Physical Interaction and Psychological Immersion: Analysis of Digital Technologies in Museum Exhibitions

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Abstract: In contemporary society, digital technologies are increasingly applied in museum exhibitions, in response to both the current digital economy, the experience economy, and the visiting needs. Rather than assessing any technical issues, this study aims to clarify the principles behind digital technologies being used in museum exhibitions through the use of examples and case studies. Based on Csikszentmihalyi's flow experience theory, it will be argued that digital technologies should enhance physical interaction and create psychological immersion. Moreover, the usage of digital technologies is fundamental to improving the intellectual experience for visitors, rather than to show off technology or cater to pleasure.

Keywords: Digital technologies, Museum exhibitions, Physical interaction, Psychological immersion

In the age of the experience economy[1], people's needs have shifted towards the pursuit of sensory enjoyment and the desire to (a) enhance cognitive abilities; (b) integrate mind and body. It is generally acknowledged that the concept 'immersion' was first put forward by the Hungarian psychologist Mihaly Csikszentmihalyi in 1975; and introduced the term 'flow' he published *Flow: The Psychology of Optimal Experience*, in which he systematically described 'Flow Experience', in 1990. Flow experience is a state of purposefully engaging in a task or pursuit that has the potential to be completed, which involves a high level of focus, and from which immediate feedback and pleasure can be derived[1]. The flow experience aims to enhance people's well-being and allow them to achieve real enjoyment[2].

Drawing on Csikszentmihalyi's flow experience theory, previous studies in this field have focused on 'immersion'. They argue that digital technologies can create immersion during visiting exhibitions[2-4], but do not offer clarity on whether such immersion is physical or psychological, or on the information carried by digital techniques. Through the lens of museum studies, this study argues that interaction and immersion are the fundamental principles of digital technologies, creating opportunities for visitors to interact with exhibitions on multi-sensory and behavioural levels and providing effective information to immerse visitors psychologically.

The following section will illustrate that digital technologies enhance the physical interaction between visitors and exhibitions.

1. Digital Technologies Enhance Physical Interaction

Interactionism is a crucial feature of the flow state[1]. To achieve the end goal of 'immersion', there has to be a sufficient focus on the interaction between people and their environment, which can be described as 'person-environment'[5]. In museums, digital technology's 'interactive' nature is reflected in how visitors use it to create meaning and foster an emotional experience[6].

Digital technology uses computers to convert physical objects into digital signals and then into a technique or format that the human senses (sight, hearing, touch, taste, and smell) can recognise or

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[1] Experience economy: B. Joseph Pine II and James H. Gilmore proposed it. From a market economics perspective, we are moving towards an experience economy: in buying an experience, one enjoys a series of memorable events provided by a particular business - as in a theatrical performance - that makes us immersive.
[2] Csikszentmihalyi distincts enjoyment and pleasure: the former means improving cognition and ability; the latter satisfies needs such as food and entertainment.

interact with[7]. The most common forms of digital techniques currently in use are Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), Extended Reality (XR), 3D holographic projection, and 5D holographic projection. These digital techniques and forms of display create an interactive environment which allows visitors to participate in exhibitions in different ways[2,8-10]. Some scholars believe that through a mixture of different disciplines, e.g., archaeology, history, heritage management, and behavioural science, digital interpretation should develop a new interpretative, engaging, and entertaining presentation that is more interactive and engaging for participants to interpret exhibits[11,12].

At the Barcelona History Museum, an exhibition on the Spanish Civil War 'bomb shelters' provides a multi-sensory and immersive experience by using digital technology to create a virtual environment that allows visitors to get close to archaeological remains and artefacts. AR technology permits museumgoers to meaningfully explore specific sites and construct their interpretations of the exhibition based on the existing historical context[13]. Digital technology is integrated with the exhibition's historical narrative to convey historical information and enhance the visitor experience. To give another example, the Acropolis Museum exhibition in Athens provides visitors with a digital mobile device which, by following its prompts, enables them to personalise their visit to the exhibition by changing randomly according to individual preferences. It means that people can decide which route to follow and what to see, which increases visiting freedom and interaction with the exhibition.

