

RESEARCH ON INTERACTIVE VISUAL DESIGN AND CULTURAL PHILOSOPHY IN VIRTUAL REALITY ENVIRONMENT

JIA XIAOJUN

COLLEGE OF ART AND DESIGN, ZHANJIANG UNIVERSITY OF SCIENCE AND TECHNOLOGY, ZHANJIANG, GUANGDONG, 524000.

EMAIL: JIAXIAOJUN2024@163.COM

Abstract: The study explored the interplay between interactive visual design, cultural philosophy, and emotional responses within virtual reality environments. A mixed methods approach was employed, utilizing surveys, interviews, and focus group discussions. In terms of design preferences, participants showed a slight favor towards minimalist aesthetics with natural elements, while still appreciating vibrant colors and high levels of detail. Interactive elements and clear narrative structures within the VR environment were highly desirable. Thematic analysis of interview data (aligned with Chinese cultural philosophy) highlighted the importance of design elements that resonate with cultural practices. Familiarity with cultural elements fostered a sense of respect and tradition (Li), while storytelling through design embodied the Daoist concept of effortless action (Wu Wei). Interactive design elements that aligned with cultural practices promoted a sense of participation and connection (Ren). Emphasis was placed on the importance of authenticity in portraying cultural practices (Zhong), reflecting a desire to learn and engage actively with the presented culture (Xuexi). Respectful depictions of religious practices were essential, aligning with the Confucian concept of filial piety (Xiao) and respect for traditions. When designing VR experiences, incorporating symbolic elements that hold meaning within a particular culture (Li) was seen as favorable. The participants also expressed a desire for a balance between immersive experiences and opportunities to learn about the culture (Junzi).

Keywords: Virtual Reality [VR], Visual Design, Cultural Philosophy, Li, Wu Wei, Ren and Li

1. INTRODUCTION

Over the past few decades, virtual reality (VR) technology has emerged as a transformative force in education, offering innovative tools that significantly enrich learning experiences. VR's unique strength lies in its ability to immerse students in interactive and stimulating environments, promoting deeper and more meaningful

engagement with the material (Maroukakis et al., 2023). This technology holds particular promise for art and design education, where sensory experience and spatial perception are fundamental aspects of the learning process (Guerra-Tamez, 2023; Kerr & Lawson, 2020). Virtual reality (VR) technology has emerged as a powerful tool for enhancing cultural experiences by creating simulated three-dimensional environments. Within the field of cultural design, VR finds extensive application in museum exhibitions, historical artifact reproduction, and virtual tourism. This technology significantly enriches the format and content of cultural engagement (Berti, 2021).

VR's roots can be traced back to the 1960s with the invention of the Sensorama by Morton Heilig. This multi-sensory simulation device, considered a precursor to today's head-mounted displays (HMDs), aimed to provide users with realistic experiences (Farah et al., 2019). Modern VR technology builds upon advancements in various fields, including 3D imaging, multimedia, and digital simulation, to deliver immersive experiences that encompass visual, tactile, and sensory elements. Aligned with constructivist theory, which emphasizes learning as an active process of constructing knowledge based on existing understanding and experiences (Pande & Bharathi, 2020), VR environments provide an ideal platform for putting these principles into practice (Soliman et al., 2021). The immersive and interactive nature of VR allows art and design students to move beyond passive observation and actively engage with their learning, facilitating a more effective and personalized construction of knowledge (Guerra-Tamez, 2023). The term "visualization" predates its establishment as a scientific field and carries diverse meanings across various contexts (Hilal Korkut & Surer, 2022; Korkut & Surer, 2023). This inherent ambiguity is further amplified in immersive environments, where data can be presented in a multitude of ways, including 3D models, graphs, simulations, and various 2D representations. This flexibility positions immersive visualization at the intersection of numerous research areas, drawing from fields such as statistics, medicine, computer science, heritage studies, and more. Its scope encompasses both technological aspects (multisensory interfaces, interaction, navigation, collaboration, rendering techniques) and domain-specific knowledge relevant to the data being visualized. The limitations of traditional 2D visualizations have spurred the visualization community to explore more effective solutions. Recent advancements in virtual reality (VR) technology, along with contributions from interdisciplinary fields, have opened new avenues for application and implementation (Zhang et al., 2020). VR offers an immersive experience within an artificially generated environment. Over time, various VR setups and methods have been developed. The simplest configuration, Desktop VR, utilizes a standard monitor for display. Fish

Tank VR builds upon this by incorporating stereoscopic glasses for depth perception and relies on the keyboard for primary input. The Cave Automatic Virtual Environment (CAVE) takes a more elaborate approach, utilizing room-sized projection surfaces to create a fully immersive environment designed for exploration and interaction. This surround-screen technology allows users to perceive their surroundings seamlessly (Korkut & Surer, 2023). Modern immersive systems predominantly rely on Head-Mounted Displays (HMDs). These stereoscopic devices present two separate images to each eye, creating a sense of depth. Interaction techniques within VR environments vary depending on the underlying technology and can include head tracking, eye tracking, and motion tracking. HMDs, in particular, offer exciting possibilities for novel data exploration and interaction methods (Korkut & Surer, 2023).

