The Interdisciplinary Integration of the Concept of Child-friendly Museums and Virtual Reality Technology

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ABSTRACT
Since the information age, cross-field integration has become a mainstream trend. As one of the frontier technologies, virtual reality technology is influencing various fields. Museums, as the carrier of human history and the placeholder of human spirit, have become an important place where virtual reality technology is embedded. This article deeply explores the core value of virtual reality technology and museum childhood education through the analysis of excellent museums at home and abroad, and puts forward suggestions and reflections on the construction and service system of "child-friendly" museums. The integration of cutting-edge technologies, traditional things and advanced concepts is increasingly strengthened. The application of virtual reality technology enhances the cultural communication power of museums, while the "child-friendly" process of museums also makes the application of virtual reality technology more meaningful. With the progress of human civilization, the combination of these fields will become an important guide for future cross-field integration.

Keywords: *Museum childhood education, "Child-friendly" concept, Virtual reality technology, Cross-field integration.*

1. INTRODUCTION

Since the 18th CPC National Congress, museums in China have made continuous progress in venue construction, cultural relic protection, collections research, exhibition design, and education and communication[1]. However, it should also be noted that there is a contradiction between the unbalanced and insufficient development of museums and the people's needs for a better life. With the continuous improvement of global education standards and the increasing number of children, the "child-friendly" construction of museums has gradually received people's attention. Therefore, it is an important development direction to improve the construction and service level of museums by building an exhibition system that is suitable for both adults and children.

To achieve the above-mentioned concept, it is necessary to take cutting-edge technologies as the foundation and people-oriented idea as the core thinking, develop smart museums, and introduce new technologies such as virtual reality, artificial intelligence, and dynamic capture to strengthen the cultural communication and education guidance capabilities of museums. At the same time, it is also necessary to consider the exhibition experience of contemporary children in museums and build smart museums that meet the needs of contemporary adults and children.

Therefore, how to use virtual reality technology to build a comfortable and fulfilling museum environment for contemporary children has become an important topic of the current era. When the museum, which carries history and continues culture, collides with virtual reality technology, which represents frontier and innovation, how to merge the characteristics of the two and form an exhibition process that is suitable for children becomes a huge challenge that every art designer needs to consider and explore.

2. USING VR TECHNOLOGY TO ENHANCE THE CORE VALUE OF MUSEUMS IN A CHILD-FRIENDLY CONTEXT

The integration of museums and virtual reality technology is not rare nowadays. Whether it is an online or offline public aesthetic place, virtual reality technology can often be seen. Such a technology that is so interesting and futuristic should attract more children to visit museums, but according to the 2017 Zhejiang Province Children's Development Plan Annual Report, only 16.281 million minors visited the exhibition[2]. Children's aesthetic education is an important way to strengthen the country and educate the people. The experience design of museums for children requires the integration of multiple fields such as psychology, engineering, and education. This article explores the core value of cross-field integration by analyzing three fields: virtual reality technology, museum public aesthetic education, and children's exhibition experience.

2.1 Development and Evolution of Virtual Reality Technology

As early as ancient China, people proposed the concept of "fusion of virtual and real", reflecting people's pursuit and expectation of the virtual world. In the real world, people cannot time and space traveling or break through physical phenomena, but virtual reality technology can help people break free and move freely between virtual and real. The famous scholar Qian Xuesen, academician, also gave virtual reality a name full of Chinese philosophical implications - "Lingjing", which to some extent expresses the essential characteristics and core value of virtual reality [3].

As a practical technology, virtual reality technology builds virtual objects or spaces, integrates them into the viewer's sensory system, and reconstructs them [4]. Its active participation, experience, interactivity, immersiveness, and virtuality have excellent cultural communication and human-computer interaction capabilities. It is well adapted to the teaching concept of "edutainment" practice in the field of contemporary children's education. On the one hand, museums can provide external devices such as VR glasses and remote sensing to provide a simple and interesting way for children to visit exhibitions. On the other hand, a virtual-reality combined interaction method can be adopted to merge virtual and reality. As the interaction progresses, the user will experience three stages: from reality to virtuality, from virtuality to reality, and to the coexistence of virtual and reality, ultimately placing themselves in a digital reality [3]. With the continuous maturity of accompanying technologies such as artificial intelligence, digital image, and dynamic perception, virtual reality technology integrates multiple resources to improve its own construction and is widely used in art design activities. On the one hand, the unique application mode of virtual reality technology brings a new model and solution to children's museum visits, breaking through the traditional flat exhibition mode; on the other hand, it increases the playability of children during the exhibition process, while the digital presentation of collections also makes them safer.

