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DIGITAL TECHNOLOGIES IN EXHIBITION SPACES: TRANSFORMING ARTISTRY AND VISITOR EXPERIENCE

He Qiying¹, Kosenko Danylo Yuriiovych²

¹Lecturer at the Department of Design, Xi'an Shiyu University, Xi'an, China;
Postgraduate Student at the Department of Interior and Furniture Design,
Kyiv National University of Technologies and Design, Kyiv, Ukraine;
Shaanxi University of Science and Technology, Xi'an, China,
e-mail: qyh@xsyu.edu, orcid: 0009-0004-7599-6305

²Candidate of Art Studies, Associate Professor,
Head of the Department of Interior and Furniture Design,
Kyiv National University of Technologies and Design, Kyiv, Ukraine,
e-mail: danylo.kosenko@gmail.com, orcid: 0000-0002-1668-6911

Abstract. Purpose. This paper investigates how digital technologies transform artistry and visitor experience in contemporary exhibition spaces, focusing on enhancing, rather than diminishing, artistic and experiential qualities. It explores the reshaping of art creation, presentation, and reception through digital mediation, addressing both opportunities and challenges.

Methodology. The study combines systematic literature review with case study analysis. The review examines research on digital technologies in museums/galleries, identifying trends and challenges. Case studies analyze three exemplary exhibitions: The Palace Museum's Digital Gallery (China), Mori Digital Art Museum TeamLab Borderless, and the National Museum of Qatar. Thematic analysis was used to identify recurring themes.

Results. Findings reveal digital technologies' potential to transform artistic practice, enabling dynamic, interactive art forms, hybrid spaces, and enhanced narratives. They also enhance visitor engagement through multi-sensory immersion, personalization, and extended reach. Challenges include technological dominance, user-centered design needs, and curatorial integrity. Case studies demonstrate successful technology integration that complements artistic content and enhances visitor experience.

Scientific novelty. This study provides a comprehensive analysis of the interplay between digital technologies, artistry, and visitor experience. It synthesizes diverse findings, offering a nuanced understanding of opportunities and challenges. The conceptual model provides a novel framework for guiding digital exhibition design and provides critical perspective about proper technology use.

Practical relevance. The insights benefit museum professionals, exhibition designers, artists, and technology developers. The paper offers guidance on effectively integrating digital technologies, emphasizing user-centered design, narrative coherence, accessibility, and balancing innovation with artistic integrity. Findings and the model inform future exhibition design. Case studies offer best-practice examples for diverse contexts.

Keywords: digital exhibition, artistry, visitor experience, immersive technology, interaction design, multimedia design, virtual reality, augmented reality, multimedia, museum studies, cultural heritage, curatorial practice.

INTRODUCTION

The contemporary exhibition environment is undergoing a profound transformation, driven by the rapid advancement and integration of digital technologies. Traditional museum and gallery practices, characterized by static displays and limited visitor interaction, are being challenged and redefined by dynamic, immersive, and participatory experiences [19; 22]. This shift represents a fundamental reconceptualization of the relationship between art, the exhibition space, and the audience. Digital technologies, including virtual reality (VR), augmented reality (AR), interactive multimedia installations, and sophisticated projection mapping techniques, are increasingly mediating the creation, presentation, and reception of art and cultural heritage. This paper explores this evolving landscape, examining the multifaceted impact of these technologies on both artistry and visitor experience. The central research question addressed is: How are digital technologies transforming artistry and visitor experience in exhibition spaces, and what are the key considerations for their effective and meaningful implementation? This question is crucial because, while digital technologies offer unprecedented opportunities for innovation and engagement, they also present significant challenges related to design, curation, and the overall visitor experience.

ANALYSIS OF PREVIOUS RESEARCH

Existing research highlights the transformative potential of digital technologies in exhibition spaces. Several key themes emerge, forming the foundation for this investigation. Digital technologies offer significant opportunities for increasing visitor interaction. Specifically, VR, AR, and interactive multimedia installations allow visitors to actively participate in the exhibition experience, moving beyond passive observation [17; 19; 23]. Research indicates that this active participation can lead to increased learning and enjoyment [12; 15].

Another key theme is the creation of immersive environments. VR and AR technologies can create immersive environments that transport visitors to virtual worlds or overlay digital information onto the real world [23; 24]. This immersion has been shown to heighten emotional responses and create memorable experiences [1; 13].

