Valorizzare il materiale nell'immateriale: Il MUSeum Editor per l'accessibilità e la *cultural heritage*

Umberto Bilotti,[1] Alessio Di Paolo,[2] Michele Domenico Todino,[3] Argyro Fella[4] e Stefano Di Tore[5]

Sommario

L'inclusione educativa e la sensibilizzazione al patrimonio culturale rappresentano obiettivi fondamentali nel contesto scolastico, in particolare per gli studenti con Bisogni Educativi Speciali (BES). Le nuove tecnologie, come la Realtà Virtuale (VR), offrono opportunità innovative affinché gli studenti possano interagire con il patrimonio culturale in modo immersivo e personalizzato, favorendo l'apprendimento attivo e lo sviluppo di competenze autonome in contesti extracurricolari. Inoltre, l'integrazione di tecnologie come la VR e l'Intelligenza Artificiale Generativa (IAG) costituisce una strategia efficace per superare le barriere legate all'accesso alla conoscenza, offrendo modalità inedite di fruizione e apprendimento che valorizzano le peculiarità di ciascun discente. Questo articolo presenta il design di un ambiente virtuale sviluppato presso il laboratorio del Teaching Learning Centre for Inclusive Technologies «Elisa Frauenfelder» dell'Università di Salerno. Il progetto mira a rendere accessibile il patrimonio intangibile della regione attraverso un museo virtuale che raccoglie e digitalizza manufatti locali, come vasi e strumenti musicali, offrendo agli studenti un'esperienza immersiva e interattiva. Tale approccio non solo facilita l'accesso al patrimonio culturale, ma promuove anche l'acquisizione autonoma di conoscenze in contesti extracurricolari, ampliando le opportunità di apprendimento.

Parole chiave

Inclusione, Realtà Virtuale, Intelligenza Artificiale Generativa, Patrimonio culturale.

[1] Dottorando in Scienze dell'apprendimento e tecnologie digitali, Università di Salerno.
[2] Dottorando in Didattica, pedagogia speciale e tecnologie per l'educazione inclusiva, Università di Salerno.
[3] Ricercatore in Didattica e pedagogia speciale, Università di Salerno.
[4] Professore associato di Pedagogia, Università di Nicosia.
[5] Professore ordinario di Didattica e Pedagogia speciale, Università di Salerno.

Vol. 24, n. 3, settembre 2025
doi: 10.14605/ISS2432503 — ISSN: 2724-2242 — pp. 41-56
Corrispondenza: Umberto Bilotti — e-mail: ubilotti@unisa.it

Valuing the material in the immaterial: The MUSeum Editor for accessibility and cultural heritage

Umberto Bilotti,[1] Alessio Di Paolo,[2] Michele Domenico Todino,[3] Argyro Fella[4] and Stefano Di Tore[5]

Abstract

Educational inclusion and raising awareness of cultural heritage are fundamental objectives in the school context, particularly for students with Special Educational Needs (SEN). Through new technologies such as Virtual Reality (VR), students can engage with cultural heritage in an immersive and personalized manner, promoting active learning and the development of autonomous skills in extracurricular contexts. Furthermore, integrating technologies like VR and Generative Artificial Intelligence (GAI) offers an opportunity to overcome barriers to knowledge access, providing new ways of engagement and learning that emphasize the uniqueness of each learner. This article specifically presents the virtual environment design developed in the Teaching Learning Centre for Inclusive Technologies «Elisa Frauenfelder» at the University of Salerno. The project aims to make the intangible cultural heritage of the area accessible through a virtual museum, which collects and digitizes local artifacts, such as vases and musical instruments, offering students an immersive and interactive experience. This approach not only facilitates access to cultural heritage but also fosters the autonomous acquisition of knowledge in extracurricular settings, expanding learning opportunities.

Keywords

Inclusion, Virtual Reality, Generative Artificial Intelligence, Cultural heritage.

[1] Phd student in Learning Sciences and Digital Technologies, University of Salerno.
[2] PhD student in Didactics, special pedagogy and technology for inclusive education, University of Salerno.
[3] Researcher in Didactics and special pedagogy, University of Salerno.
[4] Associate Professor in Education, University of Nicosia.
[5] Full Professor in Didactics and special pedagogy, University of Salerno.

Vol. 24, Issue 3, September 2025
doi: 10.14605/ISS2432503 — ISSN: 2724-2242 — pp. 41-56
Correspondence: Umberto Bilotti — e-mail: ubilotti@unisa.it

Introduction[1]

Modern society requires citizens to have a high level of adaptability and specialization that cannot be reached only through a finite formative offer that is limited to the school places during school hours. In this direction, Wong et al. (2022) suggest seamless learning; in fact, we gain new competencies and skills not necessarily as the product of an activity proposed by our teacher or arbitrarily done. The learning process, in its general form, is instead an adaptation strategy to the environment.

