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DIGITISATION OF EXHIBITION SPACES: An Educational and Cultural Tool for the Connected Society

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ABSTRACT

ThThe digitisation of exhibition spaces fundamentally transforms the perception of and access to cultural and artistic content, broadening the reach of exhibitions and redefining interactions among users, technology, and culture. The DEXED project proposes a standardised methodology for the digitisation of exhibitions, incorporating immersive technologies, including 360º tours, augmented reality, and interactive repositories. DEXED seeks to enhance both virtual and in-person experiences, offering a model that can be replicated across institutions. Social media further amplifies the visibility of cultural content and fosters active public engagement. By connecting technology, art, literature, and education within a dynamic digital ecosystem, DEXED reimagines exhibitions as interactive and participatory experiences.

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1. Introduction

The digitalisation of exhibition spaces represents a growing trend within contemporary museum practices. It entails a transformation in the ways cultural, literary, and artistic content are perceived and disseminated among the public. This synergy between art, technology, and pedagogy opens new possibilities for integrating virtual exhibitions within the information society, expanding access to exhibition environments, redefining the interaction between users, technology, and culture within a connected context, and, more broadly, enriching the user experience.

1.1. Context and Relevance

Over the past decade, numerous studies have addressed the digitalisation of culture and its relationship with the Information Society. UNESCO itself has emphasised the importance of digital technologies in the preservation and dissemination of cultural diversity, highlighting how digitalisation democratises access to culture by enhancing the visibility of diverse cultural expressions (Kulesz, 2016). According to Feige (2019), digitalisation constitutes a process of reconfiguring contemporary culture, as it renews the relationship between technology and the humanities. In doing so, it fulfils a dual function: offering new opportunities for the creation of and access to cultural content, while simultaneously posing challenges concerning authenticity and the preservation of cultural value.

It is undeniable that the digitalisation of culture is profoundly transforming traditional museography, replacing unidirectional approaches with interactive and participatory models that enrich the visitor experience. As Santacana Mestre (2015) observes, these technological innovations are leading to a reconceptualisation of museum architecture, enabling the design of more dynamic and immersive spaces. Such developments facilitate remote access to heritage collections and allow for the virtual reconstruction of objects and historical contexts.

The museum landscape has consequently evolved through the transformation of exhibition spaces from physical to digital. Calise (2023) highlights how technology has reconceptualised the role of the visitor's body, moving from its elimination in modern museums to its reappearance within more immersive and performative environments. Drawing on the Nxt Museum in Amsterdam and its exhibition *Shifting Proximities*, he demonstrates the impact of these technological and epistemological shifts on both curatorial practice and the visitor's relationship with the exhibition, noting that technological mediation has positively transformed the performative and embodied experience of art.

1.2. Contemporary Approaches to Digital Exhibition

As noted above, in recent years, cultural and educational institutions have increasingly employed digitisation technologies to manage holdings and collections. This shift responds to the fundamental need to engage an ever more connected audience, where, as Rojas (2021) observes, museums and cultural spaces confront the challenge of appealing to visitors whose tastes and modes of interaction with their environment are constantly evolving.

The aims of these institutions extend beyond the preservation of heritage, encompassing the promotion of accessibility through interactive digital exhibitions and immersive experiences that enable novel approaches to content. Digitisation, combined with extended reality tools such as augmented reality (AR), is therefore reconfiguring exhibition spaces, facilitating interaction that surpasses traditional forms of contemplation in favour of more active and participatory learning. According to Santacana Mestre (2015), augmented reality introduces three fundamental characteristics in this context: the capacity to merge the real and the virtual, three-dimensional recording, and real-time interactivity. These features are reshaping conventional exhibition spaces, creating what some authors, such as Tortosa et al. (2021), describe as hybrid and virtual spaces, in which the visitor's experience is reconceived. Observation is no longer static and contemplative, as in conventional museums; rather, as Karaoğlu (2017) explains, motionless viewing is replaced by engagement with the works, involving dialogue and response in order to derive both aesthetic pleasure and knowledge from the exchange.

Cultural institutions are responding to this transformation through what Rodríguez et al. (2018) describe as new ways of seeing, enabled by the affordances of mobile devices. Interactive exhibitions are presented in which the works remain the central focus, while technology is actively employed to facilitate fluid and meaningful dialogue. This approach generates what are termed collaborative and

participatory spaces, which, according to Tortosa et al. (2021), involve the collection itself being reformulated and co-created through the participatory engagement of visitors.