The literature also explores how digital tools are enabling new forms of artistic expression. These tools, including software, algorithms, and coding, provide artists with entirely new avenues for creative work [23]. This allows for the creation of dynamic and time-based artworks

that were previously unimaginable [18; 24]. These new art forms often incorporate real-time data streams, resulting in evolving and responsive pieces [5].

Furthermore, digital technologies significantly impact the accessibility and reach of exhibitions. Online platforms, virtual tours, and remote access technologies make collections accessible to a wider audience [13; 21; 24], which is especially important for those unable to visit in person due to geographical limitations or other constraints [6; 11].

Despite these benefits, literature also identifies significant challenges associated with integrating digital technologies. One key concern is the risk of technological dominance, where the technology itself overshadows the artistic content or curatorial message [8; 16]. Careful curatorial consideration is essential to ensure that technology is used appropriately and meaningfully to support the exhibition's goals [16]. Accessibility for all visitors, regardless of their technological literacy or physical abilities, and managing sensory overload to prevent negative experiences are also important considerations [2; 10; 17].

Finally, the concept of "hybrid spaces", which blend physical and virtual elements, is frequently discussed [8; 16]. While these spaces offer unique opportunities for layered experiences, careful design is crucial to ensure a seamless and coherent integration of the physical and digital components.

To fully understand the implications of this shift towards digital exhibition practices, it's crucial to examine the fundamental differences between traditional and digital approaches to both art creation and exhibition design. Table 1, adapted from Yao and Liu [23], highlights the core characteristics that distinguish digital art from its traditional counterparts, focusing on the essence of the art, its mode of exhibition and transmission, and the nature of audience interaction. Table 2, adapted from Wang [19], provides a comparative analysis of traditional and digital exhibition spaces, contrasting their approaches to content display, performance, technology, audience engagement, and overall experience.

While the existing literature provides valuable insights into the potential and challenges of digital technologies in exhibition spaces, it also reveals certain limitations. Specifically, much of the research focuses on the *potential* of these technologies, with less empirical evidence on their *actual* impact on artistry and visitor experience. Furthermore, there is a need for more research that directly compares different digital

Table 1

Characteristics of Digital Media Art in Urhan Environments (Yao & Liu [23], 2024)

Characteristic	Description
Essence	Reliance on digital technologies (software, algorithms, coding, interactive elements) as fundamental components of the creative process.
Exhibition	Departs from traditional gallery displays, often necessitating electronic screens, projectors, immersive installations, VR, and AR platforms.
Transmission	Relies on digital platforms and the internet for dissemination, allowing global reach and instant sharing through online platforms, social media, and digital galleries.
Interactivity and Immersiveness	Creates immersive, dynamic, and interactive experiences for the audience, transcending traditional mediums like canvas or sculpture.

Table 2

Characteristics Analysis of Various Display Spaces (Wang [19], 2023)

Project	Characteristics of Traditional Exhibition Space	Spatial Characteristics of Digital Display
Display content	Physical exhibits, sculptures, pictures and texts	Installation art, dynamic influence, etc.
Performance streamline	Fixed invariant	Flexibility and freedom
Display technology	Low technology	AR, VR, MR, 5G, Holographic projection, etc
How the audience accepts information	Passive acceptance	Take the initiative
Mode of transmission	Unidirectional propagation	Two-way communication
Experience mode	Visual experience	Multi-sensory experience
Utilization of environmental resources	Consume	save
Designer	Authority (artist)	Participants (audience)
Spread of information	limited	extensive

technologies and design approaches to determine their relative effectiveness. Finally, the existing literature often lacks a holistic perspective, failing to adequately address the complex interplay between technology, artistry, curatorial intent, and user experience. This points to the need for a more integrated and nuanced approach to understanding the transformative potential of digital technologies in exhibition spaces, which forms the basis for the current study.

STATEMENT OF THE PROBLEM

Contemporary exhibition environments are undergoing a profound transformation driven by the rapid advancement and integration of digital technologies [19; 22]. While traditional museums and galleries grapple with the challenges of engaging audiences in increasingly digital worlds, new opportunities are emerging to reshape artistic creation, presentation, and visitor experience. Existing research highlights the potential of digital technologies, such as virtual reality (VR), augmented reality (AR), and interactive multimedia installations, to enhance visitor interaction, create immersive environments, expand artistic expression, and improve accessibility. However, this technological shift also presents significant challenges,