Cultural heritage encompasses historical, scientific, and artistic artifacts and activities that hold immense value and represent a society's legacy. Unfortunately, various factors threaten the preservation of this heritage, leading to potential loss. Virtual reality (VR) technology has emerged as a vital tool in cultural heritage protection (Abokhoza & Sobieh, 2021). VR empowers conservators to conduct more precise and sustainable conservation practices by minimizing the need for direct manipulation of physical artifacts. Additionally, VR presentations offer a more engaging format for younger generations, fostering a deeper understanding of traditional cultures. In the field of education, VR serves as a valuable tool for creating vivid and intuitive learning experiences. It has found increasing application in the development of virtual simulation labs. Through VR programs, laboratory work can transcend physical limitations by providing students with their own virtual equipment, eliminating dependence on the availability of physical labs. This shift signifies the growing effectiveness of VR technology for research and learning purposes.

Notably, virtual reality technology, virtual simulation labs, augmented reality, and artificial intelligence have all seen significant advancements in Chinese education over the past decade (Abokhoza & Sobieh, 2021). Advancements in science and technology have propelled virtual reality (VR) technology to the forefront of innovation. VR offers users an immersive experience within a simulated environment, replicating sensory experiences of the real world. This technology has found widespread applications in entertainment, education, healthcare, and other fields (Walczak & White, 2003). VR's potential for safeguarding cultural heritage is particularly promising. Intangible cultural heritage embodies the crystallization of human wisdom and creativity. It encompasses elements like oral traditions, performing arts, social practices, ceremonies, and festivals (Skublewska-Paszkowska

et al., 2022). However, the very nature of intangible heritage presents unique challenges for its protection and transmission. Traditional methods, heavily reliant on field visits and oral inheritance, face limitations due to time, space, and human resource constraints (Hou et al., 2022). Additionally, the specific characteristics of intangible heritage can make on-site preservation impractical, leading to the gradual loss of these valuable cultural practices (Hou et al., 2022).

Virtual reality (VR) technology offers a novel approach to safeguarding and transmitting intangible cultural heritage. VR environments allow users to experience these traditions firsthand, fostering a deeper connection with real-world scenes and emotions (De Paolis et al., 2022). VR's ability to create limitless virtual spaces transcends temporal and spatial constraints, enabling users to personally engage with the charm of intangible cultural heritage. However, the application of VR technology in this domain remains relatively nascent (Walczak & White, 2003). Existing VR interfaces often present user experience challenges, including complex operation, limited interactivity, and a lack of realism (Sutcliffe et al., 2019). These shortcomings hinder users' ability to gain a deeper understanding and experience intangible heritage, potentially dampening their enthusiasm and participation in its preservation (Xu et al., 2022). Intangible cultural heritage encompasses the traditions, practices, and knowledge passed down through generations in the form of oral histories, performing arts, social customs, rituals, festivals, and specialized skills (Kuptsova & Sazonova, 2022). Unlike material cultural heritage, intangible heritage relies primarily on oral transmission and practical application for its continuation. It represents the crystallization of human creativity and wisdom, serving as a cornerstone of identity and cultural inheritance for specific communities (Underberg-Goode, 2016). Intangible cultural heritage holds significant meaning and value for human society. Firstly, it contributes to the rich tapestry of human cultural diversity, embodying the unique characteristics of various regions, nations, and communities (Arizpe, 2004). Secondly, it serves as a testament to human history and tradition.

By actively protecting and transmitting this heritage, we gain a deeper understanding and appreciation of our cultural roots. Furthermore, intangible cultural heritage is intricately linked to human emotions, memories, and identities, playing a vital role in fostering community cohesion and a sense of belonging (Ji et al., 2021). Despite its importance, intangible cultural heritage faces numerous challenges and threats. These include, but are not limited to, an aging population, disruptions in traditional inheritance practices, and environmental changes (Shen & Ghani, 2023). Recognizing these challenges underscores the critical role of

contemporary society in safeguarding and transmitting intangible cultural heritage for future generations.

- *Rationale and Main Objective*

The rapid evolution of virtual reality (VR) technology has opened exciting avenues for cultural exploration and engagement. However, a critical gap exists in understanding how interactive visual design elements within VR environments can be best harnessed to resonate with cultural philosophies. This study aims to investigate the interplay between interactive visual design and cultural philosophy within VR experiences. By examining this relationship, we seek to establish principles for designing VR experiences that are not only visually engaging but also culturally sensitive and meaningful.

2. METHODS

- *Study Design*

Our study adopted a mixed methods research design, strategically combining both quantitative and qualitative data collection methods to gain a well-rounded understanding of the interplay between interactive visual design and cultural philosophy in virtual reality environments. This approach involved employing surveys to gather user preferences for visual design elements in VR and their emotional responses to such experiences. Additionally, in-depth interviews and focus group discussions were conducted to explore participants' perceptions of the design, their cultural backgrounds, and how these factors influence their engagement with VR experiences.

