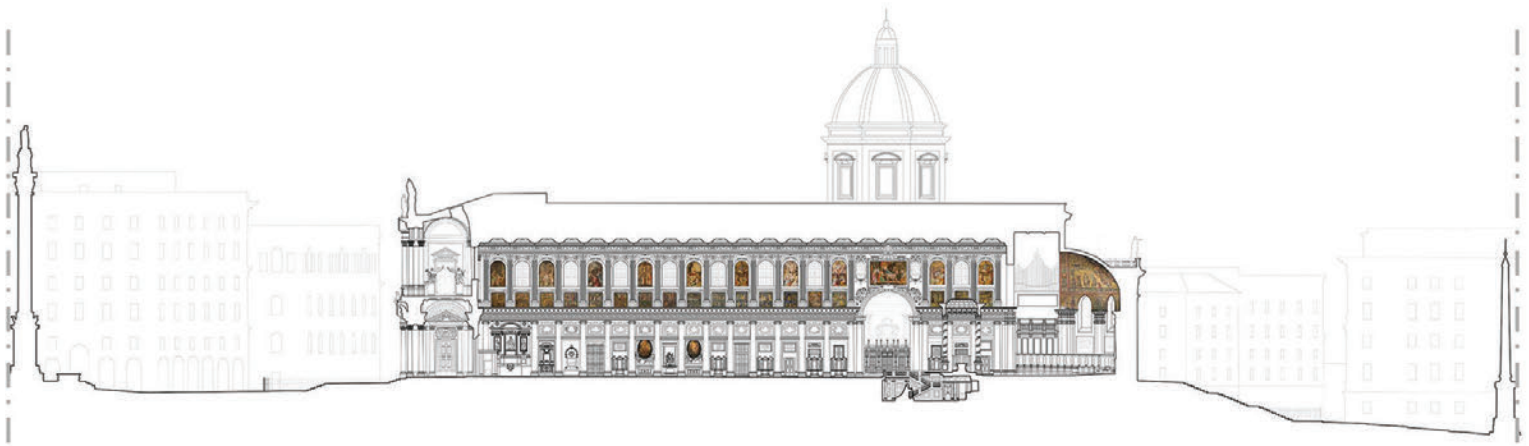
¹³ Parrinello, *Documentation and valorization of Holy Land cultural heritage*.

¹⁴ Bianchini, *The shape of (Point) Clouds*.

¹⁵ *Ibid.*

¹⁶ Spallone et al., *From survey to 3D modelling to digital fabrication*, pp. 619-626.

¹⁷ Pulcrano, *Cloud-to-BIM-to-VR: an operative approach for the construction of interactive and information models for the cultural heritage*, pp. 443-449.



4 | 2D longitudinal section derived from the elaboration and interpretation of laser scanning and photogrammetry data of the Basilica of Santa Maria Maggiore.

5 | 3D reconstructed environment of the Basilica Liberiana.

While architectural survey prioritises metric reliability, its transformation for interactive environments requires selective operations aimed at semantic clarity and spatial intelligibility. This phase involves interpretative choices through which relevant architectural elements and spatial hierarchies are identified according to communicative objectives¹⁸. Selective simplification mediates between the density of survey data and the cognitive accessibility required by non-specialist users. Through abstraction and hierarchical organisation, survey-derived representations preserve architectural meaning while remaining suitable for narrative-driven digital environments¹⁹.

In this process, simplification follows criteria of perceptual accuracy and historical-architectural relevance, retaining significant elements, omitting temporary

components or elements that are not significant for the communicative objectives, and integrating complex sculptural forms as survey-derived meshes.

In the proposed framework, metric accuracy is not an end in itself, but a prerequisite for semantic transformation. Survey data are reinterpreted to support readability and comprehension, privileging spatial relationships and architectural hierarchies over exhaustive detail. This shift allows metric reliability to be preserved while adapting representations to communicative and educational purposes²⁰. Following data interpretation and simplification, survey-derived models are integrated into interactive digital environments to support exploration and engagement. This phase does not introduce new representational content, but translates previously defined semantic structures into interactive forms, ensuring

¹⁸ Oreni, *Detect the Differences: Cultural Heritage Survey, Documentation and Interpretation for Conservation Activities*.