including the risk of technological dominance overshadowing artistic content, concerns about accessibility for all visitors, the potential for sensory overload, and the complexities of integrating physical and virtual elements in "hybrid spaces" [2; 8; 10; 16; 17]. Despite the growing body of research on digital technologies in exhibition spaces, several key gaps remain. There is a need for a more nuanced understanding of how to *balance* technological innovation with the preservation of artistic integrity and curatorial intent. Furthermore, existing literature offers limited *practical guidance* on how to *systematically* design digital exhibitions that optimize both artistic expression and visitor engagement. The *long-term impacts* of these technologies on artistry and visitor experience are also underexplored. This study addresses these gaps by investigating how digital technologies are transforming artistry and visitor experience in contemporary exhibition spaces, focusing on enhancing, rather than diminishing, these qualities. Specifically, it aims to answer the following research questions: (1) How are digital technologies reshaping artistry and visitor experience in contemporary exhibition spaces? (2) What are the *new possibilities* and *challenges* that digital technologies bring to artistic creation? (3) How can digital

exhibitions be designed to *enhance* visitor engagement, immersion, and understanding? (4) How can we *balance* technological innovation with artistic integrity, curatorial narrative, and user experience? (5) What framework can assess *long term effects*? To achieve these objectives, this research conducts a systematic literature review and analyzes three exemplary exhibitions: The Palace Museum's Digital Gallery, Mori Digital Art Museum TeamLab Borderless, and the National Museum of Qatar. Through this analysis, the study develops a conceptual model to guide the design of digital exhibitions, promoting a balance between artistry, visitor experience, and technological implementation.

THE RESULTS OF THE RESEARCH AND THEIR DISCUSSION

Digital technologies are enabling a significant transformation in the realm of artistry, shifting from static art objects to dynamic and interactive art forms [23]. This involves a move beyond traditional, fixed objects to embrace time-based, process-oriented experiences. For example, generative art, which uses algorithms to create evolving visuals and sounds, is becoming increasingly prevalent in digital exhibitions. Artists are also exploring the use of real-time data streams, such as social media feeds or environmental sensors, to create artworks that respond directly to the world around them [5]. Interactive installations, where visitors' actions directly influence the artwork, are another key trend. These can range from simple touch-based interactions to complex systems that track movement, biometrics, or even brainwaves [12; 15]. The Mori Digital Art Museum provides a compelling example of this transformation, where digital artworks respond dynamically to visitor presence and movement [4]. Furthermore, the concept of "hybrid spaces" [18] is emerging, blending physical and virtual elements and blurring the boundaries between the real and the digital [24], creating new aesthetic possibilities through techniques like projection mapping, AR overlays, and VR environments [13; 16; 22].

This shift towards dynamic and interactive art forms aligns with constructivist learning theories, emphasizing active knowledge construction [12; 15]. Visitors are no longer passive observers but active participants who co-create the artwork through their interaction. This participatory approach can lead to increased engagement, deeper understanding, and a more personal connection with art. However, this also raises the challenge of

balancing artistic intent with a visitor agency. Prioritizing content is paramount; technology should always serve the artistic content and curatorial narrative, rather than the other way around [8; 16]. How can artists guide the experience without overly controlling it? The Mori Digital Art Museum's approach of creating open-ended, explorable environments suggests one possible solution, providing a framework where visitors are free to explore and interpret the artwork in their own way, while still maintaining a cohesive artistic vision. The rise of "hybrid spaces" presents both opportunities and challenges. While they offer new aesthetic possibilities and the potential to create layered, multi-sensory experiences, careful consideration is needed to ensure that the digital elements enhance, rather than detract from, the physical art or environment. The Palace Museum's Digital Gallery offers an example of successful integration, where digital technology complements and interprets the physical space, rather than replacing it [22]. Interactive displays provide detailed information about the Forbidden City, immersive projections recreate historical scenes, and VR headsets offer virtual tours of unrestored areas, all enhancing the understanding and appreciation of the existing cultural heritage. This demonstrates a thoughtful approach where technology serves to enrich the visitor's connection with the physical site and its history. The Mori Digital Art Museum TeamLab Borderless provides a contrasting example, showcasing the potential of digital technology to create entirely new art forms that are inherently interactive and immersive [4]. Here, the digital is the art, and the visitor's interaction is essential to the experience. Digital flowers bloom and scatter as visitors touch them, and digital fish swim around visitors' legs, reacting to their movements. This creates a sense of wonder and encourages active participation, blurring the lines between artwork, visitor, and environment. This exemplifies the shift towards dynamic, participatory art forms enabled by digital technology. A key limitation of some digital art installations is their reliance on complex technology, which can be prone to malfunction or require specialized technical expertise to maintain. This can create barriers to access and sustainability, particularly for smaller institutions with limited resources. Furthermore, the rapid pace of technological change means that digital artworks can quickly become outdated, raising questions about their long-term preservation and legacy. The implications of this shift for art

criticism and art history are also significant. How do we evaluate and contextualize these new art forms, which often blur the boundaries between art, technology, and design?