Furthermore, according to Sibilio (2017), humans change due to an innate propensity for learning, which they absorb, apply, and develop into unique forms of knowledge, skills, attitudes, behavior, and conduct. These interactions are direct manifestations of our adaptation, serving as empirical evidence of each student's uniqueness. From these considerations it became necessary to consider each student, or more broadly each learner, thus endowed with unique cognitive capacities but immersed in one or more shared environments. Alongside this characteristic, it's important to keep in mind that today's environment is hybrid, meaning it includes both digital and physical spaces where relationships are formed both *online* and *offline* (Floridi, 2015).

The daily use of ICTs and the same increasingly humanised modes of interaction with the machine lead us to consider our very existence as *extended* between the two universes. Educators have a responsibility to explore alternatives that help students adapt to their evolving identities in a shared hybrid environment. The teaching and learning process is founded on didactics methods that are based on the peculiarities of the learner and, especially, their cognitive styles and that require the teacher, from time to time, to apply teaching methodologies or resort to strategies that flexibly adapt to their specificities (Sibilio, 2017).

Before projecting a teaching activity, one must abandon not only the notion of a typical student but also the fundamental flaws of linearity. A didactic approach strongly focused on cause-and-effect relation implies a hierarchical structure between teacher and students, leading to a rigid transfer of knowledge from teacher to student.

A significant issue with this model is its tendency to transform one's educational experience into learning activities. However, a scientific approach to educational action can prevent such issues while still seeking reference points. The flexibility and adaptability of teaching experiences, according to Universal

[1] The work is the scientific result of collaboration between the authors; however, it is the author of the paragraph: Umberto Bilotti is the author of Paragraph *The proposal of Virtual Reality and Generative Artificial Intelligence* and co-author of paragraph *The MUSeum Editor;* Alessio Di Paolo is the author of paragraph *The importance of digital for culture and intangible heritage awareness* and co-author of paragraph *The MUSeum Editor;* Michele Domenico Todino is the author of paragraph *Introduction;* Argyro Fella is the author of paragraph *Conclusions and future work;* Stefano Di Tore is the scientific coordinator of the work.

Design for Learning can be achieved through the three core principles (figure 1). Specifically, teaching activities should present content through multiple representations, employ various modes of content delivery, and use diverse strategies for engaging with content (Savia, 2016). To create original pathways, it is useful to follow trajectories of work that do not follow linear logic, but leave room for experimentation by the teacher, and innovation, also considering the potential offered by new technologies (Di Tore, 2016).

The proposal of Virtual Reality and Generative Artificial Intelligence

The use of Virtual Reality (VR) as a technological innovation in the teaching-learning process has been explored for over two decades. Various VR applications, such as simulations, exergames, edugames, and role-playing games, demonstrated a positive effect on several factors that influence learning outcomes, either directly or indirectly, including levels of engagement (Mouatt et al., 2020), social interaction (Pan & Hamilton, 2018), neurocognitive and emotional development (Moreno et al., 2019).

The current generation of learners, particularly those who are natively digital, are exposed to a growing variety of technical tools capable of simplifying their learning process. The risk is that a tool is adopted just for the sake of the tool, rather than for the knowledge obtained by it. Academic organizations and institutes provide an ineffective response to this topic when new technologies are not paired consistently with didactic strategies (Alshammari, 2019). In this specific case, cooperative learning strategies can find continuity outside school environments and timetables thanks to synchronous virtual experiences such as meeting rooms and asynchronous ones such as shared projects.

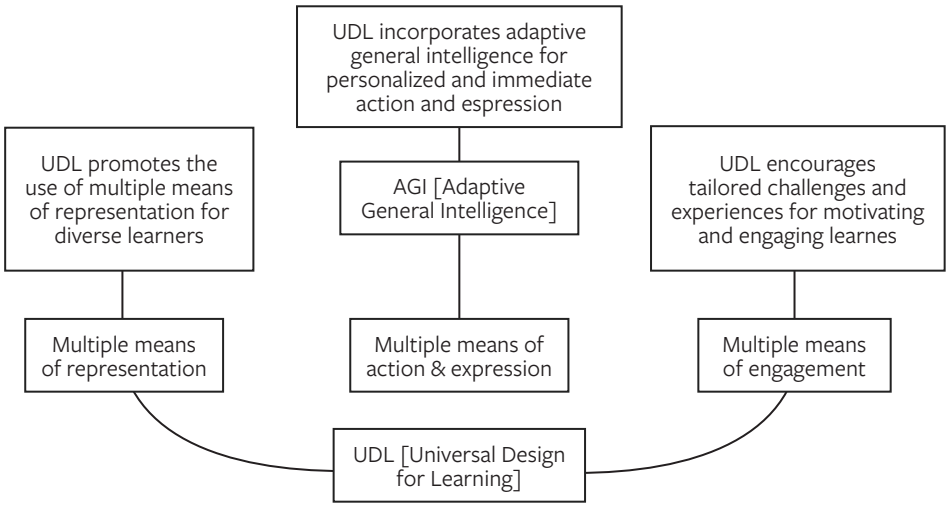
Despite students' belief that traditional teaching materials are required for better understanding, an educational offer that includes virtual reality activities can improve their ability to solve practical problems, develop creative thinking, and reduce the need for physical presence at research sites (Khalilia, 2022). Additionally, the creation of a virtual experience, and of a VR edugame often presents specific objectives while allowing a high degree of freedom. This autonomy in choosing activities or how they are performed can foster a sense of control and active learning.