- *Data Collection*

- *Survey*

The study employed a standardized 10-question survey administered to 13 participants to gather quantitative data on cultural background, design preferences, and emotional responses to VR experiences. The survey initially assessed participant demographics. Following this, Likert scale questions explored participants' cultural background, preferences for visual design elements in VR, and their emotional responses to VR experiences. Finally, all participants were debriefed and thanked for their valuable contribution.

- *Semi-Structured Interviews*

We conducted semi-structured interviews with participants following their experience in the VR environments designed with different cultural philosophies in mind. These interviews, lasting approximately 30 minutes each, employed open-ended questions to explore participants' perceptions of the design, their emotional responses, and how these elements connected to their cultural background. This approach aimed to gain a deeper understanding of the interplay between interactive visual design and cultural interpretation within VR experiences.

- *Focus Group Discussions*

We facilitated focus group discussions with 5 to 8 participants from diverse cultural backgrounds. These discussions aimed to gather insights into participants' expectations and preferences for VR experiences that resonate with their cultural philosophies. By fostering open dialogue among individuals with varied cultural perspectives, the focus groups provided valuable information about the desired characteristics of VR experiences that promote cultural sensitivity and meaningful engagement.

- *Data Analysis*

Quantitative data from the surveys, administered to 13 participants, was analyzed using GraphPad Prism statistical software version 9.5.1. This analysis focused on descriptive statistics including frequencies, percentages, means, and standard deviations to identify trends in cultural background, design preferences, and emotional responses to VR experiences. Qualitative data, gathered through interviews and focus groups, underwent thematic analysis. This involved coding the data to identify recurring themes and patterns related to participants' perceptions of the VR environment's design, their emotional responses, and how these elements connected to their cultural background.

3. RESULTS

The study consisted of a diverse group of 13 participants (100%) with ages ranging from 18-24 (4 participants, 30.8%) to 45+ (1 participant, 7.7%). The majority of participants identified as male (8 participants, 61.5%), with the remaining participants identifying as female (5 participants, 38.5%) (see Table 1).

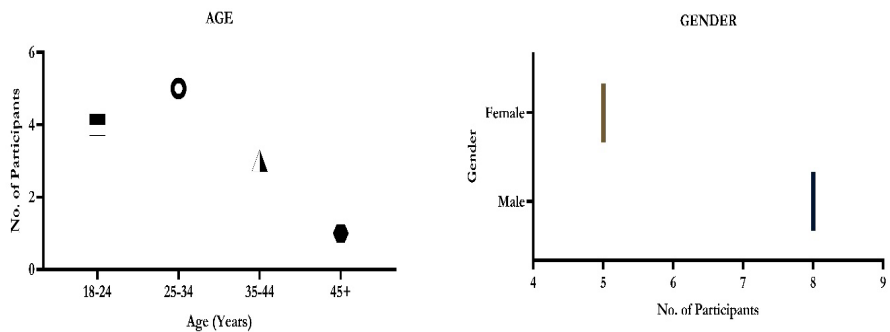


Figure 1: The Distribution of Participant Demographics based on Age Categories and Gender

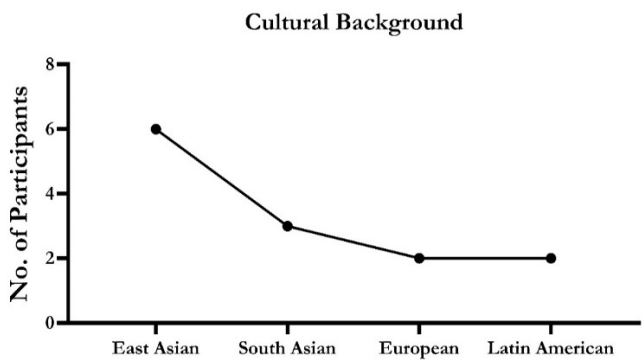


Figure 2: Line Chart Distribution of Participants based on Cultural Background

In Figure 2, A variety of cultural backgrounds were represented among the participants, with 46.2% (6 participants) identifying as East Asian, 23.1% (3 participants) as South Asian, 15.4% (2 participants) as European, and another 15.4% (2 participants) as Latin American.

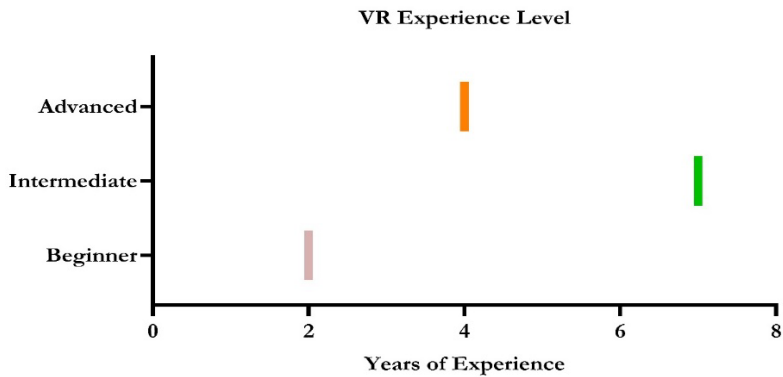


Figure 3: Analysis of Participants Years of Experience in the Utilisation of Virtual Reality in Cultural Designs.