Digital technologies also facilitate the creation of multi-sensory immersive experiences that engage visitors on a deeper emotional and cognitive level [17; 19]. VR, AR, and interactive installations can stimulate multiple senses, creating a more holistic and memorable experience [7; 9]. For instance, VR experiences can transport visitors to historical settings or fictional worlds, while AR overlays can provide contextual information about physical artifacts or artworks. Interactive projections can transform entire rooms into dynamic, responsive environments. Some exhibitions are even incorporating haptic feedback, scent technology, and spatial audio to further enhance immersion. Personalization and agency are also becoming increasingly important. Interactive elements and personalized pathways empower visitors to shape their own experiences [12; 21; 22]. This can involve allowing visitors to choose their own path through an exhibition, customize the content they see, or even contribute to the creation of the artwork itself. The Mori Digital Art Museum exemplifies how a visitor agency can be central to the exhibition experience. Digital platforms and virtual tours extend the reach of exhibitions [13; 24], making them accessible to a wider audience, including those who are unable to visit in person due to geographical limitations or other constraints [6; 11].

The creation of immersive experiences aligns with research showing that heightened emotional responses and memorable experiences are linked to deeper engagement and learning [1; 3; 13]. By engaging multiple senses, digital technologies can create a more holistic and impactful experience for visitors, fostering a stronger connection with the content. However, the “wow factor” of immersive technology can be seductive, potentially overshadowing the content if not carefully integrated with the curatorial narrative [8; 14]. It is crucial to move beyond technological spectacle and focus on how immersion can substantively enhance understanding and critical thinking. Furthermore, sensory overload, disorientation, and even physical discomfort (e.g., motion sickness) are potential risks that must be carefully mitigated through thoughtful design and user testing [2; 10; 17]. This includes providing clear instructions, allowing for breaks, and offering alternative ways to experience the content

for those who are sensitive to certain stimuli. Personalization offers the potential for more meaningful engagement but also carries the risk of creating “filter bubbles”, where visitors only encounter information that confirms their existing biases [21; 22]. Curators and designers must carefully consider how to balance personalization with the need to present a diverse range of perspectives and avoid reinforcing stereotypes or prejudices. Balancing Immersion and Interaction requires providing opportunities for both immersive experiences and active participation. Ensuring Accessibility and Inclusivity means designing for diverse audiences, including those with disabilities. Mitigating Sensory Overload involves avoiding overwhelming visitors with excessive stimuli. Providing options for different levels of engagement is crucial for accessibility and inclusivity [20]. This includes designing for visitors with different physical abilities, learning styles, and levels of technological literacy. For example, providing audio descriptions, tactile elements, and alternative input methods can make digital exhibitions more accessible to visitors with visual or motor impairments. The National Museum of Qatar utilizes large-scale film projections to create a highly immersive and emotionally resonant experience [21]. By projecting films onto the museum's internal walls, often filling entire rooms, the museum draws visitors into the narrative and fosters a powerful connection to Qatari identity, history, and culture. This demonstrates how immersion can be used not just for spectacle, but also for effective storytelling and cultural communication. The scale and quality of the projections are crucial to this approach, creating an environment where visitors are surrounded by the narrative. The Mori Digital Art Museum, as mentioned earlier, also excels in enhancing visitor experience through its emphasis on agency and interaction [4]. The absence of fixed pathways and the responsive nature of digital artworks empower visitors to explore freely and shape their own unique experiences. This aligns with the principles of constructivist learning, where visitors actively construct meaning through their interactions with the environment. A key limitation of many current digital exhibition designs is their lack of robust evaluation. More research is needed to understand the long-term impacts of these technologies on visitor learning, attitudes, and behavior. The ethical implications of using digital technologies in museums, such as data privacy and cultural representation, also require careful consideration.