An important component of VR technology is the sense of presence, which refers to the psychological feeling of existing within a digital environment. Enhancing the sense of presence increases the immersiveness of a virtual experience. This is achieved when interactions with the digital environment feel natural. Major companies have invested significantly in improving these interactions: evolving from desktop VR experiences using a mouse to ergonomic joypads, and ultimately to using one's hands as the most natural interface.

Since human learning involves adapting to the environment through multiple and multimodal interactions, immersive technologies can facilitate meaning-making by encouraging greater motor involvement through natural actions, such as body movements (Sibilio, 2015).

During teaching hours being mediated by new educational technologies, the challenge is to provide tools that facilitate knowledge construction, especially for difficult content. This responsibility extends beyond school hours to foster learner autonomy. Generative AI (GAI) shows promise in this regard, generating various content types. However, its educational use remains complex due to privacy concerns and digital literacy requirements (Di Tore, 2023). This fosters interdisciplinary interaction (Bilotti et al., 2023).

Figure 1



Possible relationship between UDL principles and new technologies.

The importance of digital for cultural and intangible heritage awareness

Raising awareness and promoting cultural heritage are essential not only for the educational growth of learners but also for their holistic personal development (Nuzzaci, 2006, 2008; ICOM, 2016; EU, 2019). This pedagogical trajectory, in which children gain autonomy in researching, exploring, and appreciating historical-artistic heritage (Lan, 2018), necessitates a rethinking of cultural transmission processes.

To enable independent artistic discovery, tools that facilitate accessibility are essential. Teachers must adopt innovative strategies to ensure cultural spaces are

inclusive, especially for children with Special Educational Needs (Mas & Monfort, 2021). Digital culture connects material and immaterial, redefining space, time, and interaction (Sibilio et al., 2023; Peshkov, 2021). This evolving system enhances creativity and cultural awareness (Folkmann, 2020; Moos & McLuhan, 2014).

Intangible cultural heritage encompasses practices, representations, expressions, knowledge, and skills that communities, groups, and, in some cases, individuals recognize as part of their cultural legacy (Idris et al., 2016). This heritage, which may include oral traditions, performing arts, rituals, festive events, and craftsmanship, is at risk of being forgotten or overlooked if not adequately valued (Hennessy & Fraser, 2012). Digital technology plays a pivotal role in ensuring that such cultural expressions are preserved, disseminated, and appreciated on a global scale.

One of the most critical aspects of digital technology lies in its ability to make intangible cultural heritage accessible to a broad and diverse audience. Traditionally, many forms of intangible heritage were confined to local or regional contexts, often inaccessible to those outside specific communities (Giovannini et al., 2021).

However, through digital platforms, these traditions can be documented and shared in interactive and engaging ways, reaching people across various settings. For example, videos, podcasts, websites, and mobile applications allow the immediate and dynamic transmission of the essence of rituals, dances, songs, and other forms of cultural expression, providing new opportunities for their promotion and understanding.

Preservation is another fundamental aspect. By its nature, intangible cultural heritage is often fragile and susceptible to change or extinction, particularly in a world where social and economic dynamics are rapidly altering community fabric.

Digital technology could offer innovative solutions for documenting and archiving these cultural expressions in formats that can endure over time (Todino et al., 2024). Audio-video recording and virtual reality enable precise capture of cultural expressions, while 3D scanners create accurate digital replicas of artifacts, ensuring their preservation. These digital archives allow future generations to rediscover traditions.

Additionally, digital technology fosters intercultural dialogue through social media, where global communities share and compare cultural practices. This exchange promotes understanding, creativity, and cultural fusion, as intangible heritage continuously evolves (Berthoz, 2015; Aiello, 2017).

Digital tools, inherently adaptive, facilitate this transformation by supporting new forms of expression. Digital technologies foster active citizen participation in preserving intangible heritage through «bottom-up digitalization» (Marienfeldt et al., 2024), allowing communities to document and share traditions.