¹⁹ Vitali et al., *Banded vaults in Turin: TLS survey, geometric interpretation, digital re-construction, between Design and Construction*, pp. 793-800; The operational workflow included integrated survey acquisition, point cloud processing, 2D and 3D outputs, and the development of interactive digital environments. These steps were supported by specialised software for data processing, three-dimensional modelling, visual optimisation, and interactive design.

²⁰ Bianchini, *The shape of (Point) Clouds*, cit.

²¹ Champion, *Critical Gaming: Interactive History and Virtual Heritage*, pp. 45-52.



“ These models are not neutral transcriptions of reality, but critical constructs that organise spatial information according to geometric, semantic, and cognitive criteria.

ing coherence between architectural meaning, spatial navigation, and user interaction²¹.

Game-engine integration requires checks of polygon conversion, face orientation, materials, collision geometries and trigger points, transforming the model from visual background into an operative environment²².

The methodological framework outlined in Section 3 establishes a progressive shift from survey data to communicative representations, grounding narrative design in scientifically reliable and semantically structured models. By treating survey outputs as interpretative resources rather than neutral datasets, the proposed approach prepares the integration of narrative structures and game mechanics without detaching them from architectural knowledge²³.

Narrative design and game mechanics

Narrative design provides the structural framework through which interaction and progression are organised within the serious game. Rather than conveying historical information through linear storytelling, the proposed approach adopts a goal-oriented narrative structure that links spatial exploration to actions and objectives. Narrative functions are articulated through actantial roles that guide user behaviour and support meaningful engagement with architectural space²⁴. Game mechanics define the rules through which users interact with space and progress within the narrative structure. Actions, feedback, and progression systems are designed to align gameplay

dynamics with educational objectives, ensuring that interaction supports understanding rather than distraction. This balance allows exploration and challenge to reinforce architectural comprehension within the digital environment²⁵.

In heritage-oriented serious games, the balance between historical reliability and ludic dynamics is essential to preserve scientific credibility without compromising engagement. Gameplay mechanics introduce abstraction and rule-based systems that must be carefully calibrated to avoid distortion of architectural meaning. In this framework, ludic elements are employed as interpretative devices, supporting understanding through interaction while remaining grounded in historically and architecturally validated content²⁶.

The complete game is conceived as a chronological sequence dedicated to the chapels progressively added to the Liberian basilica. Each level may introduce the historical figures connected with a specific transformation and employ minigames tailored to its architectural and artistic content.

Case Study: Basilica of Santa Maria Maggiore

Historical and architectural stratification

The Basilica of Santa Maria Maggiore results from a long process of architectural stratification rooted in a pre-existing domus developed between the late Republican period and 255 AD, which constitutes the substratum upon which the later basilical complex was established²⁷. The first monumental basilica was con-

6 | Interactive 3D environment of the Cesi Chapel.

²² Jouan et al., *Built Heritage Visualizations in Immersive Environments to Support Significance Assessments by Multiple Stakeholders*, pp. 267-274.

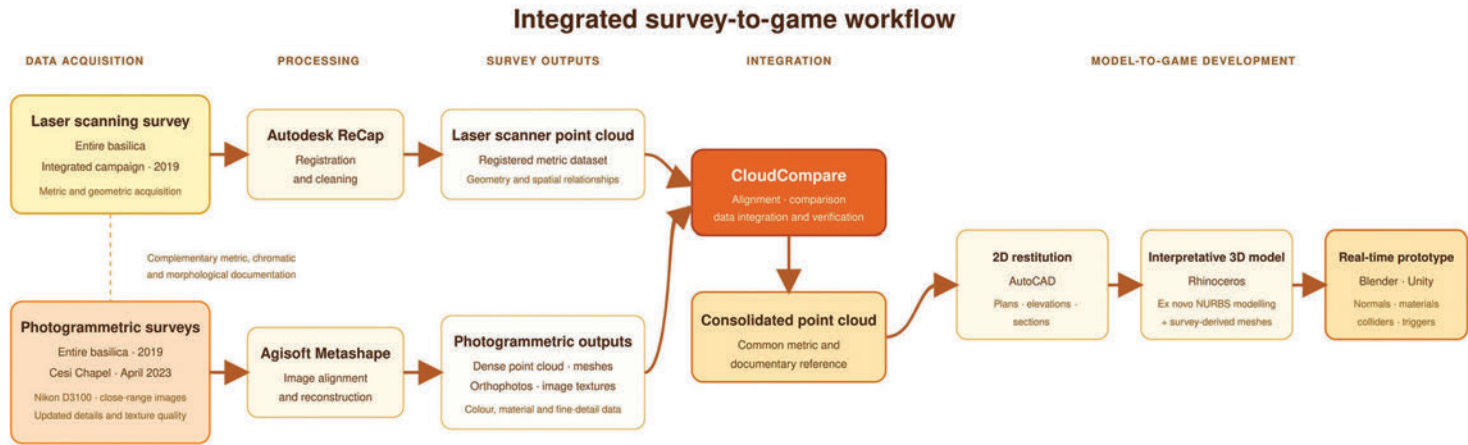
²³ Parrinello, *Documentation and valorization of Holy Land cultural heritage*.