While digital technologies offer numerous benefits for artistry and visitor experience, they also present several key challenges. Technological dominance is a recurring concern, where the technology itself overshadows the artistic content or curatorial message [8; 16]. This can lead to a superficial engagement with the exhibition, where visitors are more impressed by the technology than by the art or ideas being presented. Accessibility is another major challenge. Not all visitors have equal access to or comfort with digital technologies. Digital exhibitions must be designed to be inclusive of visitors with varying levels of technological literacy, physical abilities, and sensory sensitivities [2; 10; 17]. This requires careful consideration of factors such as interface design, navigation, content presentation, and the provision of alternative options for engagement. Sensory overload is a potential risk, particularly with immersive technologies like VR and AR. Overwhelming visitors with excessive visual, auditory, or haptic stimuli can lead to discomfort, disorientation, and even motion

sickness. Designers must carefully manage the sensory environment to create a positive and engaging experience. Maintaining narrative coherence can also be challenging in digital exhibitions, especially those that incorporate interactive or non-linear elements. It is important to ensure that technology is used to tell a clear and compelling story, and that visitors are not left feeling lost or confused [16]. The long-term preservation of digital artworks and exhibitions also presents unique challenges. Digital technologies are constantly evolving, and formats, software, and hardware can quickly become obsolete. This raises questions about how to ensure that digital heritage can be accessed and experienced by future generations. Finally, cost can be a significant barrier, particularly for smaller institutions. The development, implementation, and maintenance of digital exhibitions can be expensive, requiring specialized equipment, software, and expertise.

The conceptual model above (Fig.1) synthesizes the findings of this study, offering a

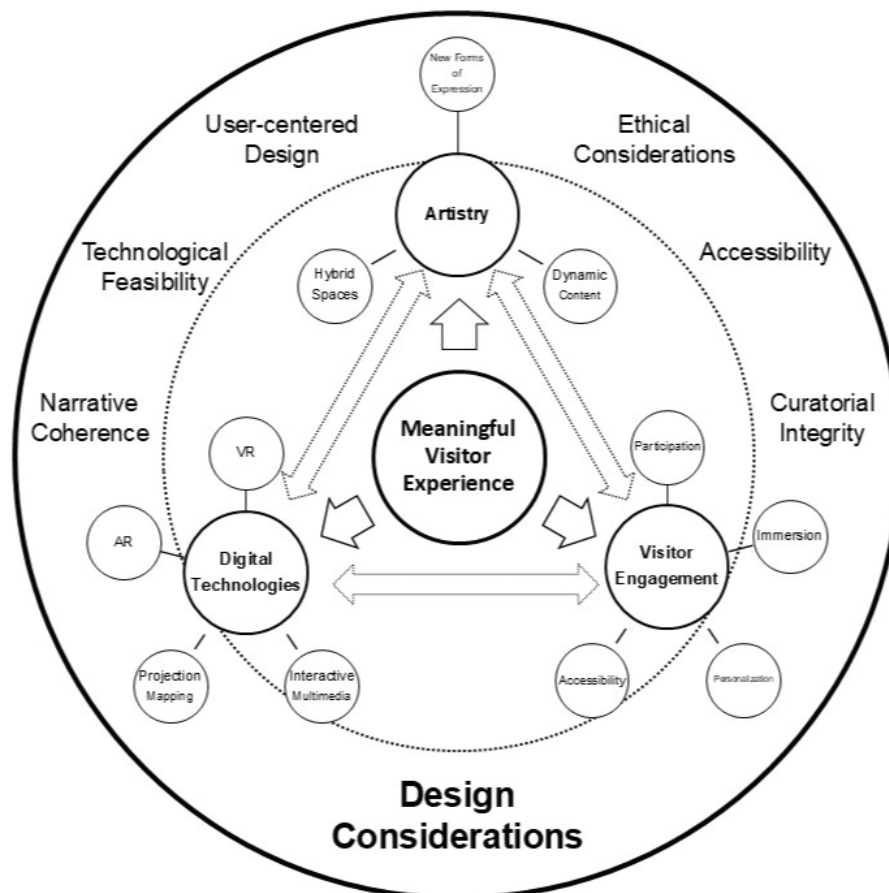


Fig. 1. Conceptual Model of Digital Exhibition Design (He, 2025)

framework for designing digital exhibitions that effectively integrate technology, artistry, and visitor experience. The model consists of three core components: Digital Technologies, Artistry, and Visitor Engagement. These components are interconnected and influence each other, as indicated by the arrows. The central element, "Meaningful Visitor Experience", represents the ultimate goal of digital exhibition design. Surrounding the core components are key considerations, including user-centered design, narrative coherence, accessibility, ethical considerations, and technological feasibility. This model emphasizes the importance of a holistic approach, where technology serves to enhance both artistry and visitor engagement, rather than dominating the experience.