Figure 1: Holographic projection environment (photograph by author)

Figure 2: Technologies plus performance (photograph by author)

Additionally, digital technologies are often combined with other forms of display in museum exhibitions. They can be incorporated into dramas and performances to bring exhibition objects or narratives to life through a combination of factual information and performance or role play. The

exhibition A Dream Journey through A Panorama of Rivers and Mountains[3] creates a live-action performance enhanced by a holographic projection environment in the exhibition hall (Figure 1), incorporating multimedia into the dance performance. Visitors do not simply look passively at objects but also watch a live performance featuring various choreographic techniques that may help them better understand how the painter Wang Ximeng created this masterpiece and his mood while painting it, which is exactly the information of the exhibition. (Figure 2)

In conclusion, digital technologies create an interactive environment between visitors and exhibitions, enhancing the visiting experience. The following section will examine the process of immersion when visitors interact with exhibitions through digital technologies.

2. Psychological Immersion During Interaction

Compared to traditional forms of museum display, digital technologies break with the 'parade' model[4] and create an immersive environment where visitors can interact with exhibitions. This interaction process is a physical experience visitors have during their visits. However, interaction with exhibitions is different from total immersion in them. This study identifies a preferable goal for digital technologies —to create complete psychological immersion by conveying cultural information in exhibitions.

First, the relationship between people and museum objects should be clarified to understand better that psychological immersion means a complete exploration and awareness of the emotional and intellectual dimensions of the exhibits at the forefront of the mind, without any distractions. Since the 1950s, museums have increasingly focused on integrating 'people' and 'objects' and on understanding the public's experience of the space they visit and the information they receive. The design of exhibitions and educational activities is more human than ever, allowing people to come with different motivations, such as acquiring knowledge and sensory enjoyment or simply for social interaction.

Museums construct a narrative environment through exhibition names and main text[5] and tell the specific 'story' through the exhibits, textual information such as titles, and exhibit descriptions. Using digital technologies in an exhibition is a more vivid interpretation of that narrative 'story'. Interpretative work consists of adding presentations to solo exhibits and keeping these presentations as varied as possible to match different visitors' mental structures or preferences successfully.

In the process of embodying exhibition information, digital technologies use advanced techniques to create psychological immersion, resulting in visitors (a) remaining focussed on the exhibition's content; (b) receiving continuous and immediate feedback from the exhibition; and (c) enjoying it as a source of pleasure. The feedback comes from the exhibition information being disseminated, including its theme, various ideas of the curators in terms of presentation, and the various messages of the exhibits. Exhibits can be regarded as the material basis for the daily work of museums as well as the material carriers of the content of the exhibition display. When curators create exhibitions, they interpret the connotations inherent in the exhibits and offer up cultural and artistic knowledge behind them to visitors. Therefore, the goal of a museum visit is not merely to satisfy the senses with advanced stylistic techniques but also to enhance visitors' cognitive abilities and provide meaningful enjoyment that simultaneously educates them. Ideally, museums should provide opportunities for visitors to learn about, experience and fundamentally read the information and narrative contained within an exhibition.

The following section will examine a particular case study of a museum exhibition that applies digital technologies to enhance physical interaction and create immersion for visitors.

3. An Exhibition Case Study: teamLab's Forest of Flowers and People6

The Forest of Flowers and People is a part of the teamLab digital exhibition,[7] which combines the

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[3] This exhibition was supported by Beijing Palace Museum Phoenix Lingke Technology Co., Ltd., in Gongyan Gallery, Beijing, China, from 2 Feb 2022 to 31 Oct 2022.