The integration of immersive technologies is realised through a variety of devices. Santacana Mestre (2015), in his discussion of AR applications, differentiates between handheld displays, such as tablets and smartphones, and head-mounted displays (HMDs), such as glasses and helmets. The use of these tools supports these new ways of seeing and consolidates the notion of active participation within contemporary exhibition spaces. Visitors, when employing these devices, perceive themselves as co-creators of their experiences, while creators adopt a more cross-disciplinary and integrative approach to the production of immersive works of art (Eve, 2023).

Thus, in line with the exhibition strategies adopted by smart museums, which have facilitated the transition from traditional static exhibitions to more interactive and immersive experiences, Yang and Guo (2023) emphasise the importance of integrating digital and multimedia technologies to transform exhibition spaces and present diverse narratives and perspectives. In this way, technological advances are accommodated while also addressing the evolving expectations of visitors, thereby enriching the user experience and enhancing the cultural value of museums.

Specifically, these authors identify five key tools driving this transformation: (1) interactive touch screens, which allow users to access detailed information, view enlarged images, or explore data dynamically; (2) AR and VR (augmented and virtual reality), which enable users to engage with historical and cultural reconstructions; (3) multimedia projections and video mapping, which provide narratives within engaging and accessible contexts; (4) mobile applications and digital audio guides, offering personalised tours and gamified multimedia experiences tailored to audience interests; and (5) artificial intelligence, including chatbots that respond to queries and provide information in real time.

The deployment of these tools extends the impact of digital transformation beyond the physical confines of the museum. As Szlifman observes:

> Digital media involves the use of multimedia elements for the production and distribution of content. Hypermedia offers a combinatorial and interactive architecture that brings aesthetic and expressive possibilities that can be particularly valuable for exhibiting a show virtually (Szlifman, 2020, p. 3).

In this context, social media has emerged as a crucial instrument for the dissemination and democratisation of art, providing global reach, two-way interaction with audiences, and the formation of digital communities around art. According to Poole (2011), these constitute the three principal dimensions of the relationship between social media and cultural spaces. This dynamic is exemplified by initiatives such as Google Arts & Culture, which features content from more than 2,000 leading museums and archives across 80 countries in association with the Google Cultural Institute (Szlifman, 2020). Such initiatives demonstrate the democratisation of access to culture, highlighting the development of technologies and tools that enable participating institutions to showcase their cultural heritage and make it accessible to audiences worldwide via the Internet.

Many cultural institutions are developing autonomous virtual exhibitions that facilitate enriched interaction. Notable examples include the exhibition *Gameplay. Video Game Culture* at the CCCB (*Centre de Cultura Contemporánea de Barcelona*), an expanded adaptation of *Gameplay: The Next Level* from the ZKM | Centre for Art Media Karlsruhe. In 2019 to 2020, this exhibition combined physical and digital elements including audiovisual stations, documents, historical machines, indie creations, research projects and numerous installations, employing AR to extend the narrative and enhance visitor immersion. Other noteworthy initiatives include the Rijksmuseum in Amsterdam, the Thyssen Museum, the Prado Museum's Virtual Tours and MoMA's Virtual Views programme, all of which have popularised 360º virtual tours that integrate high-quality imagery with interactive elements to guide visitors and provide additional narrative contexts.

These projects illustrate the significance of integrating technological tools not merely as supplements to in-person exhibitions but as autonomous experiences that address the expectations of an audience increasingly familiar with digital interaction.

At the same time, AR technologies are transforming the design of exhibition spaces and enhancing the capacity of museums to present their collections in accessible and educational ways. The British

Museum, with its Tablet Tours of the *Parthenon*, *Sutton Hoo* and the *Roman Empire*, and the Melbourne Museum, with its *Dinosaur Walk*, among others, provide clear examples of institutions that have implemented AR technologies to enrich the user experience. These initiatives enable visitors to become, as noted above, co-creators of their own journey, a concept that supports a more transdisciplinary approach to the production of immersive works.