²⁴ Greimas, *Del senso* (1970); Greimas, *Structural Semantics: An Attempt at a Method*, pp. 197-205.

²⁵ Pistono et al., *Framework for adaptive serious games*, art. e22731.

²⁶ Champion, Cumming, *Playing with the Past: Authenticity, Accuracy and Meaning in Digital Heritage Games*, pp. 83-102.

²⁷ Liverani, *Osservazioni sulla domus sotto S. Maria Maggiore a Roma e sulla sua relazione con la basilica*, pp.459-467.



7 | Integrated workflow from digital survey to serious game development.

8 | Dialogue window within the serious game interface.

9 | In-game minigame interface.

structed in the fourth century AD, traditionally associated with the Liberian phase completed in 366 AD. Subsequent medieval, Renaissance, and early modern interventions progressively transformed the complex, producing a layered architectural organism²⁸. Within this stratified framework, later additions such as the Cappella Sforza – designed by Michelangelo Buonarroti as his final project before his death – were integrated into an already complex spatial system²⁹. This coexistence of multiple historical layers makes Santa Maria Maggiore a suitable case study for testing interpretative and narrative strategies grounded in architectural survey data, particularly for mediating historical depth and spatial complexity to non-specialist users³⁰.

Survey campaign, data restitution and digital modelling

The survey campaign documented the architectural stratification and spatial articulation of the basilica through an integrated approach oriented toward interpretative and communicative goals. Data acquisition and restitution focused on identifying geometries and spatial relationships relevant for narrative translation rather than exhaustive architectural description³¹.

The documentation derives from two campaigns. In 2019, the entire basilica was surveyed through an integrated use of laser scanning, with a scanner ZF, and photogrammetry, with a DJI FC3170 drone and a Canon EOS RP, by the group coordinated by Alfonso Ippolito.

In April 2023, Matilde Di Giovine carried out an additional close-range photogrammetric campaign, using a Nikon

D3100, focused on the Cesi Chapel. The second campaign integrated and updated the earlier dataset, with closer attention to detail and texture quality. (figg. 2, 3, 4). Survey outputs were registered in Autodesk ReCap and Agisoft Metashape, and then processed in AutoCAD to generate representations suitable for communication, privileging clarity and hierarchical organisation. This phase provided the geometric and semantic basis for the digital models employed within the interactive environment³².

Survey-derived representations were translated into simplified digital models in Rhinoceros, together with visual assets designed to support interaction and narrative progression. The modelling process prioritised semantic readability and spatial orientation, emphasising architectural hierarchies and key elements over exhaustive geometric detail.

Before import into Unity, the model passed through Blender to correct inverted surface normals. Materials were subsequently applied in Unity, combining textures derived from the 2023 photogrammetric campaign with the materials created within the software (figg. 5, 6). These assets provide a visually coherent and cognitively accessible basis for interaction, ensuring continuity between survey interpretation, narrative design, and user experience within the serious game environment³³ (fig. 7).

Implementation within the serious game

The digital models and visual assets were integrated into the serious game to support exploratory interaction and narrative progression. Architectural elements function as active components of game-

²⁸ Panzera, *La basilica di S. Maria Maggiore dalla fine del 1400 alla fine del 1600*, pp. 147-186.

²⁹ Ackerman, *The Architecture of Michelangelo*, pp. 243-248.

³⁰ Within this framework, the Cesi Chapel was selected as the setting for the serious game due to its architectural coherence and narrative potential, as well as its chronological significance as the earliest chapel constructed within the basilica.