In Figure 3, the participants possessed a range of VR experience levels: 15.4% (2 participants) were beginners, 53.8% (7 participants) were intermediate users, and 30.8% (4 participants) identified as advanced in their VR experience.

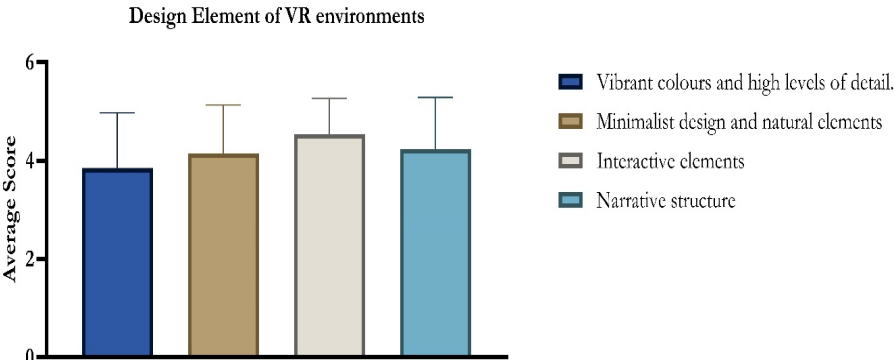


Figure 4: Design Preferences of VR environments

In Figure 4, the participants' preferences for design elements in VR environments leaned towards interactivity and clear narratives. Interactive elements received the highest mean score (4.54) with a standard deviation of 0.72, followed by narrative structure (4.23, SD = 1.05). While minimalist design with natural elements scored slightly higher (4.15, SD = 0.98) than vibrant colours and high levels of detail (3.85, SD = 1.12), both scored above average on the rating scale, suggesting a general appreciation for a variety of aesthetics in VR environments.

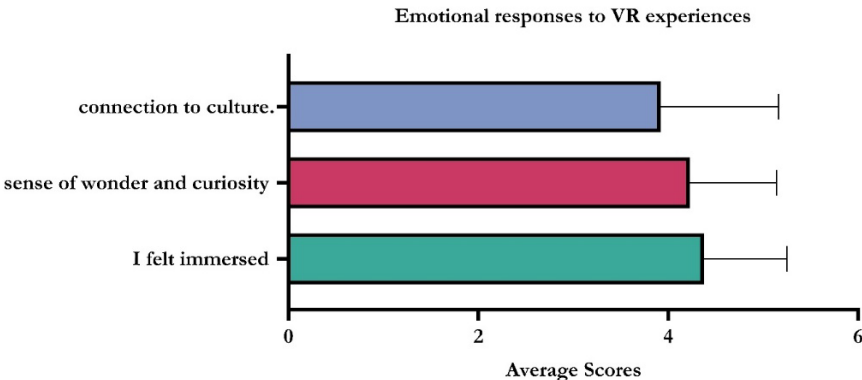


Figure 5: Emotional Responses to the VR environment

In Figure 5, the VR experience elicited positive emotional responses from participants. The feeling of immersion received the highest mean score (4.38, SD = 0.87), followed closely by a sense of wonder and curiosity (4.23, SD = 0.91). The mean score for feeling a connection to the culture was lower (3.92, SD = 1.24), but still indicated a positive response overall.

Table 1: Thematic Analysis of VR Design and Cultural Resonance

Theme	Explanation (Aligned with Chinese Cultural Philosophy)	Quote
Familiarity with Cultural Elements	The concept of "Li" (礼) in Confucianism emphasizes proper social conduct and respect for tradition. Familiarity with cultural elements in the VR environment evokes a sense of "Li" by reinforcing established visual cues and practices associated with a particular culture.	"The inclusion of traditional [cultural symbol] in the VR experience felt very welcoming. It reminded me of [cultural significance]." (East Asian participant)
Importance of Storytelling Through Design	Daoism emphasizes the concept of "Wu Wei" (无为) or effortless action. In VR design, storytelling through design elements embodies "Wu Wei" by subtly guiding users through the experience without explicit instructions.	"The way the VR environment transitioned from a bustling marketplace to a serene temple through color and sound design was beautiful. It felt like a story unfolding." (South Asian participant)
Impact of Interactive Design	Confucianism emphasizes the importance of "Ren" (仁) or benevolence. Interactive design elements that resonate with cultural practices promote "Ren" by fostering a sense of participation and connection to the presented culture.	"Being able to virtually participate in the [cultural activity] within the VR environment felt very meaningful. It was a unique way to learn about the culture." (Latin American participant)

In Table 1, the VR environment's design elements significantly influenced participants' experiences. Familiarity with cultural elements resonated with Confucian "Li" (礼), emphasizing respect for tradition. Storytelling through design embodied Daoist "Wu Wei" (无为) by subtly guiding users. Finally, interactive design elements aligned with Confucian "Ren" (仁) by fostering connection to the presented culture.

