Development of Interactive 360 Degree for Enhanced Visitor Experience in Luoyang Museum

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Abstract

This study aimed to 1) develop interactive 360 degrees for enhanced visitor experience in Luoyang Museum; 2) compare visitor perceptions before and after using the interactive 360-degree media in the Luoyang Museum; and 3) evaluate the satisfaction of visitors towards interactive 360 degrees in Luoyang Museum. It was quantitative research. The sample consisted of 400 individuals who provided information before the 360-degree interactions were developed and another 400 who used the interactive media after they were completed. The sample size was determined according to Taro Yamane's formula, and the sample was selected by a simple random sampling method. Data were collected online using the following tools: 1) an evaluation of 360-degree interaction quality; 2) a pre- and post-interaction perception assessment; and 3) a visitor satisfaction evaluation of the 360-degree interaction. Data analysis employed descriptive statistics, including frequency, percentage, mean, standard deviation, and the paired samples t-test.

The research findings revealed that: 1) the development process of the interactive 360-degree exhibit involved three suitable stages, and the interactive media demonstrated high quality; 2) there was a statistically significant difference in visitor perceptions before and after using the interactive 360-degree media at the Luoyang Museum at the 0.05 level; and 3) visitors were highly satisfied with the 360-degree interactive exhibits at the Luoyang Museum. The implementation of interactive technology in museums significantly enhanced the visitor experience and educational outcomes.

Keywords: interactive 360-degree technology; museum visitor experience; cultural heritage digitization; virtual museum exhibitions; Luoyang Museum

Introduction

Located in Luoyang City, Henan Province, the Luoyang Museum is a modern museum with a long history (Lei, 2017). The new museum was built in 1958 and opened to the public in 2011, covering an area of about 100,000 square meters and a building area of about 62,000 square meters (Li et al., 2019). In addition to exhibitions, the new museum also has facilities such as a lecture theatre, an educational experience area, and a library, and carries out cultural exchanges and academic research cooperation at home and abroad (Cinnamon & Jahiu, 2023). Indeed technological advances have transformed the way museums present their collections, with innovative modern technologies such as Augmented Reality (AR) and Virtual Reality (VR) increasingly being incorporated into exhibitions to increase visitor engagement (Argyriou et al.) According to a report by the International Council of Museums (ICOM, 2020), the use of interactive technologies in museums has increased significantly, thereby increasing on-site visitor engagement and learning (Fan et al., 2022). Despite the Luoyang Museum being a prestigious venue, visitor interaction and retention rates are still not as high as they could be, and the introduction of 360-degree interactive exhibits offers an encouraging way to address these challenges by providing more engaging and educational immersive experiences (Hwang et al., 2023). Through innovation, the Loyang Museum can bridge the gap between traditional exhibition styles and the modern needs of different target markets.

Over the past decade, there have been numerous studies exploring the use of virtual reality and AR in academic and cultural fields. For example, Liao's (2023) study demonstrated how immersive learning with modern technologies can significantly improve interaction and discovery outcomes in online education and learning, while Wu (2022) identified the use of VR in museum artifact screens, highlighting its potential to merge the traditional with the modern. In addition, research by Man and Gao (2022) highlights the effectiveness of electronic immersive experiences in enhancing visitors' understanding of social heritage. Despite these technologies, there are still significant gaps in the existing literature, particularly in terms of how interactive 360-degree media affects the understanding and awareness of website visitors in the gallery environment (Shin, 2023). Existing research has focused on fixing virtual reality applications and has under-explored the vibrant interactive capabilities of 360-degree displays (Wuebben et al., 2023).

Furthermore, while research confirms the benefits of multimedia in teaching and learning, little is known about how the technology affects website visitors' satisfaction and long-term engagement with their social heritage (Sirikulpipat & Nadprasert, 2020). Previous research has tended to focus on the visitor's momentary experience, leaving questions such as repeat engagement and cognitive retention unanswered (Pisani et al., 2023) This gap suggests the need for more research on how 360-degree interactive screens can enhance visitors' immediate and lasting satisfaction, especially in a historically and socially significant museum pavilion setting such as Luoyang.