Platforms like YouTube, Instagram, and TikTok act as cultural mediators (Champion & Rahaman, 2020). In education, digital tools enable interactive

learning through virtual tours, 3D simulations, and augmented reality, making cultural heritage more engaging and accessible (Cuhna et al., 2022).

Cultural institutions, such as museums and archives, are also embracing digital technologies to further their mission of safeguarding intangible heritage.

Through large-scale digitization projects, these institutions are creating digital collections that document and preserve intangible heritage for future generations (Inglese et al., 2019).

Beyond preservation, museums are exploring new modes of engagement, developing digital experiences that allow visitors to interact more directly with intangible heritage. For example, immersive installations that combine audiovisual and tactile elements, or applications that provide in-depth information directly to visitors' smartphones, offer innovative ways to engage with cultural heritage.

Thus, the importance of digital technology in raising awareness of intangible cultural heritage is undeniable. Digital technologies not only preserve these cultural expressions for future generations but also make them accessible, understandable, and appreciated by a global audience.

Through documentation, dissemination, and interaction, digital technology is transforming how we experience, understand, and value intangible heritage, ushering in a new era of cultural awareness that connects the past, present, and future in an increasingly interconnected world.

The MUSeum Editor

Testing of Inclusive Virtual Museum

The Inclusive Virtual Museum application (Campitiello et al., 2023) was developed to promote the cultural heritage of Campania's museums and to provide an immersive VR experience tailored to meet the needs of diverse users. The environment allows users to adjust audio-video settings in real-time and choose from various interaction modes, ranging from a simple video start button to engaging with humanoid robots and human Non-Playable Characters (NPC).

After implementing a range of inclusive options included in the tool, the virtual museum conducted exploratory research about the effective advantage of the use of virtual environments in several primary and secondary schools.

According to Campitiello et al. (2023), 88.6% of the interviewed students were already familiar with VR and 82.9% had personally experienced it through school activities. And the familiarity and experience with VR reported by 95.3% of respondents, led to numerous suggestions for enhancing the virtual experience.

Many students recommended enriching the virtual environment with additional archaeological finds, paintings, and statues that could be observed and

manipulated. They also expressed a desire for increased interactivity in the museum room, such as the possibility to initiate conversations with NPCs of historical characters or avatars of other players.

These suggestions, beyond their technical aspects of interest to edugame developers, certainly confirm Dalgarno et al. (2002) observation about the non-linear relationship between the degree of fidelity of the virtual with the real environment and the development of understanding.

Improvement of these components alone is not sufficient to foster the learning process; conversely, a lack of expected results does not directly result from a low level of fidelity. From these suggestions, designers attempted to implement those functions that would attempt to respond to the logic of adapting content to the cognitive specificities of different users.

It was crucial to design tasks that are user-friendly for the specific group of students with diverse needs, ensuring that the learning activities they engage in while exploring the virtual environment genuinely require them to develop an understanding of the content.

MUSE: A VR application for the promotion of Cultural Heritage

Traditional activities within the Museums-Schools-Universities systems, such as guided tours or orientation courses, often result in one-way information flow, typically from the museum or university to the students. To address this limitation, the Teaching Learning Centre for Inclusive Technologies «Elisa Frauenfelder» aims to introduce tools and actions that facilitate a two-way exchange of knowledge and skills within the system.

The Museums-Schools-Universities diagram (figure 2) is commutative, thus promoting a mutual exchange of knowledge and competencies. These initiatives include the digitization of historical and archaeological artifacts, 3D printing to reproduce objects of educational value, the development of virtual and augmented reality applications to create immersive experiences, and the realization of experiments and practical tests actively involving students and teachers.

Figure 2

The image summarises the «mission» of the commutativity of the Museums-Schools-Universities diagram.

Due to the above considerations, the issue of independence between the design of the teaching action by the teachers and the proposal of virtual experience is evident. In order to be able to coherently and effectively channel the efforts of both parties involved in the virtual experience proposal, we developed an application that integrates the inclusive components of the Inclusive Virtual Museum while encouraging teachers to actively design the virtual environment (table 1).

Table 1
Comparison between the Inclusive Virtual Museum and MUSeum Editor applications

	Inclusive Virtual Museum	MUSeum Editor
Gamepad modality	v	v
VR modality	v	v
Editor modality	x	v
Upload custom videos	x	v
Upload custom images	x	v
Audio-video inclusive settings	v	v
Number of rooms	v	vv
3D-objects availability	v	vv
NPC AI-based	v	vv

The MUSeum Editor (MUSE) is an innovative VR application, aimed at transforming museum education by offering an interactive and customisable museum experience. MUSE allows teachers to emulate a virtual museum room, where they can create learning paths tailored to their students' needs. In Editor mode, teachers can configure the virtual space by adding objects, which are accurate reproductions of artefacts and exhibits from participating museums in Campania (figure 3).