CONCLUSIONS

Digital technologies are fundamentally reshaping the landscape of exhibition design, offering transformative possibilities for both artistry and visitor engagement. The transition to dynamic, interactive, and immersive environments presents unprecedented opportunities to create engaging and meaningful cultural experiences. However, the successful integration of these technologies requires a nuanced understanding of their potential benefits and their inherent challenges. By prioritizing user-centered design, carefully considering the relationship between technology and content, fostering a dynamic interplay between the physical and virtual realms, and maintaining a commitment to accessibility and inclusivity, exhibition designers and curators can harness the power of technology to enhance, not diminish, the enduring value of art and cultural heritage. Further research should focus on evaluating the long-term impacts of these technologies on audience perceptions, learning outcomes, and the evolving role of museums, galleries, and other cultural institutions in the digital age. The key lies in finding the optimal balance between technological innovation and the core mission of preserving, interpreting, and sharing cultural heritage with diverse audiences. This balance requires ongoing critical reflection, experimentation, and a commitment to creating experiences that are both technologically sophisticated and deeply human.

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АНОТАЦІЯ

Хе Ціїн, Косенко Д. Цифрові технології в виставкових просторах: трансформуючи мистецтво та досвід відвідувача

Мета. У цій статті досліджується як цифрові технології перетворюють мистецтво і досвід відвідувачів у сучасних виставкових просторах, зосереджуючись на посиленні, а не на зменшенні мистецьких якостей і досвіду. Робота досліджує зміну творчості, презентації та сприйняття мистецтва через цифрове посередництво, розглядаючи як можливості, так і виклики.

Методологія. Дослідження поєднує систематичний огляд літератури з аналізом прикладів. Огляд розглядає дослідження цифрових технологій у музеях/галереях, визначаючи тенденції та виклики. Тематичні дослідження аналізують три зразкові виставки: Цифрова галерея Палацового музею (Китай), Музей цифрового мистецтва Mori TeamLab Borderless і Національний музей Катару. Для визначення основних тенденцій використовувався тематичний аналіз

Результати. Результати розкривають потенціал цифрових технологій для трансформації художньої практики, уможливаючи динамічні інтерактивні форми мистецтва, гібридні простори та розширені наративи. Вони також покращують залучення відвідувачів завдяки мультисенсорному зануренню, персоналізації та розширеному охопленню. Проблеми включають

технологічне домінування, потреби дизайну, орієнтовані на користувача, і чесність куратора. Тематичні дослідження демонструють успішну інтеграцію технологій, яка доповнює художній вміст і покращує враження від відвідувачів.

Наукова новизна. Це дослідження досліджує комплексний аналіз взаємодії між цифровими технологіями, мистецтвом і досвідом відвідувачів. Через різноманітних висновків вдосконалено розуміння можливостей і викликів. Концептуальна модель забезпечує нову основу для керівництва дизайном цифрових виставок і забезпечує критичний погляд на правильне використання технологій.

Практична значущість. Отримана інформація принесе користь музейним фахівцям, дизайнерам виставок, художникам і розробникам технологій. Робота пропонує вказівки щодо ефективної інтеграції цифрових технологій, акцентуючи увагу на орієнтованому на користувача дизайні, зв'язності оповіді, доступності та балансі між інноваціями та художньою цілісністю. Результати та запропонована модель формують майбутній дизайн виставки. Тематичні дослідження пропонують приклади найкращої практики для різноманітних контекстів.

Ключові слова: цифрова виставка, мистецтво, досвід відвідувачів, технологія занурення, дизайн взаємодії, мультимедійний дизайн, віртуальна реальність, доповнена реальність, мультимедіа, музеєзнавство, культурна спадщина, кураторська практика.

АВТОРСЬКА ДОВІДКА:

Хе Ціін, викладачка кафедри дизайну, Університет Сіань Шію, Сіань, Китай; аспірантка кафедри дизайну інтер'єру і меблів, Київський національний університет технологій та дизайну, Київ, Україна, Університет науки і технологій Шеньсі, Шеньсі, Китай, e-mail: qyh@xsyu.edu.cn, orcid: 0009-0004-7599-6305.

Косенко Данило, кандидат мистецтвознавства, доцент, завідувач кафедри дизайну інтер'єру і меблів, Київський національний університет технологій та дизайну, Київ, Україна, e-mail: danylo.kosenko@gmail.com, orcid: 0000-0002-1668-6911.

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