³¹ Guidi, Russo, Angeleddu, *3D Survey and Virtual Reconstruction of Archeological Sites*, pp. 55-69.

³² Parrinello, *Documentation and valorization of Holy Land cultural heritage*.

³³ Champion, *Critical Gaming: Interactive History and Virtual Heritage*, cit., pp. 45-52.

play, guiding user actions and reinforcing the relationship between spatial experience and interpretative objectives³⁴. Interaction is structured to encourage orientation, observation, and goal-oriented exploration, allowing users to engage with architectural space through actions that are directly linked to narrative advancement rather than passive visualisation (figg. 8, 9).

The serious game is designed with explicit educational aims, targeting primary and lower secondary school users through age-appropriate interaction and narrative structures. User experience is shaped to promote curiosity, spatial awareness, and progressive understanding of architectural heritage, integrating exploratory interaction as a complementary support to established educational approaches³⁵.

Discussion

Educational potential

Recent studies confirm the educational potential of serious games as effective complementary tools for cultural heritage learning, particularly when designed to align interaction, narrative structure, and learning objectives³⁶. Contemporary research highlights how engagement, motivation, and knowledge acquisition are strengthened when gameplay mechanics are explicitly connected to educational goals rather than entertainment alone. In this perspective, serious games support architectural understanding by fostering active participation and experiential learning, especially among younger audiences³⁷.

Methodological limits

Despite their potential, serious games for cultural heritage present methodological limitations that require critical consideration. Recent analyses underline how design complexity, cognitive load management, and the risk of excessive simplification remain central challenges, particularly in environments based on spatial and historical data³⁸.

At the same time, uncritical gamification may result in forms of trivialisation or spectacularisation of heritage content; interpretative openness must therefore maintain coherence between ludic dynamics and historical meaning³⁹.

Disciplinary implications and transferability

From a disciplinary perspective, serious games reinforce survey and modelling as interpretative practices, extending their communicative potential through narrative and interaction without replacing their analytical functions⁴⁰.

Empirical evaluations of serious games and immersive applications demonstrate their adaptability across different cultural heritage contexts and user groups. Recent research emphasises how modular methodological frameworks – separating data acquisition, interpretation, and interaction design – enhance transferability and scalability. This flexibility supports the application of the proposed approach to diverse architectural sites and educational scenarios, reinforcing its relevance beyond the specific case study presented⁴¹.

Conclusion

This paper has presented a methodological framework that integrates architectural survey, interpretative modelling, narrative design, and serious game mechanics to support the communication of architectural heritage. By treating survey data as structured interpretative resources, the approach enables the transformation of metric accuracy into semantically readable and interactive representations, suitable for educational and communicative purposes without compromising scientific reliability⁴².

The case study of Santa Maria Maggiore has demonstrated how narrative-driven digital environments can mediate architectural complexity for younger audiences, highlighting their role as complementary tools that extend the communicative potential of architectural drawing and modelling within digital heritage practices, rather than replacing traditional forms of education⁴³.

Future research may further investigate evaluation methodologies, long-term learning outcomes, and the scalability of the framework across different heritage contexts. In this perspective, serious games emerge as a promising field for interdisciplinary experimentation, capable of reinforcing the dialogue between architectural representation, digital media, and cultural heritage communication⁴⁴.

³⁴ Salen, Zimmerman, *Rules of Play: Game Design Fundamentals*.

³⁵ Deterding, Dixon, Khaled, Nacke, *From Game Design Elements to Gamefulness: Defining "Gamification"*, pp. 9-15.

³⁶ Mortara et al., *Learning cultural heritage by serious games*, cit., pp. 318-325.

³⁷ Bontchev et al., *Students' attitude to serious games for cultural heritage*, pp. 316-321.

³⁸ Chatsiopoulos, Michailidis, *Augmented Reality in cultural heritage: a narrative review of design, development and evaluation approaches*, art. 421; Zhou et al., *Cognitive load-based multi-level annotation model for knowledge acquisition in heritage games*, art. 559; DaCosta, Kinsell, *Serious Games in Cultural Heritage: A Review of Practices and considerations in the design of location-based games*, art. 47.

³⁹ Eco, *Opera aperta*.