This approach enables students to engage with local cultural heritage in an immersive and interactive way, promoting a deeper and more participatory understanding of history and art. Beyond selecting artifacts for display, MUSE provides teachers with an additional level of educational customization. Teachers can easily upload their own educational material in various formats, such as videos and images. Once uploaded, these files are automatically integrated into the application and are ready to be used in creating virtual learning paths (figure 4). This intuitive integration of personal content enriches the virtual visit experience by combining teacher-specific material with available museum resources, resulting in a highly flexible and stimulating learning environment. Within this virtual setting, students can independently explore museum objects,

view them from different angles, examine details closely, and access multimedia content such as audio descriptions, explanatory videos or high-resolution images.

Figure 3

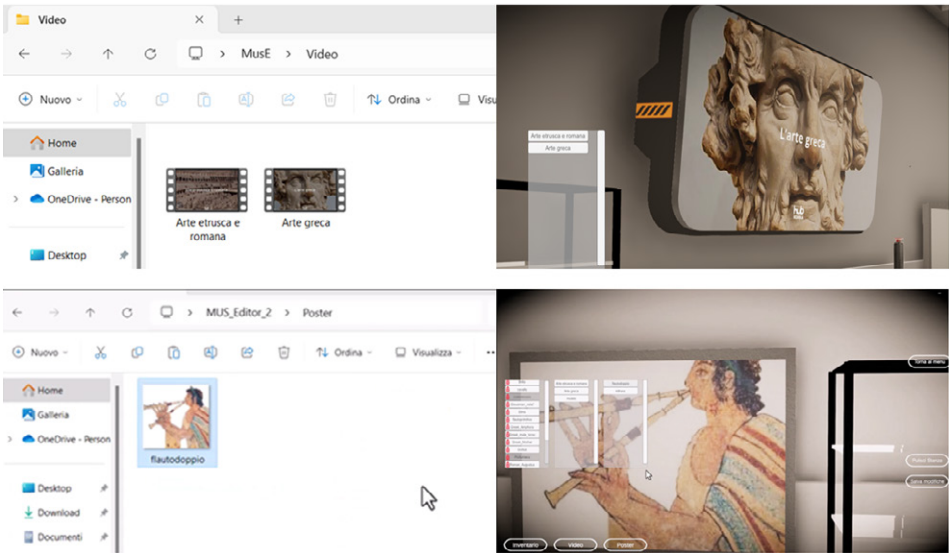
In the image one of the museum rooms has been set up with the 3D objects available through the MUSE Editor mode.[2]

By adopting an innovative *design-based research approach*, the work also aims to redefine the museum learning experience. The virtual environment, which is highly customizable and interactive, not only offers democratic access to cultural heritage, but also stimulates active learning, promoting the development of skills that are fundamental to today's society. This educational paradigm, which places the user and his or her needs at the center, aligns perfectly with current trends in digital education, fostering student engagement and the construction of meaningful knowledge. In addition, it contributes to enhancing cultural heritage

[2] The 3D-scanning of the *Victa* by Francesco Jerace and that of the *Testa del Fanciullo* by Luca della Robbia was realised thanks to the framework agreement/protocol of understanding signed on 16 December 2022 between the Department of Human, Philosophical and Educational Sciences (DISUFF) of the University of Salerno and the Gaetano Filangieri Civic Museum. This agreement envisaged the development of activities of common interest, with particular reference to museum didactics, the design of edugames, 3D scanning and the creation of Digital Assets, aimed at the digital enjoyment of the collections held at the foundation. The red-figure krater, on the other hand, comes from the Sannio Caudino National Archaeological Museum, with which the university has been collaborating for many years. Some of the scanned objects are available on the website at: http://www.labh.it/disuff/download/. The other objects come from a study and research programme focused on the promotion and valorisation of technologies applied to museum didactics, with particular attention to methodological and didactic innovation. This activity is implemented at the Archaeological Museum of Carife and Baronia, starting from 27 February 2022. The initiatives include the design of interactive educational paths, the use of digital tools for the enjoyment of cultural heritage and the organisation of training events for educators, students and visitors.

in a sustainable way, offering new opportunities to enjoy and interact with the past. In this sense, the virtual museum is an innovative model for disseminating culture and promoting social inclusion.

Figure 4



In the image, the files chosen by the teacher, once copied into the respective Video and Poster subfolders of MUSE, are automatically loaded into the application and made available in Editor mode.

The latest component the research group is working on concerns GAI. The goal is to produce different forms of high-quality content using available text generators without critically lowering the level of immersiveness. On one hand, the validity of AI-generated content remains a complex issue for both professionals and end users. The common strategy proposed by major companies is to offer users opportunities for input during the training phase, such as interactions during a chat or the preliminary arbitrary uploading of data. On the other hand, less natural interactions, like keyboard prompt formulation, stand in contrast to the unique features of immersive environments.