The goal of this study was to create and implement a 360-degree interactive exhibit configuration at the Luoyang Museum and analyze its impact on site visitors' preconceptions, communication and satisfaction (Jia et al., 2023). The anticipated benefits of this study include facilitating visitor communication, deepening social understanding, and improving teaching and learning through the use of immersive and innovative modern technology. The insights gained from this study will not only benefit the Luoyang Museum but will also provide important recommendations for other museums to help them modernize their displays and meet the needs of a more interactive and engaged audience. The insights gained from this study will not only benefit the Luoyang Museum but will also provide important recommendations for other museums to help them modernize their displays and meet the needs of a more interactive and engaged audience.

Research objectives

1. To develop interactive 360 degrees for enhanced visitor experience in Luoyang Museum
2. To compare visitor perceptions before and after using the interactive 360-degree media in the Luoyang Museum.
3. To evaluate the satisfaction of visitors towards interactive 360 degrees in Luoyang Museum.

Scope of Research

1. Population and Samples

1.1 Population: The sample comprised all visitors to the Luoyang Museum, including both residents and tourists. This diverse group represented individuals of various ages, cultural

backgrounds, educational levels, and interests in Luoyang's history, art, and cultural heritage. The museum typically welcomes approximately 20,000 visitors each month. Data for this study were collected through a survey conducted in January 2024.

1.2 Sample: To ensure the findings were representative of the visitor population, the researchers selected a random sample from the approximately 20,000 visitors to the Luoyang Museum each day. Using a 95% confidence level and a 5% margin of error, Taro Yamane's formula was used to calculate the required sample size and select the sample by simple random sampling. Based on these parameters, a sample size of approximately 392 participants was deemed adequate for this study (Yamane, 1967). To mitigate the effects of potential data loss or incomplete responses, the researchers decided to increase the sample size to 400 participants.

2. Research variables

2.1 Independent variables: Interactive 360 Degree for Enhanced Visitor Experience in Luoyang Museum

2.2 Dependent Variables:

1) The quality of interactive 360–degree media to enhance the visitor experience in the Luoyang Museum

2) The result compares visitor perceptions before and after using the interactive 360–degree media in the Luoyang Museum.

3) The result evaluation of the satisfaction of visitors towards interactive 360 degrees in Luoyang Museum

3. Geographical Scope: The study focuses on the interactive environments and exhibits in Luoyang museums, located in Luoyang City, Henan Province, China.

4. Content in Interactive 360–degree Scope: This research uses 10 accessible antiques presented in 360–degree interactive research: 1) Multi–Faced Buddha Head (Qing Dynasty), 2) Dragon and Phoenix Double–Storey Attic Incense Burner (Tang), 3) Guanyin (Qing Dynasty), 4) Western Zhou Beast–face Pattern Square Tripod (Western Zhou), 5) Bronze Sword (Spring and Autumn and Warring States), 6) Dragon and Phoenix Wood Carving (Ming Dynasty), 7) Shuang'er Colorful Glazed Earthenware Vase (Qing Dynasty), 8) Pottery Cup (Han Dynasty), 9) Ceramic Horse (Tang), and 10) Blue and White Porcelain Bottle

5. Interactive Elements Scope: The study involves implementing 360–degree interactive technology, including videos, virtual and augmented reality, and digital media to create immersive experiences. The interactive design process covers planning, 3D content production of the ten antiques, and integrating features like basic information, movable 3D images, and background music to enhance learning and engagement.

6. Media development time: Developing interactive 360 degrees for enhanced visitor experience in Luoyang Museum takes approximately 1 year.

Literature Reviews

1. Related Theory

The objective of this study is to discover the effect of 360–degree interactive exhibits in Luoyang Museum on site visitors' experience; for that reason, this area will certainly assess relevant literary works on immersive understanding, virtual reality technology, and advancement in museum screen art.