2.2 The Essence of "Child-friendly" Museums

Museums are important venues for the inheritance of human history and artistic style, and constitute a second education system independent of ordinary schools [5]. What museums undertake is not just a physical collection and storage, but more of a spiritual gathering. With the advent of the digital age, although museums are used to store and display witnesses of human activities and the natural environment, they should not be labeled as "antiques" [9]. When designing exhibitions for children, who have an average age, designers need to make the cultural reception easier for them and enable children who lack cultural background and aesthetic vision to enjoy themselves in history, humanities, science, and art.

The famous psychologist Jean Piaget divided the development of children's cognitive abilities into four stages: the sensory-motor stage (from birth to 2 years old), the preoperational stage (2 to 7 years old), the concrete operational stage (7 to 11 years old), and the formal operational stage (after 11 years old) [6]. Children in the concrete operational stage have a certain logical ability and can develop simple cognition and understanding of the things in the museum. Therefore, the "long-winded" and "textbook" exhibition models are not matching with the aesthetic perception abilities of children aged 6 to 12. The "child-friendliness" of museums today needs to start from the perspective of children's senses and provide them with information cognition through the process of sight, sound, and touch. Combined with a certain degree

of logical thinking process, it can bring the greatest exhibition stimulation to children.

2.3 The Core of the "Child-friendly" Concept in Virtual Reality Technology

Of course, the cross-field integration of virtual reality and museum construction is not a simple technological carnival, but aims to provide children with a more scientific and effective museum exhibition experience through virtual reality technology. Simple technology patchwork will only backfire. Museum construction workers should keep in mind the "child-friendly" concept, and the use of virtual reality technology is not to achieve complete immersion, but to feed back the real world through virtual technology to enhance the productivity, cultural communication power, and cultural self-confidence of museums [10], so that children in China and even the world can have a better museum experience. Museums in China should firmly grasp their core values in the digital and smart world trend, and strive to improve their self-construction level and service standards.

3. THE INNOVATIVE COMBINATION OF VIRTUAL REALITY TECHNOLOGY AND "CHILD-FRIENDLY" MUSEUMS

Frontier technologies, represented by virtual reality, are increasingly widely used in the "child-friendly" construction and services of museums, art galleries, and art museums. The innovative combination of virtual reality and museums has infinite possibilities, and museums all over the world are keeping up with the "fashion trend" and vigorously developing the integration of museums and virtual reality technology. However, whether the combination of the two provides a more advanced and interesting exhibition model for children needs to be gradually improved through continuous try and reflect.

3.1 Emotional Virtual Avatars

The Slovenian Digital Heritage Museum project originated in 1993, mainly through the method of panoramic capture to digitalize and record the natural scenery and urban history of the entire Slovenia and form a huge virtual reality digital heritage website. From the Ljubljana Castle to the waterfalls in National Park, and then to the construction of virtual urban scenes, this digital museum turns the entire Republic of Slovenia into a huge museum, where people can walk into this beautiful country through virtual reality technology. Interestingly, the virtual museum has a cute virtual image of a bee (the Slovenian endemic species, Carniolan bee), which serves as the virtual proxy of the visitors and takes them to every corner of the Republic of Slovenia and even the world, thus allowing the visitors to emotionally engage (“Figure 1”).

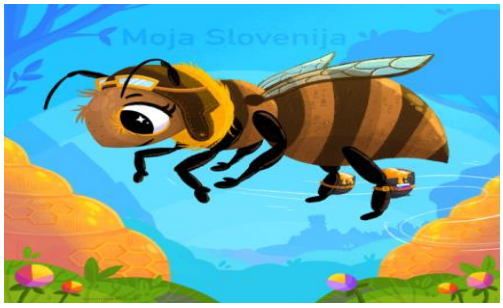

Figure 1 Virtual Proxy - Carniolan Bee.

Adults may not pay much attention to this cute bee, but children love it very much. With their boundless imagination and unrestrained emotional investment, children hope that one day they can fly through the sky, overlook the city where they grow up, and are willing to follow a cute little bee to explore the city's corner tower. Therefore, many children are willing to stop by the website and browse. The Digital Heritage Museum discovers children's whimsical ideas and emotional cognition, while also allowing them to browse and enjoy the humanistic style and natural scenery of their native land through virtual simulation scenes, achieving a perfect integration of museum cultural communication and cutting-edge technology.