A potential solution to mediate between these two needs could be the inclusion of one or more AI-based Non-Playable Characters (NPCs) within the virtual room (figure 5). These in-game elements, besides seamlessly fitting into the virtual environment as museum guides, could serve as intelligent interfaces for the educational pathways designed by the teacher. Once the lesson topic is chosen, the teacher could actively participate in building the database used to train AI, and through the configuration of expressive parameters and domain relevance, further guide the content generation process.

In addition to being a tool capable of offering a new way of presenting information, MUSE allows interactions with reproductions of archaeological artefacts that would be highly risky for their very integrity.

The potential of MUSE also extends directly to the students, since thematic paths can be implemented directly by working groups structured by the teachers. In this way, the creation of customized multimedia files can easily lend itself as a strategy for cooperative and creative learning.

Figure 5

In the image, a proposal of AI-based NPCs.

A starting proposal for an educational pathway in a musical key.

The museum features a dedicated section focused on the collection of scanned artifacts related to the artistic and musical world. The guiding research question posed is, «How can awareness of cultural heritage and learner inclusion be enhanced through the use of technological systems such as AR or AR, and AI?».

The primary objective is to improve the learning experience and promote inclusion through the BYOD (Bring Your Own Device) approach, which functions as a methodology adaptable to classrooms characterized by cognitive diversity (Gardner, 2005; Di Tore et al., 2023).

This environment enables learners and educators to «touch» the digital replicas using VR headsets and controllers, enhancing tactile engagement with cultural objects.

The user is not limited to viewing the artifact but can also access auditory and visual information via an integrated multimedia system, with captions accompanying each artifact. This feature caters to diverse cognitive styles, ensuring that different learning needs are met.

The approach employs several key axes:

1. *Virtual Reality:* the focus is on creating a virtual museum experience using augmented reality to enrich students' learning experiences.
2. *Generative Artificial Intelligence:* visitors can interact with digital exhibits in real time through a virtual assistant powered by AI, obtaining detailed, context-sensitive information about the artifacts.
3. *Digital Assets:* the virtual museum allows students, under the guidance of educators, to act as museum curators. They can apply museological principles such as inclusivity, using BYOD as a shared «language» that promotes collaboration and engagement.
4. *Accessibility:* the project adheres to the principles of the European Agency for Special Needs and Inclusive Education (2012), ensuring that the museum is accessible to all learners, regardless of their abilities.

Regarding the musical aspect, a 3D scan of an Etruscan flute reproduction was carried out, in line with the activities of the laboratory at the University of Salerno. It is important to note that the scanned flute is not calibrated to produce accurate notes, making it unsuitable for functional archaeology.

However, it serves as a valuable educational tool, drawing attention to objects documented in Etruscan vase paintings or represented in museums, such as the Archaeological Museum of Venafro or the Tomb of the Leopards in Tarquinia. These artistic depictions provided a reference for creating the digital artifact.

Through VR headsets and touch controllers, users can examine the flute closely and hear its sound. The sound experience is supported by a newly composed musical piece created using Sibelius software. The audio was then converted to MIDI and MP3 formats and uploaded to the virtual museum.

Multiple formats were chosen to ensure compatibility with various sound cards and to optimize sound quality by adjusting bitrates and memory usage, ensuring an ideal balance between audio fidelity and file size.

To enhance the authenticity of the experience, three musical accompaniments were created:

1. a solo flute track, adhering to the musical characteristics of the period (e.g., repetitive motifs, embellishments, moderate range, harmonic simplicity);
2. a flute and tambourine track
3. a flute, tambourine, and bass track, incorporating the adaptation of «Anxahtuum», a tribal song characteristic of the time.

Plans include acquiring additional artifact scans and creating new textual content for integration into the virtual museum. The project aims to install the virtual museum in schools, where its educational impact will be evaluated to ensure the medium effectively enhances learning and inclusion.

Conclusions and future work

In conclusion, the evolution towards more inclusive and accessible museums reflects a fundamental shift in how we conceive of these cultural institutions. They are no longer merely places of preservation and exhibition, but rather spaces open to all, where accessibility is not only physical but also cognitive, sensory, and digital. Immersive technologies, such as augmented and virtual reality, combined with the integration of digital musical assets, play a crucial role in this context, offering new possibilities to break down barriers and engage a diverse audience. The inclusion of digital musical content within a virtual museum further enriches the user experience, creating a multisensory environment that can deepen understanding and appreciation of the exhibited works. Music has the power to evoke emotions and forge deep connections, making the museum experience more engaging and inclusive.