1.1 Immersive Knowing and Virtual Reality Technology

Over the last few years, with the advancement of innovation, Virtual Reality (VIRTUAL REALITY) and Augmented Fact (AR) innovations have been widely made use of in the field of education and learning and cultural displays. By evaluating the impact of immersive virtual reality factors on the outcomes of online knowing, Liao's (2023) research study demonstrated that these technologies can dramatically enhance the individual's sense of engagement and discovery outcomes (Liao, 2023) These technologies transform typical easy discovering right into interactive learning by producing immersive experiences that enable customers to actively participate in the knowledge expedition process. The concept of immersive learning has been thoroughly researched in the field of pedagogy, particularly in cultural heritage conservation units such as galleries, where its application isexcellent possible (Yang, 2023)

1.2 Style and execution of 360–degree interactive exhibitions

Event design in museums is progressively inclined to make use of multimedia modern technologies to enhance site visitors' experience. Wu (2022) emphasized the application of virtual reality modern technology in social heritage displays as an essential means to combine practice with modernity (Wu, 2022). 360–level interactive exhibits provide abundant visual and auditory

experiences that can offer visitors a thorough understanding of the historical and social context behind the exhibits. The successful implementation of this exhibition layout counts on well–designed interfaces and material combination to ensure that users can conveniently run and acquire complete satisfaction (Man & Gao, 2022)

1.3 Technology in Museum Present Art

This study investigates the behavioral intentions of museum visitors towards Virtual Reality (VR) technology, spanning the years 2010–2023. It evaluates literature quality, explores research theories, and identifies trends. Findings indicate that most museum visitors hold positive attitudes towards VR, necessitating further research on generational perspectives. Quantitative research methods dominate (77.8%), with 38.9% employing the Technology Acceptance Model (TAM) or its extensions. Key influencing factors include perceived usefulness, information quality, perceived ease of use, and psychological cognition. The study underscores the importance of comprehending generational differences among museum visitors and advocates for adopting comprehensive theoretical models in future research within the museum domain. This research contributes to understanding how museum visitors engage with VR technology, emphasizing nuanced approaches considering generational variations and recommending more inclusive theoretical frameworks (Li & Mohd, 2024) This remains in line with the goal of this research study, which is to boost the visitor's exhibition experience and to advertise advancement in gallery display art through the style and development of interactive 360–degree exhibit settings (Pisani et al., 2023)

In summary, existing literary works recommend that immersive discovering and virtual reality innovations use considerable benefits in enhancing gallery site visitor experience and understanding. With the advancement of technology, galleries can even boost the educational and interactive nature of the display screen material by integrating these technical means to fulfill the needs of different target markets and promote the dissemination and protection of cultural heritage.

2. Related Research

To expand the research study on 360–degree interactive events in Luoyang Gallery, the adhering to a couple of vital studies related to the subject, which have checked out the most up–to–date developments and applications in the fields of virtual reality, immersive discovering, and the art of gallery display screens, respectively:

Application of Virtual Reality in Gallery Displays: Wu (2022) researched the application of electronic virtual reality modern technology in museum social heritage events, keeping in mind that virtual reality innovation can enhance the interactivity and immersion of exhibitions, making it possible for site visitors to experience and comprehend the historic and cultural context behind the exhibitions in higher depth. The research emphasized the relevance of multi–user real–time communication and closeness to improve the gallery experience.

Efficiency of Immersive Learning: Liao's (2023) research study assessed the influence of immersive virtual reality innovation on online knowing results. The results showed that immersive virtual reality can considerably boost online discovery results by raising learners' focus, psychological interaction, and satisfaction. This research supplies a brand–new point of view for recognizing the application of virtual reality innovation in education.

Technology in Gallery Present Art: Li and Mohd (2024) checked out the use of virtual reality modern technology in the manufacturing process of gallery exhibition programs and found that this innovation not only boosts the immersion of exhibits but also improves design interaction and cultural circulation. This research gives a useful understanding right into the future development of gallery display screen art.