Table 2: Thematic Analysis of VR Emotional Responses and Cultural Connection

Theme	Explanation (Aligned with Chinese Cultural Philosophy)	Quote
Eliciting Positive Emotions	Confucianism emphasizes the importance of "Yi" (义) or righteousness. Positive emotions evoked by the VR experience can foster "Yi" by creating a sense of respect and appreciation for the presented culture.	"The VR experience made me feel a sense of awe exploring the ancient ruins. It sparked a real interest in learning more about [culture]." (European participant)
Evoking Feelings of Nostalgia	The concept of "Xiao" (孝) in Confucianism emphasizes filial piety and respect for one's ancestors. Nostalgia triggered by the VR experience can connect to "Xiao" by reminding participants of their cultural heritage and traditions.	"The sights and sounds of the VR marketplace transported me back to my childhood visits to similar markets in my home country. It was a very emotional experience." (East Asian participant)
Encouraging Empathy and Understanding	Confucianism emphasizes the importance of "Shu" (恕) or reciprocity, treating others as you wish to be treated. The VR experience fostering empathy aligns with "Shu" by encouraging users to see the world through the lens of another culture.	"Stepping into the shoes of someone from a different culture through VR helped me appreciate their way of life in a way that documentaries or books couldn't." (South Asian participant)

In Table 2, the VR experience evoked positive emotions that aligned with Confucian "Yi" (义), fostering respect for the presented culture. Nostalgia triggered by the experience connected to "Xiao" (孝), reminding participants of their heritage. Empathy encouraged by the VR environment resonated with "Shu" (恕), promoting understanding of other cultures.

Table 3: Thematic Analysis of VR Design and Emotional Response

Theme	Explanation (Aligned with Chinese Cultural Philosophy)	Quote
Immersion Through Design	Daoism emphasizes the concept of "Ziran" (自然) or naturalness. A high level of detail in the VR environment aligns with "Ziran" by creating a realistic and immersive experience that feels harmonious and natural.	"The level of detail in the VR environment, from the textures to the lighting, truly made me feel like I was transported to another place." (Latin American participant)
Design Influencing Emotional Response	Confucianism emphasizes the importance of "He" (和) or harmony. Design elements that influence emotional response align with "He" by creating a balanced and aesthetically pleasing experience within the VR environment.	"The calming music and natural landscapes in the VR experience created a sense of peacefulness that I found very relaxing." (European participant)
Dissonance Between Design and Expectation	Confucianism emphasizes the importance of "Li" (礼) or proper social conduct and respect for tradition. A mismatch between design and cultural expectations creates a dissonance with "Li" by potentially misrepresenting or disrespecting cultural practices.	"The portrayal of the [cultural practice] in the VR experience felt somewhat stereotypical, which lessened the impact for me." (East Asian participant)

In Table 3, VR design elements influenced emotional responses and cultural connection. High detail aligned with Daoist "Ziran" (自然) for a natural, immersive experience. Design elements influencing emotions mirrored Confucian "He" (和) by creating a balanced and aesthetically pleasing VR environment. However, a mismatch between design and cultural expectations created dissonance with "Li" (礼), potentially disrespecting traditions.

Table 4(a): Thematic Analysis of Expectations for Cultural Representation

Theme	Explanation (Aligned with Chinese Cultural Philosophy)	Quote
Importance of Authenticity	Confucianism emphasizes the importance of "Zhong" (忠) or loyalty. Participants' desire for authenticity aligns with "Zhong" by seeking a truthful representation of cultural practices, reflecting respect for the presented culture.	"I would expect the VR experience to accurately portray the cultural practices, not just show stereotypical images." (South Asian participant)
Desire for Interactive Learning	Daoism emphasizes the concept of "Xuexi" (学习) or learning. Participants' desire for interactive learning aligns with "Xuexi" by seeking an experience that goes beyond passive observation and encourages active engagement with the cultural content.	"It would be great if the VR experience allowed us to participate in cultural activities, not just watch them happen." (East Asian participant)

Table 4(b): Thematic Analysis of Expectations for Cultural Representation

Theme	Explanation (Aligned with Chinese Cultural Philosophy)	Quote
Respectful Depictions of Religious Practices	Confucianism emphasizes the importance of "Xiao" (孝) or filial piety, which extends to respect for traditions and elders. This aligns with participants' desire for respectful depictions of religious practices, honoring the cultural heritage and beliefs associated with them.	"VR experiences should portray religious practices accurately and avoid anything that could be perceived as offensive." (Latin American participant)

In Table 4, discussions highlighted the importance of cultural respect. Participants' desire for authenticity in VR experiences mirrored Confucian "Zhong" (忠), emphasizing loyalty to truthful representations. Their preference for interactive learning embodied Daoist "Xuexi" (学习), seeking active engagement with the culture. Finally, the emphasis on respectful portrayals of religious practices resonated with Confucian "Xiao" (孝), honoring traditions and beliefs.