This project introduced a systemic vision of the digital transformation in schools, highlighting the need to equip teachers with the appropriate tools to face the challenges of innovative teaching, as well as the staff involved in the training and growth of learners, including teachers, external collaborators who have the arduous task of mediating knowledge and cultural awareness with educational and inclusive processes, for whom preventive training is essential, not exclusively on the topics of art-historical didactics, but on the link between general and disciplinary didactics, according to a dialogical approach (Nuzzaci, 2001).

It is worth noting, in addition, that the recent Ministerial Decree 66 of 2023 further strengthened the importance of specialized training, promoting courses aimed at the professional development of teachers and museum staff. Specialization, once considered the prerogative of students, is now progressively becoming an essential component also for teachers, who are expected to deal with constantly evolving digital tools. As proof of this, there is an increase in the number of training courses provided following the implementation of Ministerial Decree 66/2023, as well as an expansion in the offer of educational software for learning and cultural mediation.

A paradigm shift is therefore necessary: the role of the trainer should evolve from a mere transmitter of knowledge to a facilitator of *flexible* and *adaptable* learning (Ulanday et al., 2021). In this perspective, training should be designed to strengthen the capacity of teachers and museum staff to integrate digital

technologies in a critical and conscious way, with the goal of enhancing heritage interpretation and promoting an increasingly inclusive and interactive education.

References

Aiello P. (2017), *Creare mondi possibili. Una sfida per la pedagogia dell'inclusione*. In M. Sibilio (Eds.), *Vicarianza e didattica. Corpo, cognizione, insegnamento,* Brescia, La Scuola.

Aiello P., D'Elia F., Di Tore S. & Sibilio M. (2012), *A constructivist approach to virtual reality for experiential learning*, «E-learning and Digital Media», vol. 9, n. 3, pp. 317-324.

Alshammari S.H. (2019), *The role of virtual reality in enhancing students' learning*, «International Journal of Educational Technology and Learning», vol. 7, n. 1, pp. 1-6.

Berthoz A. (2015), *La vicarianza: Il nostro cervello creatore di mondi*, Torino, Codice.

Bilotti U., Campitiello L., Todino M.D. & Sibilio M. (2023), *Emulation and understanding the emotion according to Generative Artificial Intelligence: Case study of emotional component extracted from visual artworks*, «Journal of Inclusive Methodology and Technology in Learning and Teaching», vol. 3, n. 4.

Campitiello L. (2023), *Innovative educational technologies: A preliminary survey to detect the accessibility of the Inclusive Virtual Museum*, «Journal of Inclusive Methodology and Technology in Learning and Teaching», vol. 3, n. 3.

Champion E. & Rahaman H. (2020), *Survey of 3D digital heritage repositories and platforms*, «Virtual Archaeology Review», vol. 11, n. 23, pp. 1-15.

Cunha C.R., Mendonça V., Moreira A., Gomes J.P. & Carvalho A. (2022), *Using Virtual Reality in Museums to Bridge the Gap Between Material Heritage and the Interpretation of Its Immaterial Context*. In *Advances in Tourism, Technology and Systems: Selected Papers from ICOTTS 2021, Volume 1,* Singapore, Springer Nature Singapore.

Decreto Ministeriale del 12 aprile 2023, n. 66, *Decreto di riparto delle risorse alle istituzioni scolastiche, in attuazione della linea di investimento 2.1 «Didattica digitale integrata e formazione alla transizione digitale per il personale scolastico» nell'ambito della Missione 4, Componente 1 — «Potenziamento dell'offerta dei servizi all'istruzione: dagli asili nido all'Università» del Piano nazionale di ripresa e resilienza, finanziato dall'Unione europea — Next Generation EU,* https://www.mim.gov.it/-/decreto-ministeriale-n-66-del-12-aprile-2023 (consultato il 23 gennaio 2025).

Di Tore S. (2016), *La tecnologia della parola. Didattica inclusiva e lettura*, Milano, FrancoAngeli.

Di Tore P.A. (2023), *Artificial Intelligence and educational processes according to Artificial Intelligence*, «QTimes», vol. 15, n. 2, p. 1.

European Agency for Development in Special Needs Education (EADSNE) (2012), *Profile of Inclusive Teachers*, Denmark, Odense.

European Union-EU (2019), *European framework for action on cultural heritage,* https://op.europa.eu/en/publication-detail/-/publication/5a9c3144-80f1-11e9-9f05-01aa75ed71a1 (consultato il 10 febbraio 2024).

Floridi L. (2015), *The onlife manifesto: Being human in a hyperconnected era*, Berlin, Springer Nature.

Folkmann M.N. (2020), *Post-material aesthetics: A conceptualization of digital objects*, «The Design Journal», vol. 23, n. 2, pp. 219-237.

Giovannini E.C., Lo Turco M. & Tomalini A. (2021), *Digital practices to enhance intangible cultural heritage*, «The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences», vol. 46, pp. 273-278.