An Educational Structure for Immersive Knowing: Yang (2023) suggested a structure for developing academic atmospheres for immersive knowing based upon virtual reality and increased reality, intending to boost understanding by enhancing aesthetic design, multidimensional spatial setup, and image quality. The structure gives methodical design concepts for immersive knowing in educational atmospheres.

Influence of Virtual Reality on Social Heritage Presentation: Pisani et al. (2023) checked out making use of virtual reality in interpreting Pictish sculptures and found that individuals were extra going to check out the knowing web content in–depth in this method, showing higher inspiration and engagement. This research study demonstrates the fantastic capacity of virtual reality modern technology in social heritage presentations.

Research Methodology

1. Research methodology

Quantitative methodology was used in this study. A questionnaire was used to compare visitors' responses before and after experiencing the 360-degree exhibits. This is to understand how interactive media affects the museum experience.

2. Population and Sample

2.1 Study Population: The research population of this study is all visitors to the Luoyang Museum, including tourists and local residents. These visitors come from a variety of populations, including different age groups, educational backgrounds, and occupations.

2.2 Sample size and sampling method: A simple random sampling method was used in this study, and the sample size was calculated using Taro Yamane's formula with 95% confidence level and a 5% margin of error. This method gives each visitor an equal chance of being selected, thus minimizing bias.

3. Research tools

3.1 The evaluation form of the quality of interactive 360-degree media to enhance the visitor experience in the Luoyang Museum

3.2 The evaluation form of the result compares visitor perceptions before and after using the interactive 360-degree media in the Luoyang Museum.

3.3 The form of the evaluation of the satisfaction of visitors towards interactive 360 degrees in Luoyang Museum

4. The evaluation of research instrument quality

The content validity was examined by assessing whether the questions in the evaluation forms for quality, perceptions, and satisfaction covered the intended content to be measured. Subsequently, the alignment between the measured content and the intended objectives was verified. Five experts considering the questions and provided scores, which were then used to calculate the Index of Item-Objective Congruence (IOC). The content validity indices revealed a score of 0.90 for the quality evaluation, 0.86 for the perception evaluation, and 0.88 for the satisfaction evaluation.

5. Data collection

5.1 The researcher presented the fully developed 360–degree interactive media to five experts for evaluation of its quality. The experts were assessing the media's effectiveness in enhancing the visitor experience at the Luoyang Museum.

5.2 The researcher distributed the 360–degree interactive media to 400 viewers for evaluation of their perceptions before and after using the media in the Luoyang Museum. The data was collected online through the social media platform WeChat, focusing on an online audience.

5.3 After the 400 viewers had evaluated their perceptions, they also assessied their satisfaction with the 360–degree interactive media in the Luoyang Museum. This evaluation was conducted online through the WeChat platform as well.

6. Data Analysis

6.1 The quality of the 360–degree interactive media was evaluated by five experts. The researcher was analyzed the data using descriptive statistics, specifically calculating the mean and standard deviation.

6.2 The perceptions and satisfaction of 400 visitors regarding the 360–degree interactive media, aimed at enhancing the visitor experience at the Luoyang Museum, were analyzed using descriptive statistics to calculate the mean and standard deviation.

6.3 A comparison of the perceptions of 400 visitors before and after using the 360–degree interactive media to enhance the visitor experience at the Luoyang Museum was conducted. The researcher was performing an inferential statistical analysis, applying a paired samples t–test, which revealed significant improvements in their experience. The significance level for all tests was set at $p < 0.05$.

Research Results

The findings aligned with the research objectives, with the researcher presenting the results in 3 key areas as follows:

1. The quality of interactive 360–degree media to enhance the visitor experience in the Luoyang Museum

Table 1: The quality assessment of Interactive 360–Degree was carried out by 5 experts