Table 5: Thematic Analysis of Preferences for VR Design Elements

Theme	Explanation (Aligned with Chinese Cultural Philosophy)	Quote
Incorporating Symbolic Elements	Confucianism emphasizes the importance of "Li" (礼) or proper social conduct and respect for tradition. Integrating symbolic elements aligns with "Li" by acknowledging the significance of symbols within a culture and using them appropriately within the VR environment.	"I would be more engaged with a VR experience that uses symbols and imagery that have meaning in my culture." (East Asian participant)
Balance Between Immersion and Education	Confucianism emphasizes the importance of "Junzi" (君子) or the cultivated person, who seeks knowledge alongside experience. This theme reflects a balance between "Junzi" ideals – the immersive experience and the opportunity to learn about the culture.	"The VR experience shouldn't be so immersive that it forgets to educate us about the culture it portrays." (European participant)
Design Tailored to Different Cultural Backgrounds	Confucianism emphasizes the importance of "Ren" (仁) or benevolence. Tailoring VR experiences to different backgrounds aligns with "Ren" by acknowledging cultural diversity and striving to create a respectful and inclusive experience for users from various cultures.	"It might be beneficial to have different versions of the VR experience catering to specific cultural contexts." (South Asian participant)

In Table 5, discussions revealed preferences for VR design that respects cultural nuances. Incorporating symbolic elements aligned with Confucian "Li" (礼), acknowledging their significance within a culture. The desire for balanced immersion and education mirrored the "Junzi" (君子) ideal, seeking both experience and cultural knowledge. Finally, tailoring VR experiences to diverse backgrounds resonated with Confucian "Ren" (仁), emphasizing benevolence and inclusivity.

4. DISCUSSION

Our findings revealed a significant alignment with Chinese cultural philosophies. Participants emphasized the importance of "Li" (礼) or respect for tradition, evident in their desire for VR experiences to accurately portray cultural elements and avoid stereotypes. "Wu Wei" (无为) from Daoism resonated with the concept of storytelling through design, subtly guiding users without overwhelming instructions. Interactive design elements that aligned with cultural practices fostered a sense of "Ren" (仁) or benevolence, promoting connection with the presented culture. Focus group discussions highlighted the significance of "Zhong" (忠) or loyalty, as participants expressed a desire for authenticity in VR representations. Their preference for interactive learning mirrored "Xuexi" (学习) from Daoism, seeking active engagement with cultural content. Additionally, respectful portrayals of religious practices resonated with "Xiao" (孝) or filial piety, honoring cultural traditions and beliefs.

Virtual reality (VR) technology is revolutionizing the cultural landscape by offering unique experiences that combine immersion and interactivity (Bekele & Champion, 2019). VR's immersive nature transcends traditional museum design, which relies on lighting, exhibits, furnishings, and other external elements to create a sense of place. VR goes beyond mere cognitive processing, instead providing visitors with a realistic sensory experience that fosters deep engagement with the exhibit's content. Within a virtual museum environment, visitors can don head-mounted displays (HMDs) or utilize other interactive devices to explore various exhibition halls and examine valuable artifacts and relics firsthand. This immersive visual space transforms viewers from passive spectators into active protagonists, fostering a completely new and engaging exhibition experience. Several museums have embraced VR technology to enhance their offerings. For instance, the Guggenheim Museum in New York collaborated with the Google Cultural Institute to create a virtual tour accessible through computers or VR viewers (Udell, 2019). This collaboration exemplifies how VR innovations, such as interactive displays, holographic projections, and virtual interpretations, can significantly enrich museum exhibition design. Similarly, the Palace Museum leveraged VR to provide a 360-degree panoramic view of its buildings, accompanied by an online audio guide and video introductions to key artifacts. The tourism industry in China has also embraced VR to enhance tourist attractions and cultural heritage protection. Virtual tourism systems allow individuals to explore breathtaking landscapes, transcending geographical and temporal constraints. This technology offers a novel approach to

showcasing cultural heritage sites. For instance, in 2016, China Eastern Airlines provided passengers with VR headsets to experience virtual tourism products (Zhong et al., 2021). Likewise, the digital technology employed at Yuanmingyuan empowers tourists to grasp the historical background of the scenic spot efficiently, saving valuable time. VR technology can even recreate vanished human civilizations, as exemplified by simulations of the Afang Palace. This allows tourists to gain a more intuitive understanding of these historical structures, moving beyond reliance on solely imaginative reconstructions. The rapid development of new media significantly accelerates globalization. VR technology, as a powerful platform for global cultural exchange, presents exciting creative opportunities for media (Zhong et al., 2021).