Digitisation has similarly encouraged universities and cultural institutions to develop interactive virtual exhibitions with the aim of making cultural heritage accessible to a wider audience. In Spain, notable initiatives include the Príncipe Felipe Science Museum in Valencia, in collaboration with the Polytechnic University of Valencia, the University of Navarra Museum (MUN) at the University of Navarra, and the Malaga Contemporary Art Centre (CAC), developed by the University of Malaga, all of which provide virtual tours and digital access to their collections.

1.3. The Challenge of Effective Cultural Digitisation

However, the digital transformation of cultural heritage currently faces a fundamental challenge: the gap between technological implementation and its actual effectiveness in transmitting cultural knowledge. Despite increasing investment in digital technologies by cultural institutions, a significant disconnect remains between the solutions deployed and the genuine needs of cultural mediation. This issue is particularly evident in two critical dimensions. First, the absence of methodological criteria that effectively link pedagogical objectives with technological applications results in digital experiences that, while technically functional, fail to achieve authentic cultural mediation. Second, the lack of specific evaluation parameters to assess the impact of these implementations hinders the identification and refinement of effective practices.

The consequences of this situation are especially apparent in educational and cultural contexts. As Santacana Mestre (2015) observes, there is an inherent risk of compromising the authenticity of originals, a phenomenon he terms digital deception. It is therefore essential, in order to maintain the legitimacy of museums and heritage spaces, to balance respect for the intrinsic value of the originals with the benefits afforded by digitisation. UNESCO has also identified significant structural challenges, highlighting the concentration of power within large digital platforms and the pressing need for public policies that protect and promote cultural diversity (Kulesz, 2016).

This context underscores the importance of developing methodological approaches that address not only technical considerations but also the social and cultural dimensions of digitisation. The cultural sector must urgently reconsider digitisation models that go beyond mere technological deployment. Such an approach should be grounded in the specific needs of cultural mediation and establish methodological links between educational objectives and technological possibilities. Only by doing so can the current disconnect between implemented technologies and their effectiveness as instruments of cultural transmission be overcome. Accordingly, this research seeks to develop a methodological framework that integrates pedagogical and technological aspects into the process of cultural digitisation. This framework aims to provide clear criteria for the design, implementation, and evaluation of digital experiences that genuinely enrich the understanding and appropriation of cultural heritage.

2. Methodology

This project is therefore based on a mixed methodological approach that integrates qualitative and quantitative elements, with a special emphasis on participatory action research. This methodological choice responds to the complex nature of the object of study: the digitisation of cultural heritage in the specific context of the DEXED project.

2.1. Methodological Approach

The methodological design is structured around four interrelated phases of action research: planning, action, observation, and reflection. Colmenares and Piñero (2012) summarise each stage as follows: (1) identification of the problem, design of strategies, objectives, goals, and actions to be undertaken, (2) implementation of strategies, direct intervention, and application of measures, (3) monitoring and collection of data on implementation and its effects, accompanied by systematic documentation, and (4) analysis of the collected data and evaluation of the results obtained.

The initial diagnostic phase comprises a qualitative analysis of the exhibition context, assessing specific digitisation needs and the potential for adapting existing curatorial practices to the digital environment. This preliminary stage incorporates the perspectives of all relevant stakeholders, from curators and artists to the target audience. The second phase, encompassing development and implementation, follows an iterative approach to designing the digitisation standard. The launch of pilot exhibitions constitutes the observation stage, functioning as a testing ground to validate and refine the methodological proposals, while ensuring detailed documentation of both process and outcomes, enabling adjustments grounded in practical experience. The final phase, evaluation and adjustment, involves an in-depth and reflective analysis of the user experience and its impact on the understanding and accessibility of cultural content. The findings of this evaluation provide feedback on the actions implemented and, by identifying areas for improvement, inform a continuous process of refinement, ensuring the standard evolves in response to emerging needs.

This methodology, grounded in the critical paradigm of social research, recognises and leverages the dual role of the researcher as both observer and active participant in the transformation process. Such a positioning facilitates a nuanced understanding of the social and cultural dynamics that shape the digitisation of cultural heritage while simultaneously generating practical solutions to the identified challenges.