And the Digital Heritage Museum also attaches great importance to sound recording. Unlike most indoor virtual venues, the Slovenian Digital Heritage Museum has a large number of outdoor scenes, and the designers have focused on recording various sounds in nature, such as water flow, wind, animal cries, and street noise. The use of sound elements can give children a sense of familiarity and enhance the immersive experience of virtual reality.

3.2 Learning Through Virtual and Real Exploration

With the continuous development of virtual reality technology, more and more museums are beginning to undergo cross-field integration and transformation, treating virtual reality as a medium

for educational materials and connecting with young audiences. The Madrid Digital Arts (MAD) is currently one of the most advanced digital arts centers in Europe, showcasing examples of the integration of art and cutting-edge technology through its unique environment. For children, direct audio-visual perception can better immerse them in the narrative environment [2].

The Guiyang Provincial Museum in China presents its collections through holographic projection, and under each projection device, there is a device that introduces the collection through games and animation. This way of presenting collections grabs children's attention from a visual perspective, and then guides them through the life of the collection through progressive and interesting content. Virtual reality can bring different topics and perspectives to collections, guiding children to reflect on their previous ideas and overturn the cultural implant teaching model they are used to, greatly enhancing the flexibility and pleasure of children's museum visits.

3.3 Educational and Fun Interactive Experiences

Traditional museum human-object interaction methods cannot meet children's effective absorption of cultural knowledge [7]. Some museums have designed VR applications and services that are suitable for children to learn while playing, taking children's learning habits as the entry point. The intervention of virtual reality technology has expanded the subjective time and space of children's museum visits, and promoted the transfer of collection information from fragmentation to continuity.

The Petrie Museum of Egyptian Archaeology has collaborated with VR technology vendor Musemio to develop a game-based VR museum visiting application. Children can enter a digital world matching the theme of the museum through a simple external device, and complete a series of fun challenges and exploration tasks, such as pyramid mazes and Egyptian pharaoh arrangement. This allows children to naturally experience the history and culture behind the museum collections.

The Athens National Archaeological Museum (“Figure 2”) in Greece has also made a proper integration of virtual reality and the process of children's museum visits. The museum has launched a series of children's museum education programs, and uses virtual reality technology to bring children a unique learning experience. In the "Athens in 1824" project, the museum uses a virtual reality application to tell children the most iconic buildings in Athens from ancient times to the 19th century, taking the historical development as the context and leading children into Athens in 1824 through story telling.

Figure 2 Schematic Diagram of the "Athens in 1824" Project.

4. IMPLICATIONS AND REFLECTIONS ON THE CONSTRUCTION OF MUSEUMS IN CHINA

Child-friendly" Museum Construction with Cutting-Edge Tech and The Prospect of Constructing a Child-Friendly Museum Education System with Virtual Reality Technology are both important directions for the development of museums. Through the use of these technologies, museums can provide children with better educational experiences, stimulate their curiosity and exploration, and enhance their learning effectiveness and abilities.

4.1 “Child-friendly” Museum Construction with Cutting-Edge Tech

China needs to place greater emphasis on the "child-friendly" construction of museums. Currently, there are only three children's museums in China that have been officially registered, and even fewer museums that integrate virtual reality technology or other cutting-edge technologies. In contrast, there are over 300 professional children's museums and institutions in the United States to date, and Western museums have developed a

significant number of children's education programs as a branch of museum development. Therefore, museum educators must enhance the importance of "child-friendly" museum design. In China, museum exhibitions and educational activities are usually designed for adults, neglecting children's interests and cognitive characteristics. This makes it difficult for children to actively participate and learn in museums. In addition, the majority of Chinese museums have not yet fully utilized virtual reality technology and other advanced technologies to improve the exhibition and educational experience of children. Although some museums have begun to introduce VR technology, the majority of them are still in the exploratory stage and need to be improved. To solve these problems, China needs to strengthen the development of children's museums and increase investment in technological innovation. At the same time, museums need to pay more attention to the needs and interests of children and design more child-friendly exhibitions and educational activities. Only in this way can educators better promote the development of "child-friendly" museums in China.

4.2 Integrating VR Technology with Children's Emotional Needs in Museum Education

Museum public education practitioners need to explore more deeply the accurate positioning of virtual reality or other cutting-edge technologies in museum childhood education. Although the use of virtual reality technology in museum childhood education is very common, how to integrate virtual reality technology into children's cognitive process appropriately and consider children's emotions and feelings in the process of integration in these fields is an important link to embody the people-oriented service concept of museums [2]. The "Child-friendly" education of museums should be a creative and emotional cultural communication process, and children's emotional cognition and feelings should be given priority. Therefore, in the current "Child-friendly" construction of Chinese museums, children's feelings should be taken into account first, viewed from the perspective of children, and creativity should be regarded as the main clue.