Khalilia W.M., Gombár M., Palková Z., Palko M., Valiček J. & Harničárová M. (2022), *Using virtual reality as support to the learning process of forensic scenarios*. In IEEE Access, 10, 83297-83310.

Hennessy K. & Fraser S. (2012), *From intangible expression to digital cultural heritage*, «Safeguarding intangible cultural heritage», vol. 1, pp. 33-45.

Idris M.Z., Mustaffa N.B. & Yusoff S.O.S. (2016), *Preservation of intangible cultural heritage using advance digital technology: Issues and challenges*. «Harmonia: Journal of Arts Research and Education», vol. 16, n. 1, pp. 1-13.

Inglese C., Docci M. & Ippolito A. (2019), *Archaeological heritage: Representation between material and immaterial*. In *Analysis, Conservation, and Restoration of Tangible and Intangible Cultural Heritage,* USA, IGI Global.

International Council of Museums [ICOM] (2016), *Museum and Inclusion*. Available on https://icom.museum/en/research/cultural-democracy-and-inclusion/ (last consultation 10/02/2024).

Marienfeldt J., Wehmeier L.M. & Kuhlmann S. (2024), *Top-down or bottom-up digital transformation? A comparison of institutional changes and outcomes*, «Public Money e Management», pp. 1-10.

Moos M. & McLuhan M. (2014), *Media research: Technology, art and communication*, Germany, Routledge.

Moreno A., Wall K.J., Thangavelu K., Craven L., Ward E. & Dissanayaka N.N. (2019), *A systematic review of the use of virtual reality and its effects on cognition in individuals with neurocognitive disorders*, «Alzheimer's e Dementia: Translational Research e Clinical Interventions», vol. 5, pp. 834-850.

Mouatt B., Smith A.E., Mellow M.L., Parfitt G., Smith R.T. & Stanton T.R. (2020), *The use of virtual reality to influence motivation, affect, enjoyment, and engagement during exercise: A scoping review*, «Frontiers in Virtual Reality», vol. 1, pp. 56-66.

Nuzzaci A. (2001), *Musei, visita guidata e apprendimento: Una ricerca sperimentale nel settore demoetnoantropologico*, Roma, Kappa.

Nuzzaci A. (2006), *General education and museum education: Between singularity and plurality*, «Revista complutense de educación», vol. 1, pp. 1-12.

Nuzzaci A. (2008), *Il museo come luogo di apprendimento*, Brescia, Pensa Multimedia.

Pan X. & Hamilton A.F.D.C. (2018), *Why and how to use virtual reality to study human social interaction: The challenges of exploring a new research landscape*, «British Journal of Psychology», vol. 109, n. 3, pp. 395-417.

Peshkov A.V. (2021, April), *Construction 4.0: Immaterial assets types in the development of design estimates for effective digitalization of building projects.* In *IOP Conference Series: Earth and Environmental Science*, vol. 751, n. 1, England, IOP Publishing.

Savia G. (2016), *Universal Design for Learning: La Progettazione Universale per l'Apprendimento per una didattica inclusiva*, Trento, Erickson.

Sibilio M. (2015), Simplex *didactics: A non-linear trajectory for research in education*, «Revue de synthèse», vol. 136, nn. 3-4, pp. 477-493.

Schön D.A. (1993), *Il Professionista riflessivo: per una nuova epistemologia della pratica professionale*, Bari, Dedalo.

Sibilio M. (2017), *Vicarianza e didattica. Corpo, cognizione, insegnamento*, Brescia, La Scuola.

Sibilio M., Di Tore S., Todino M.D., Lecce A., Viola I. & Campitiello L. (2023), *MetaWelt: Embodied in Which Body? Simplex Didactics to Live the Web 3.0.* In *International Conference on Human-Computer Interaction*, Cham, Springer Nature Switzerland.

Todino M.D., Campitiello L. & Di Paolo A. (2024), *Intelligenza artificiale e realtà aumentata per un apprendimento inclusivo: il museo virtuale Scanitaly*. In *Book of Abstracts. I linguaggi della Pedagogia Speciale: la prospettiva dei valori e dei contesti di vita*, Brescia, Pensa Multimedia.

Ulanday M.L., Centeno Z.J., Bayla M.C. & Callanta J. (2021), *Flexible learning adaptabilities in the new normal: E-learning resources, digital meeting platforms, online learning systems and learning engagement*, «Asian Journal of Distance Education», vol. 16, n. 2.

Wong L.H., Looi C.K. & Voon X.P. (2022), *A descriptive study on the translation of the seamless science learning model for wider diffusion*. In *Proceedings of the 30th International Conference on Computers in Education, ICCE 2022* (pp. 560-569), Asia, Asia-Pacific Society for Computers in Education.