2.2. Tools and Technologies used

The methodological development is underpinned by an integrated set of technological tools, strategically selected in accordance with a review of the existing literature. 360º virtual tours constitute a fundamental component, implemented using specialised technology that enables the creation of immersive experiences with significant educational and cultural value. According to Gafar et al. (2022), such tours are characterised by their immersion, interactivity and accessibility. Their application in the educational context provides enriched learning experiences, enhances comprehension through detailed and visual exploration of complex content, and offers both flexibility and remote access, thereby facilitating distance learning and inclusive education.

Augmented reality (AR) is incorporated as a complementary tool, enabling the creation of interactive informational layers, such as virtual tours of historical reconstructions, visualisation of 3D artefacts, or interaction with works that respond to user movement. These features enrich the visitor experience and deepen understanding of the exhibition content, effectively conveying the artists' intentions and the context in which their work is produced (Li et al., 2023; Wang et al., 2024; Wang, 2024).

Interactive repositories play a pivotal role in the management and preservation of digitised cultural material, providing a robust foundation for the accessibility and dissemination of heritage. Scholars such as De Marco (2024) emphasise the significance of the connections between digital repositories, user experience, and the potential of Metaverse applications as key elements for enhancing interaction and compatibility within cultural heritage.

The aforementioned tools are complemented by analysis and documentation systems that enable rigorous monitoring of the research process and its outcomes. The collaborative dimension of the project is facilitated through various dissemination and participation platforms, with social media serving a central role as a channel for two-way communication with the public. These platforms support the distribution of content while also allowing the collection of valuable feedback, which informs the continuous refinement of the standard. Finally, the integration of these technological tools is implemented according to a user-centred approach, in which the primary focus is the effective transmission of cultural content and its accessibility. This methodological framework provides a systematic foundation for the development of the digitisation standard, while retaining the flexibility necessary to accommodate the specific characteristics of each exhibition project and the diverse needs of its audiences.

Figure 1. DEXED project methodology.

Source: Author's elaboration, Santín Álvarez, 2025.

3. Objectives

The DEXED project was developed to provide continuity to the DEED and PLATA projects, previously undertaken by the ECSiT research group at UDIT – University of Design, Innovation and Technology. The design of virtual spaces for educational and dissemination purposes (DEED) involves the creation of a standard grounded in the principles of pedagogy, didactics, and active methodologies for the development of virtual environments aimed at education, as well as cultural and scientific dissemination (Conde Melguizo et al., 2024). PLATA, in turn, builds upon the objectives of UN-Habitat's New Urban Agenda for educational purposes, proposing a model for designing educational activities based on the digitised editorial archive of the *Residencia de Estudiantes*, in combination with artificial intelligence tools and cloud services, thereby exploring the potential of integrating digitisation with pedagogy (Conde Melguizo and Blanco Marcos, 2024).

3.1. General Objective

Consequently, the DEXED project seeks to establish a design standard for the digitisation of exhibition spaces within the university context, addressing the need for a coherent framework that integrates accessibility, interactivity, and educational content. The digitisation of exhibitions in educational settings presents several challenges, including the absence of a structured system that prioritises active learning and embeds pedagogical principles. While methodologies exist for commercial and institutional exhibitions, many are not tailored to the specific requirements of universities, where digital environments are expected to be both informative and educational.

The development of this standard is warranted for two principal reasons. First, the proliferation of interactive exhibitions and the use of immersive technologies necessitate standardisation in line with Jakob Nielsen's (1994) principle of consistency and standards, ensuring an intuitive and accessible experience. This is further supported by the need for a design standard that, as Conde Melguizo (2021) emphasises, enables a scientifically grounded evaluation of these initiatives beyond traditional heuristic approaches. Second, the university context demands that exhibitions incorporate clearly defined pedagogical elements that can be aligned with specific learning objectives, an aspect frequently lacking in commercial exhibition practices.

3.2. Specific Objectives

- Analyse the role of social media in promoting the dissemination of cultural content.
- Establish a replicable framework for the digitisation of exhibitions.
- Demonstrate how immersive technologies enhance cultural experiences.
- Review the state of the art of technologies available for the digitisation of exhibitions and museums, emphasising the limitations of current methodologies and their applicability within the educational field.