Virtual social and collaborative tools enable people to share cultural experiences, showcase art in virtual environments, and foster deeper understanding between cultures. Virtual reality (VR) technology, with its burgeoning capabilities as an interactive interface, offers exciting possibilities for safeguarding and transmitting intangible cultural heritage (Wu, 2023). VR environments enable users to experience intangible heritage in an immersive manner, fostering a deeper appreciation for its unique charm and value. VR technology can realistically simulate the sights, sounds, music, and dance elements that constitute intangible heritage, allowing users to virtually participate and gain a heightened understanding and sense of connection to these traditions. Furthermore, VR presents solutions to some of the intricate challenges faced by intangible cultural heritage protection, such as disruptions in traditional inheritance practices and environmental changes (Xu et al., 2022). By leveraging VR, intangible heritage can be preserved and transmitted in a digital format, mitigating the risks of physical loss and the difficulties associated with traditional inheritance methods. VR technology can also recreate the original environments where these traditions were practiced, allowing users to virtually experience the authentic cultural context within the virtual space. This immersive experience fosters a deeper understanding and appreciation for intangible heritage, ultimately contributing to its preservation and transmission. Virtual Reality (VR) technology is a computer-generated simulation environment that enables users to interact with and experience immersive experiences in a virtual world. The core of virtual reality technology is to completely immerse users in a virtual environment through head-mounted displays, gamepads, sensors and other devices to make them feel as if they are in the scene. The application of virtual reality technology in intangible cultural heritage protection has great potential (Shen, 2021). Firstly, VR technology can provide a highly realistic environment that enables users to personally experience the unique charm of intangible cultural heritage (Fu et al.,

2023). Through virtual reality technology, users can visit traditional villages, watch traditional performances, and learn traditional crafts in a virtual environment without going to the site (Yapp & Kim, 2022). This immersive experience can greatly improve users' understanding and appreciation of intangible cultural heritage. Secondly, virtual reality technology can realize the digital preservation and inheritance of intangible cultural heritage. Many intangible cultural heritages face the erosion of time and the loss of human resources. Virtual reality technology can preserve these intangible cultural heritages through digital means, and make more people understand and learn through the display and dissemination of virtual environment (Walczak & White, 2003). For example, through virtual reality technology, traditional folk stories, traditional music, traditional dance, etc. can be preserved in digital form, and more people can enjoy and learn through the display of virtual environments. In addition, VR technology can also provide interactive learning and interactive experience. Traditional intangible cultural heritage protection can only be displayed by static ways such as words and pictures, while virtual reality technology can enable users to participate in it personally and interact with the characters in the virtual environment through interactive ways (Feng, 2023). This interactive learning and experience can better stimulate users' interest and participation and enhance users' awareness and participation in the protection of intangible cultural heritage (Shen, 2021). To sum up, the application of VR technology in intangible cultural heritage protection has a broad prospect. By providing immersive experience, digital preservation and inheritance, as well as interactive learning and interactive experience, virtual reality technology can greatly improve the user experience of intangible cultural heritage protection and promote the inheritance and development of intangible cultural heritage.

5. CONCLUSION

Overall, the study suggests that VR experiences designed with cultural sensitivity and respect can foster deeper engagement and emotional connection with the presented cultures. By incorporating elements that resonate with users' cultural backgrounds and philosophies, VR technology has the potential to serve as a powerful tool for intercultural understanding and learning. Intangible cultural heritage, as a cornerstone of human cultural diversity, holds immense significance and value. The integration of VR technology offers innovative approaches and possibilities for safeguarding and transmitting this heritage. VR environments provide users with immersive experiences, significantly enhancing the user experience of intangible cultural heritage protection.