The integration of virtual reality technology in museum childhood education should not only focus on technological means, but also pay attention to children's emotional needs and interests. Museums can use virtual reality technology to create more child-friendly educational scenarios and experiences, taking into account children's cognitive levels, emotional needs, and interests. For example, museums can use virtual reality technology to create virtual dinosaurs, allowing children to experience the living environment and habits of dinosaurs through virtual reality technology. In addition, museums can also use virtual reality technology to create virtual art exhibitions, allowing children to experience different styles of art through virtual reality technology. In the process of museum childhood education, it is also necessary to pay attention to children's emotional needs and feelings. Museums can provide more child-friendly services and facilities, taking into account children's safety, comfort, and fun. For example, museums can provide child-friendly toilets, child-friendly restaurants, and child-friendly activity areas to meet children's needs. In addition, museums can also organize more child-friendly activities and games, allowing children to have more fun and experiences in the museum. In conclusion, in the current "Child-friendly" construction of Chinese museums, educators should pay attention to the accurate positioning of virtual reality technology and other cutting-edge technologies, and consider children's emotional needs and feelings in the process of integration. Only in this way can educators and curators provide more child-friendly museum exhibitions and educational experiences, and promote the all-round development of children.

4.3 The Prospect of Constructing a Child-friendly Museum Education System with Virtual Reality Technology

The development of Chinese museums should take the needs of the public as a clue to help itself open up a new path [11]. The current museum "Child-friendly" transformation in China is not only a technological transformation of museums, but also the integration of the needs of the traditional museum and children's public aesthetic education, which is the establishment of a unique teaching system. The emergence of virtual reality technology has created a good prerequisite for this museum reform, and by exploring the common characteristics of virtual reality and children's public aesthetic education, it is possible to explore a unique exhibition process suitable for children.

In China, the traditional museum exhibition model is usually based on adult cognition and interests, neglecting children's needs and interests.

This makes it difficult for children to actively participate and learn from exhibitions in art museum. With the development of virtual reality technology, museums can provide more child-friendly exhibitions and educational activities, taking into account children's cognitive levels, emotional needs, and interests. For example, museums can use virtual reality technology to create virtual exhibitions, allowing children to experience different styles of exhibitions through virtual reality technology. In addition, museums can also use virtual reality technology to create virtual educational scenarios, allowing children to learn and practice different skills through virtual reality technology.

The integration of virtual reality technology in museum childhood education should not only focus on technological means, but also pay attention to children's emotional needs and interests. Museums can use virtual reality technology to create more child-friendly educational scenarios and experiences, taking into account children's cognitive levels, emotional needs, and interests. For example, museums can use virtual reality technology to create virtual playgrounds, allowing children to experience different types of playgrounds through virtual reality technology. In addition, museums can also use virtual reality technology to create virtual nature reserves, allowing children to experience different types of nature reserves through virtual reality technology.

5. CONCLUSION

The development path of "Child-friendly" museums in China is a long-term task, and the arrival of cutting-edge technology trends cannot be stopped. Educators should have the courage to try and continuously explore, not afraid to use new technologies, new science and new means, and place children's exhibition experience on an equally important position with adults, continuously improve the current and future construction and service levels of museums home and abroad, adhere to the "Child-friendly" development path of museums in the context of new technologies, and make full effort to provide the children with an advanced and comfortable cultural acquisition place. However, much more attention should be paid that the exhibition experience suitable for children is not simply to use cool and gorgeous virtual reality effects, but to reasonably use the advantages of technology for cultural communication. This is the core purpose of the combination of the "Child-friendly" concept of museums and virtual reality technology, and also the correct development path for the future cross-field integration of the museums.

AUTHORS' CONTRIBUTIONS

Dr. Tengfei Xu is an associate professor in the Department of Design at the School of Future Design, Beijing Normal University. He teaches design education, art history, and professional thesis writing at Beijing Normal University, and guides master's students. In this study, Associate Professor Xu Tengfei provided abundant resources and guidance, and completed translation and submission. Provide rich guidance and revision suggestions during the paper writing process.

Guanjie Ye, a postgraduate student at the School of Design for the Future, Beijing Normal University, has made great efforts in the topic selection, manuscript writing, and specific implementation process of this thesis. Under the guidance of his supervisor, he completed the writing of this thesis.

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