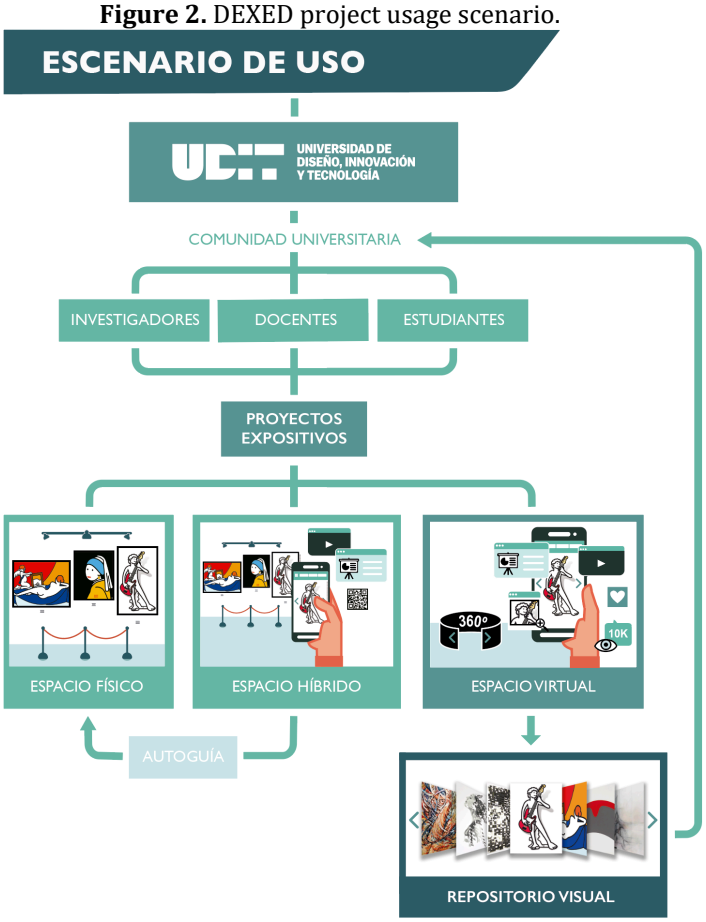
- Conduct a literature review of current applications of virtual and augmented reality in museums and exhibitions, evaluating their educational potential in a university context.
- Define a proposal for a specific design standard for the digitisation of exhibitions, adaptable to different types of institutions and content.
- Develop and test one or more prototypes that integrate digital technologies with exhibition content, including virtual tours, educational activities, and access to supplementary information about the works, such as technical data sheets, works in progress, or interviews with the artists

4. Analysis of the DEXED Project

4.1. Project Description

The DEXED project constitutes an innovative proposal that addresses the requirements identified within the field of university cultural digitisation, providing methodological solutions to the challenges outlined in the theoretical framework. Unlike initiatives focused solely on digital preservation, this project establishes a comprehensive framework that integrates immersive technologies with specific pedagogical objectives. These are underpinned by a literary, socio-historical, and biographical approach, aligned with educational competencies, to deliver a more complete and profound cultural experience. The project not only adapts immersive technologies, but also develops a design standard intended to enhance accessibility, education, and cultural dissemination through the creation of interactive layers and multi-channel experiences. This approach offers a dynamic reinterpretation of university cultural production, responding to the growing demand for accessible and participatory cultural experiences. In doing so, the proposal facilitates a reimagining of the relationship between educational institutions and society, enabling researchers, teachers with artistic and humanistic profiles, and students to engage with cultural heritage while actively participating in its reinterpretation and dissemination through immersive virtual experiences.

Figure 2. DEXED project usage scenario.



Source: Author's elaboration, Santín Álvarez, 2025.

4.2. Technological Components

The architecture of the project is founded on the three technological components outlined above, which, through their systematic integration, form a cohesive educational ecosystem designed to enhance access to and dissemination of university cultural heritage. Firstly, the 360º virtual tours constitute the core infrastructure of the system, functioning as interactive learning environments that surpass traditional passive observation. These spaces incorporate interaction nodes that enable detailed analysis of cultural content, allowing students, teachers, and visitors to engage more deeply with the material through virtual itineraries and educational activities, both on-site and remotely.

Secondly, augmented reality enhances the functionalities of these virtual tours by superimposing complementary layers of information. This technological element supports the comprehension of technical and contextual aspects of the works, fostering active and participatory learning that cultivates skills in managing and understanding cultural and artistic knowledge. The proposal does not seek to replace the traditional exhibition space, but rather to complement and extend it, creating meaningful connections between digital content and the in-person experience.