REFERENCES

- Abokhoza, R. R., & Sobieh, Y. M. (2021). The role of virtual reality to enhance cultural communication. *International Journal of Web Portals (IJWP)*, 13(2), 20-35.
- Arizpe, L. (2004). Intangible cultural heritage, diversity and coherence. *Museum international*, 56(1-2), 130-136.
- Bekele, M. K., & Champion, E. (2019). A comparison of immersive realities and interaction methods: Cultural learning in virtual heritage. *Frontiers in Robotics and AI*, 6, 91.
- Berti, M. (2021). The unexplored potential of virtual reality for cultural learning. *The EuroCALL Review*, 29(1), 60-67.
- De Paolis, L. T., Chiarello, S., Gatto, C., Liaci, S., & De Luca, V. (2022). Virtual reality for the enhancement of cultural tangible and intangible heritage: The case study of the Castle of Corsano. *Digital Applications in Archaeology and Cultural Heritage*, 27, e00238.
- Farah, M. F., Ramadan, Z. B., & Harb, D. H. (2019). The examination of virtual reality at the intersection of consumer experience, shopping journey and physical retailing. *Journal of Retailing and Consumer Services*, 48, 136-143.
- Feng, F. (2023). Research on the Protection System of Tangka Intangible Cultural Heritage Based on VR Technology. *Academic Journal of Science and Technology*, 7(2), 178-182.
- Fu, K., Sharudin, S. A., Wang, Y., & Huang, Z. (2023). Virtual Reality in Ancient Village Cultural Heritage Protection: Zhen Shan Village Case Study. *Journal of Sociology and Ethnology*, 5(9), 22-26.
- Guerra-Tamez, C. R. (2023). The impact of immersion through virtual reality in the learning experiences of art and design students: The mediating effect of the flow experience. *Education Sciences*, 13(2), 185.
- Hilal Korkut, E., & Surer, E. (2022). Visualization in virtual reality: a systematic review. *arXiv e-prints*, arXiv: 2203.07616.
- Hou, Y., Kenderdine, S., Picca, D., Egloff, M., & Adamou, A. (2022). Digitizing intangible cultural heritage embodied: State of the art. *Journal on Computing and Cultural Heritage (JOCCH)*, 15(3), 1-20.
- Ji, Y., Zhong, S., Zhang, B., & Sean, C. (2021). Constructing embodied interaction of intangible cultural heritage course through immersive virtual reality. In *Proceedings of the Ninth International Symposium of Chinese CHI* (pp. 133-138).

- Kerr, J., & Lawson, G. (2020). Augmented reality in design education: Landscape architecture studies as AR experience. *International Journal of Art & Design Education*, 39(1), 6-21.
- Korkut, E. H., & Surer, E. (2023). Visualization in virtual reality: a systematic review. *Virtual Reality*, 27(2), 1447-1480.
- Kuptsova, I., & Sazonova, V. (2022). Intangible Cul-tural Heritage: Conceptual Approaches to the Phenom-enon Definition, Observatory of Culture, 2022, vol. 19, no. 1. *Обсерватория культуры 2022. Т. 19, № 19(1)*, 63.
- Maroungkas, A., Troussas, C., Krouska, A., & Sgouropoulou, C. (2023). Virtual reality in education: a review of learning theories, approaches and methodologies for the last decade. *Electronics*, 12(13), 2832.
- Pande, M., & Bharathi, S. V. (2020). Theoretical foundations of design thinking—A constructivism learning approach to design thinking. *Thinking Skills and Creativity*, 36, 100637.
- Shen, S., & Ghani, D. A. (2023). Design a Virtual Reality Interface to Enhance the User Experience of Intangible Cultural Heritage Protection. *Global Journal of Emerging Science, Engineering & Technology*, 1(1), 37-47.
- Shen, Y. (2021). Study on the Protection and Product Development of Intangible Cultural Heritage with Computer Virtual Reality Technology. In *Data Science: 7th International Conference of Pioneering Computer Scientists, Engineers and Educators, ICPCSEE 2021, Taiyuan, China, September 17–20, 2021, Proceedings, Part I 7* (pp. 515-527). Springer.
- Skublewska-Paszkowska, M., Milosz, M., Powroznik, P., & Lukasik, E. (2022). 3D technologies for intangible cultural heritage preservation—literature review for selected databases. *Heritage Science*, 10(1), 3.
- Sutcliffe, A. G., Poullis, C., Gregoriades, A., Katsouri, I., Tzanavari, A., & Herakleous, K. (2019). Reflecting on the design process for virtual reality applications. *International Journal of Human–Computer Interaction*, 35(2), 168-179.
- Udell, M. K. (2019). The museum of the infinite scroll: assessing the effectiveness of google arts and culture as a virtual tool for museum accessibility.
- Underberg-Goode, N. M. (2016). Conveying Peruvian intangible heritage through digital environments. In *The Routledge Companion to Intangible Cultural Heritage* (pp. 442-452). Routledge.
- Walczak, K., & White, M. (2003). Cultural heritage applications of virtual reality. In *Proceedings of the eighth international conference on 3D Web technology* (pp. 182-183).

- Wu, X. (2023). Application of Virtual Reality Technology in the Digital Inheritance of Intangible Cultural Heritage. In *2023 International Conference on Distributed Computing and Electrical Circuits and Electronics (ICDCECE)* (pp. 1-6). IEEE.
- Xu, W., Sun, X., & Pan, S. (2022). Visual dissemination of intangible cultural heritage information based on 3D scanning and virtual reality technology. *Scanning*, 2022.
- Yapp, A., & Kim, L. C. (2022). The Development of an Immersive Malay Village Virtual Reality Experience. *Asian Journal of Arts, Culture and Tourism*, 4(1), 42-51.
- Zhang, Y., Liu, H., Kang, S.-C., & Al-Hussein, M. (2020). Virtual reality applications for the built environment: Research trends and opportunities. *Automation in Construction*, 118, 103311.
- Zhong, H., Wang, L., & Zhang, H. (2021). The application of virtual reality technology in the digital preservation of cultural heritage. *Computer Science and Information Systems*, 18(2), 535-551.