⁴⁰ Camuñas-García et al., *Digital Game-Based Heritage Education: Analyzing the Potential of Heritage-Based Video Games*, cit., art. 396.

⁴¹ Liamruk et al., *Development and evaluation of an augmented reality serious game to enhance 21st century skills in cultural tourism*, art. 13492.

⁴² DaCosta, Kinsell, *Serious Games in Cultural Heritage: A Review of Practices and considerations in the design of location-based games*, art. 47; Chatsiopoulos, Michailidis, *Augmented Reality in cultural heritage: a narrative review of design...* cit.

⁴³ Camuñas-García et al., *Digital Game-Based Heritage Education: Analyzing the Potential of Heritage-Based Video Games*, art. 396.

⁴⁴ DaCosta, Kinsell, *Serious Games in Cultural Heritage: A Review of Practices* cit.

Bibliography

- J. S. Ackerman, *The Architecture of Michelangelo*, University of Chicago Press, Chicago 1986.
- M. Bercigli, *Masada, the Desert Fortress. Discovering the Archaeological Site by Gaming*, in *Proceedings of CHNT 23 – Conference on Cultural Heritage and New Technologies*, Museen der Stadt Wien – Stadtarchäologie, Vienna 2018, pp. 1-12.
- C. Bianchini, *The Shape of (Point) Clouds*, in *TRIBELON Journal of Drawing and Representation of Architecture, Landscape and Environment*, II, 2025, 4, pp. 16-25.
- E. Bonacini, S. C. Giaccone, *Gamification and Cultural Institutions in Cultural Heritage Promotion: A Successful Example from Italy*, in *Cultural Trends*, XXXI, 2022, 1, pp. 3-22.
- B. Bontchev, V. Terzieva, D. Vassileva, Y. Dankov, *Students' Attitude to Serious Games for Cultural Heritage*, in *IFAC-PapersOnLine*, LVIII, 2024, 3, pp. 316-321.
- F. Cameron, S. Kenderdine (eds.), *Theorizing Digital Cultural Heritage: A Critical Discourse*, MIT Press, Cambridge (MA) 2007.
- D. Camuñas-García, M. P. Cáceres-Reche, M. de la E. Cambil-Hernández, M. E. Lorenzo-Martín, *Digital Game-Based Heritage Education: Analyzing the Potential of Heritage-Based Video Games*, in *Education Sciences*, 14, 2024, 4, art. 396.
- A. Chatsiopolou, P. D. Michailidis, *Augmented Reality in Cultural Heritage: A Narrative Review of Design, Development and Evaluation Approaches*, in *Heritage*, VIII, 2025, 10, art. 421.
- E. Champion, *Critical Gaming: Interactive History and Virtual Heritage*, Routledge, London-New York 2015.
- E. Champion, *Playing with the Past*, Springer, London 2011, DOI: 10.1007/978-1-84996-501-9.
- E. Champion, Cumming, *Playing with the Past: Authenticity, Accuracy and Meaning in Digital Heritage Games*, pp. 83-102.
- B. DaCosta, C. Kinsell, *Serious Games in Cultural Heritage: A Review of Practices and Considerations in the Design of Location-Based Games*, in *Education Sciences*, XIII, 2023, 1, art. 47.
- S. Deterding, D. Dixon, R. Khaled, L. Nacke, *From Game Design Elements to Gamefulness: Defining "Gamification"*, in *Proceedings of the 15th International Academic MindTrek Conference*, ACM, New York 2011, pp. 9-15.
- U. Eco, *Opera aperta* (1962), Bompiani, Milano 1971.
- D. Ferdani, *Ricostruzioni virtuali dal sito archeologico al videogiochi*, in S. Pescarin (a cura di), *Videogames, ricerca, patrimonio culturale*, FrancoAngeli, Milano 2020, pp. 136-149.
- V. Geroimenko (ed.), *Augmented Reality in Education: A New Technology for Teaching and Learning*, Springer, Cham 2020.
- A. J. Greimas, *Del senso* (1970), Bompiani, Milano 1974.
- A. J. Greimas, *Structural Semantics: An Attempt at a Method*, University of Nebraska Press, Lincoln 1983.
- G. Guidi, M. Russo, D. Angheleddu, *3D Survey and Virtual Reconstruction of Archeological Sites*, in *Digital Applications in Archaeology and Cultural Heritage*, 1, 2014, 2, pp. 55-69, DOI: 10.1016/j.daach.2014.01.001.