Finally, the repository system completes the technological framework, serving as a dynamic and open archive that documents institutional cultural activity. This component fulfils a role that extends beyond the storage and cataloguing of virtual tours, as it also facilitates access to, and connections with, complementary educational resources, establishing a record of artistic activity and the trajectories of participating individuals. Its implementation incorporates specific user experience design principles for engaging with art in virtual environments, ensuring intuitive and enriching interaction that is both accessible and inclusive for the entire university community.

4.3. Role of Social Media

In the digital age, the role of social media as a tool for distributing information, due to its capacity for effective and instantaneous global reach, is undeniable. González et al. (2014) investigates the role of social media in Spanish cultural industries, employing the Delphi method to gather expert opinions on how cultural organisations utilise these platforms and the primary motivations behind their use. In the context of museums, social media enables the promotion of events and exhibitions, interaction with the public, increased visibility, facilitation of learning, and the creation of interactive cultural experiences. This demonstrates that social media functions not merely as a marketing instrument but also as a platform for storytelling and the sharing of experiences, thereby enriching the cultural engagement of visitors. In other words, it confirms the profitability of these networks and the transfer of influence from providers to consumers of cultural goods and services.

Wang and Fang (2024) specifically examine the relationship between culture and social networks, presenting a theoretical framework that elucidates how the two influence one another and co-evolve across multiple levels. Their analysis highlights several theoretical principles and practical implications, notably that both culture and social networks operate as multilevel systems at individual, group, and organisational scales, necessitating cohesive and collaborative policies; and that they form part of dynamic processes that require flexibility and adaptability to diverse environments and circumstances. Among their proposed avenues for future research, particular attention is given to the impact of social networks on acculturation processes and the combined effects of cultural characteristics and network properties on everyday life.

As a prototype, DEXED seeks to engage with the synergies between culture and social networks outlined above, while extending the reach of the ECSiT group's exhibition projects and reinforcing its knowledge transfer activities through strategic collaborations with institutions, museums, and archives. It further aims to reach broader audiences through the strategic use of social media, which constitutes an essential mechanism for cultural dissemination and participation within the Information Society, capable of amplifying content, fostering communities for promotion, interaction, and cultural co-creation, and democratising access to culture while facilitating direct engagement between creators and the public.

5. Results

5.1. Impact on Education

As demonstrated above, the DEXED project, as a prototype for the digitisation of exhibition spaces, involves the creation of a standardised methodology that can be applied and replicated in museums, art galleries, and other literary and cultural institutions. The integration of the various immersive tools described ensures the accessibility, interactivity, flexibility, and collaboration necessary to engage with an active and innovative educational approach. Moreover, it fosters synergy between cutting-edge technologies for the conservation of cultural heritage and advances in research on human–art interaction, which, together with the creation of a repository of executable files containing the 360º virtual tours, represents a tangible advancement for the educational community in terms of teaching, dissemination, outreach, and research.

In the pedagogical context, virtual exhibitions and their accompanying supplementary information facilitate immediate global access for both teachers and learners, without temporal or inclusion constraints. Interactivity and the variety of multimedia resources support online collaboration, autonomous learning, and personalised engagement, motivating students and teachers to interact with content and explore it in depth. The potential of digitised exhibition spaces to integrate content into educational settings is considerable, as exemplified by initiatives such as the British Museum's Tablet Tours, organised by age group for primary school students. Additionally, virtual exhibitions can be incorporated into educational programmes through teaching proposals, interactive workshops, and activities such as gamified tours and collaborative guides, all aligned with curricular content. This approach enables students to reinterpret artistic and literary works from their own perspectives, thereby designing personalised tours.

In terms of research, DEXED primarily ensures the development of a design standard for virtual exhibitions, thereby addressing existing gaps in scientific knowledge. It also facilitates participation in publications and conference presentations concerning the various virtual exhibitions, their outcomes, and the reception of the project by the public and the wider educational community. In doing so, it contributes to significant advances in educational technology, digital museology, digital humanities, and the interplay between art and literature. Additionally, the project enhances the visibility of artistic and humanistic profiles within the university context, as fine arts and humanities educators can utilise this digitisation prototype to foster synergies. Finally, DEXED promotes strategic collaborations with museums and other artistic and cultural institutions.