[4] The 'Parade' model means visitors can only look at exhibits in front of the showcase quickly, without a more profound understanding of cultural connotations.

[5] Influenced by postmodernism and deconstructionism since the 1980s, narrative theory has evolved from classical to post-classical narrative. It has become increasingly integrated into a wide range of sectors, which is reflected in the narrative turn in museum exhibitions in the museum field.

[6] teamLab (2019) Forest of Flowers and People: Lost, Immersed and Reborn. Available at: https://borderless.team-lab.cn/shanghai/ew/flowerforest_shanghai/ (Accessed: 5 April 2022).

[7] This study chooses the digital exhibition in teamLab Borderless, Shanghai, China.

content of the artwork with multimedia and digital technologies such as sound and light. It has several 'seasons', which gradually change, and the flowers' rate of growth changes to match. The exhibition presents visitors with a world of flowers; some lost, some growing, some immersed in flowing water, and some reborn, flowing water, growing flowers and more[14]. Through digital technology, the visitors influence and affect the 'forest of flowers and people' through their presence and behaviour, making them even more connected to the exhibition environment. Rather than projecting unchanging, pre-produced images on a loop, the exhibition is mapped by a computer programme in real-time, altering its state according to visitor behaviour in the museum and influencing the growth of flowers from birth to withering and death. If a visitor stands still, the flowers near them grow more than usual and bloom; if they touch or step on a flower, it will wither and die (Figure 3).
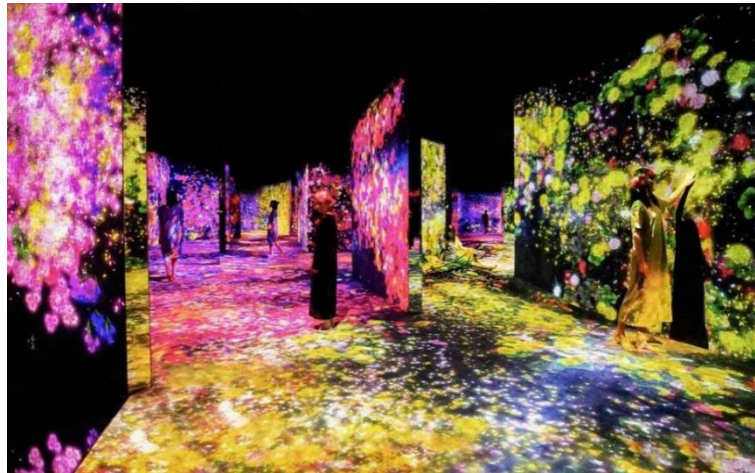

Figure 3: Forest of Flowers and People (photograph from teamLab Borderless)

This exhibition uses an advanced digital drawing technique that senses changes in people's behaviours and accordingly alters the real-time presentation of the exhibition (Table 1). This digital technology means that visitors can instantly see how the work responds to their visit. The immediacy of this feedback incorporates the visitors into the work itself, making them part of the work, which is at the centre of interactivity. The exhibition was designed as an immersive experience. The visual and auditory impact may be strong in its own right. However, the interactive element encourages visitors to actively participate, i.e., by 'moving' and thereby 'changing' the exhibition around them. Appropriately given that it is a forest of flowers and people, the exhibition creates connections between people and the environment and between people and each other[15]. Visitors are immersed in the 'living world of flowers' in the intertwined social networks that make up that 'living world'.

Table 1: The analysis of digital technologies in the exhibition.