- H. Jenkins, *Convergence Culture: Where Old and New Media Collide*, New York University Press, New York 2006.
- P. Jouan, L. Moray, P. Hallot, *Built Heritage Visualizations in Immersive Environments to Support Significance Assessments by Multiple Stakeholders*, in *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLVI-2/W1, 2022, pp. 267-274.
- P. Liamruk, N. Onwong, K. Amornrat, A. Arayapipatkul, K. Sipiyaruk, *Development and evaluation of an augmented reality serious game to enhance 21st century skills in cultural tourism*, in *Scientific Reports*, XV, 2025, art. 13492.
- P. Liverani, *Osservazioni sulla domus sotto S. Maria Maggiore a Roma e sulla sua relazione con la basilica*, in *Mitteilungen des Deutschen Archäologischen Instituts. Römische Abteilung*, 116, 2010, pp. 459-467.
- A. Luigini, C. Panciroli (a cura di), *Ambienti digitali per l'educazione all'arte e al patrimonio*, FrancoAngeli, Milano 2018.
- M. Mortara, M. Mortara, C. E. Catalano, F. Bellotti, G. Fiucci, M. Houry-Panchetti, P. Petridis, *Learning Cultural Heritage by Serious Games*, in *Journal of Cultural Heritage*, XV, 2014, 3, pp. 318-325.
- D. Oreni, *Detect the geometrical differences: cultural heritage digital documenta-tion and interpretation for conservation activities. Methodological aspectss*, in *DISEGNARECON*, XVI, 2023, 31, art. 19.
- A. Palombini, *Narrazione e semiotica nei videogames: il caso della "Pleistostation"*, in S. Pescarin (a cura di), *Videogames, ricerca, patrimonio culturale*, FrancoAngeli, Milano 2020, pp. 70-73.
- S. Parrinello, *Documentation and Valorization of Holy Land Cultural Heritage: The Virtual Space for the Historical Sites*, Universidad de Oriente, Santiago de Cuba 2017.
- A. M. Panzera, *La basilica di S. Maria Maggiore dalla fine del 1400 alla fine del 1600*, in R. Luciani (a cura di), *Santa Maria Maggiore e Roma*, Fratelli Palombi Editori, Roma 1996, pp. 147-186.
- A. M. A. de A. Pistono, A. M. P. dos Santos, R. J. V. Baptista, H. S. Mamede, *Framework for Adaptive Serious Games*, in *Computer Applications in Engineering Education*, XXXII, 2024, 4, art. e22731.
- M. Pulcrano, *Cloud-to-BIM-to-VR: An Operative Approach for the Construction of Interactive and Information Models for the Cultural Heritage*, in *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLVI-2/W1, 2022, pp. 443-449.
- M.-L. Ryan, *Narrative as Virtual Reality 2: Revisiting Immersion and Interactivity in Literature and Electronic Media*, Johns Hopkins University Press, Baltimore 2015.
- R. Rouse III, *Game Design: Theory and Practice*, Jones & Bartlett Learning, Burlington 2010.
- K. Salen, E. Zimmerman, *Rules of Play: Game Design Fundamentals*, MIT Press, Cambridge (MA) 2004.
- R. Spallone, R. Spallone, M. C. López González, M. Vitali, G. Bertola, F. Natta, F. Ronco, *From Survey to 3D Modelling to Digital Fabrication: A Workflow Aimed at Documenting and Transmitting Built Heritage*, in *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLIII-B2, 2021, pp. 619-626.
- A. Valentini, *La Patriarcale Basilica Liberiana*, descritta da F. M. Gerardi, a spese di A. Valentini, Roma 1839.
- M. Vitali, M. Vitali, M. C. López González, G. Bertola, F. Natta, *Banded Vaults in Turin: TLS Survey, Geometric Interpretation, Digital Reconstruction, between Design and Construction. Palazzo Capris di Cigliè*, in *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLVI-M-1, 2021, pp. 793-800.
- W. Zhou, Y. Xue, S. Wang, M. Cang, K. Qi, Z. Qiao, *Cognitive Load-Based Multi-Level Annotation Model for Knowledge Acquisition in Heritage Games*, in *npj Heritage Science*, XIII, 2025, art. 559.