5.2. Expansion of Cultural Access

Consequently, the social and media impact of DEXED facilitates broader cultural access, thereby helping to mitigate the elitism often associated with the arts and humanities. The visibility afforded to cultural content through the digital tools employed in the project contributes both to the democratisation of knowledge, by providing access to diverse audiences, including those with physical and geographical limitations, and to the personalisation of the educational experience, enhancing overall accessibility. This approach aligns with opportunities for dissemination through the press and specialised media, which, alongside social networks, can reach wide audiences due to the increased visibility and relevance of the tools and the specific themes of each exhibition. Furthermore, collaboration with the Artboxy platform is proposed to support the internationalisation of cultural access.

5.3. Public Participation

Unlike traditional passive viewing experiences, DEXED enables students, teachers, and visitors to engage more deeply with content through interactive virtual itineraries and educational activities, which can be accessed on-site as self-guided tours or remotely, adapting technological possibilities to a context that is both accessible and affordable for the university community. This approach offers two principal benefits. Firstly, it promotes active and participatory learning by combining practical and creative teaching methods that develop skills in managing and understanding cultural and artistic information. Secondly, it complements the experience of physical exhibitions, positioning DEXED as a

tool that does not compete with the traditional exhibition space, but rather extends and enhances it. This allows the immersive experience to coexist with the physical environment, creating a more diverse cultural offering: a 360º itinerant experience accessible to new audiences that serves as a bridge to the in-person appreciation of original works and more multifaceted encounters.

It is important to note that as DEXED is implemented, the audience can contribute feedback on virtual exhibitions, not only by creating their own itineraries and tours, but also by sharing opinions and comments that inform adjustments and improvements to each exhibition theme. This approach is directly applicable to educational practice, as student feedback is essential for the implementation of various pedagogical proposals. Moreover, analysing audience interactions and contributions via collaborative repositories will form an important component of future research lines.

6. Conclusions

The DEXED project represents a significant advance in the digitisation of cultural and educational resources. The standard methodology it proposes for the digitisation of exhibitions and their integration into educational and informative contexts addresses two complementary frameworks for action. Firstly, the methodological framework involves the development of a replicable, scalable and sustainable standard that supports the creation of immersive educational experiences and teaching activities, while simultaneously linking exhibition objects with complementary resources and enhancing both the in-person and virtual user experience. Secondly, the conceptual framework ensures that the exhibition discourse remains flexible and adaptable to the diverse thematic proposals of the participating members, relying on the technological tools discussed above, including 360º tours and AR, to generate an interactive experience. The synergy between these two frameworks underscores the relevance of this methodological approach in guiding future digitisation efforts and promoting knowledge transfer within and beyond the university community, with virtual repositories and social networks serving as essential instruments for dissemination and outreach.

With regard to potential limitations, it should be noted that DEXED is an ambitious project that seeks to extend the principles and methodologies established by DEED and PLATA. These initial initiatives were small-scale undertakings led by the ECSiT research group, constrained by limited budgets and resources. With greater human, financial and temporal resources, the prototype could be expanded to accommodate cultural exhibitions beyond the UDIT group and the university community. However, rather than representing mere constraints, these factors are understood as stages in a long-term proposal with substantial future potential. Other limitations include technical challenges, such as obtaining licences for the software necessary to generate these environments, including Kuula, and the logistical difficulties associated with travelling to capture 360º tour imagery. Another area requiring further development is the number and scale of exhibition projects, which initially comprises six, but is intended to expand in order to offer greater thematic variety and enrich the institutional virtual repository in subsequent editions.

As previously noted, DEXED is conceived as a long-term initiative, and a future-oriented projection is therefore essential. Once the methodology and initial prototypes are fully developed and implemented, a phased schedule can be established, informed by feedback from the university community and the public, and by the exploration of new technologies to enhance the immersive experiences. In this context, we plan to investigate the expansion of the multisensory design of virtual spaces, incorporating not only audio, immersive projections and VR glasses, but also motion sensors and haptic devices. Consequently, a longitudinal analysis of the educational and cultural impact of the DEXED model is planned, alongside efforts to broaden the thematic scope of exhibitions by generating synergies with other university departments, museums, galleries and cultural institutions.

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