Digital Technologies	Interaction	Experience	Immersion
1. Real-time computer programme 2. capture behavioural changes	Visitor behaviours influence the flower growth process	1. Visual, auditory, and touch 2. Interaction behaviour	1. Human and nature 2. Art without borders[8]

In addition, the exhibition's use of digital technology is meant to stimulate visitors' senses and effectively communicate the dual themes of the exhibition: the relationship between 'people and nature', and the concept of 'art without borders'. Using digital technology to create an immersive experience might be an impressive technical highlight of the teamLab exhibition. However, rather than merely being an empty exercise in spectacle, it is backed up by artistic connotations and networks of meaning. For example, *Forest of Flowers and People* can influence other parts of the teamLab exhibition and be influenced and changed by others. The waterfall will drown a butterfly flying into a place where flowers bloom, and if an eight-handed bird flies in, it will drift away. The work embraces the idea that humans, nature, and the world are a single holistic whole and that everything exists as one borderless, fragile, and uncanny being. In addition to physical interaction, visitors can deepen their understanding of 'boundlessness' and 'wholeness' by witnessing and even causing some of these 'changes' within the exhibition.

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[8] It is a core idea that in a museum without a map, artworks move out of rooms and communicate with other works, and the body interacts with the exhibition.

In this exhibition, digital technologies are not simply a means for showing off advanced techniques with which people can interact; they are fully integrated with the exhibition theme and artistic concept. This allows art to be presented in an innovative technical form and enhances the meaning of the work and the artistic potential of these technological advances. Therefore, this exhibition realises physical interaction and psychological immersion through the power of the artwork's network of meaning.

4. Conclusion

Nowadays, many exhibitions claim to be 'immersive' (see Appendix A)—however, some over-emphasise technical displays and sensory experiences. As a result, there has been an increasing number of technical showcases and entertainment exhibitions which lack a meaningful thematic 'core' and do not adequately achieve the goal of 'immersion'.

Csikszentmihalyi's idea of the 'flow experience' clarifies the importance of focused and unbroken concentration in successfully achieving interaction and immersion. The use of ground-breaking digital techniques should better convey information about the exhibition, create an immersive environment for visitors, focus their attention on the content, and enhance the overall experience.

Based on the above discussion of the interaction and immersion of digital technologies, the conclusion can be made that using digital technologies first requires a solid grasp of the concept of 'interaction' from flow experience theory and the idea that an immersive environment should be primarily focussed on conveying exhibition content to visitors. Secondly, current immersion techniques can factor in the pioneering use of technological development, multimedia, and digital technology.

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Appendix A

Title	Location	Digital Technologies	Time
Rain Room	Yuz Museum Shanghai	Real-time computer programme	2015 and 2019
Discovering Yangxin Temple	The Palace Museum	AR, VR	10 Oct - 26 Nov 2017
A Journey through Springtime along the River 3.0	The Palace Museum	Dynamic projection, 180° Fulldome	29 May, 2018
Van Gogh: Fantasy of the Inner World	National Museum of China	Holographic projection, VR, Multimedia	22 June - 22 September 2019
The World of the Sea in the Forbidden City	Sea World Culture & Arts Centre	Multimedia	12 Jul - 8 Oct 2019
DE JA VU	Today Art Museum	Real-time computer programme	19 Aug - 27 Oct 2019
teamLab	teamLab Borderless in Shanghai	Real-time computer programme, Capture behavioural changes, Multimedia	5 Nov 2019
A Space-Time Romp through Heritage	The Capital Museum	Motion capture, AR, Holographic projection, 180° Fulldome, Multimedia	26 Sep - 15 Nov 2020
Claude Monet: Fantasy of the Inner World	Zhejiang Exhibition Hall	Holographic panoramic, VR, Multimedia	20 Aug - 20 Dec 2021
Boats on the Canal	China Grand Canal Museum	Multimedia, AR, 360° Fulldome	16 Jun 2021
Van Gogh Alive	Dewey Centre	SENSORY 5 technology, Multi-channel projection, Acoustic system	1 Oct 2021 - 28 Feb 2022
Lanterns and Festoons	Beijing Light Science and Technology Museum	Holographic projection	15 Nov 2021 - 1 Mar 2022
A Dream Journey through A Panorama of Rivers and Mountains	Gongyan Gallery	Holographic projection, VR	2 Feb - 31 Oct 2022