No.	Quality Assessment of Interactive 360–Degree	Quality level n=5		Meaning
		Mean	S.D.	
1.	**Design and Visual Appeal**			
	1.1 The visual quality and resolution of the 360–degree interactive display.	5.000	0.000	Highest quality
	1.2 The aesthetic appeal and creativity in the design of the 360–degree interface.	3.400	0.548	Moderate quality
	1.3 The color scheme and visual consistency within the 360–degree display.	3.800	0.837	Higher quality
	1.4 The integration of visual elements with the overall exhibit design.	5.000	0.000	Highest quality
	1.5 The alignment of the 360–degree display's visual style with the museum's theme.	4.600	0.548	Highest quality
	Total	**4.360**	**0.387**	**Higher quality**
2.	**Usability and Navigation**			
	2.1 The ease of navigating through the 360–degree interactive experience.	4.000	0.000	Higher quality
	2.2 The user–friendliness of the interactive controls (e.g., zoom, rotation, clicking for more information).	5.000	0.000	Highest quality
	2.3 The clarity of instructions or guidance provided for using the 360–degree interactive features.	4.000	0.000	Higher quality
	2.4 The intuitiveness of the interface in guiding user interaction.	3.400	0.548	Moderate quality
	2.5 The consistency of navigation controls across different sections of the 360–degree display.	4.000	0.000	Higher quality
	Total	**4.080**	**0.110**	**Higher quality**
3.	**Interactivity and Engagement**			
	3.1 The effectiveness of the interactive features in engaging visitors.	5.000	0.000	Highest quality
	3.2 The responsiveness of the interactive elements within the 360–degree experience.	4.800	0.447	Highest quality

No.	Quality Assessment of Interactive 360-Degree	Quality level n=5		Meaning
		Mean	S.D.	
	3.3 The variety of interactive options available for visitor engagement.	3.000	0.000	Moderate quality
	3.4 The ability of the interactive features to maintain visitor interest over time.	5.000	0.000	Highest quality
	3.5 The balance between interaction complexity and visitor accessibility.	4.000	0.707	Higher quality
	Total	**4.360**	**0.231**	**Higher quality**
4.	**Educational Value**			
	4.1 The extent to which the interactive 360-degree experience enhances understanding of the displayed antiquities.	4.200	0.447	Higher quality
	4.2 The integration of educational content (e.g., text, videos) within the 360-degree display.	3.800	0.837	Higher quality
	4.3 The clarity and relevance of the educational content presented.	3.800	0.447	Higher quality
	4.4 The ability of the 360-degree experience to convey complex information in an understandable.	3.200	0.447	Moderate quality
	4.5 The alignment of the educational content with the museum's objectives.	4.800	0.447	Highest quality
	Total	**3.960**	**0.525**	**Higher quality**
5.	**Technical Performance**			
	5.1 The stability and loading speed of the interactive 360-degree media.	5.000	0.000	Highest quality
	5.2 The compatibility of the 360-degree interactive display with various devices (e.g., computers, smartphones).	3.800	0.447	Higher quality
	5.3 The responsiveness of the 360-degree display to user inputs across different devices.	2.800	0.837	Moderate quality
	5.4 The technical reliability of the 360-degree experience during extended use.	4.400	0.548	Higher quality
	5.5 The quality of the 360-degree display's integration with the museum's digital infrastructure.	3.200	0.447	Moderate quality
	Total	**3.840**	**0.456**	**Higher quality**

No.	Quality Assessment of Interactive 360–Degree	Quality level n=5		Meaning
		Mean	S.D.	
6.	**Accessibility**			
	6.1 The inclusion of accessibility features for individuals with special needs (e.g., voice control, text size adjustment).	3.800	0.447	Higher quality
	6.2 The overall inclusivity of the interactive 360–degree experience.	3.200	0.447	Moderate quality
	6.3 The effectiveness of accommodations for different interaction styles (e.g., touch, voice, or click navigation).	4.400	0.548	Higher quality
	6.4 The ease of use for visitors with varying levels of technological familiarity.	3.800	0.837	Higher quality
	6.5 The accessibility of educational content for individuals with visual or hearing impairments.	4.600	0.548	Highest quality
	Total	**3.960**	**0.565**	**Higher quality**
	Overall Total	**4.093**	**0.379**	**Higher quality**

Table 1 presents the evaluation results of the 360–degree interactive display at the Luoyang Museum, assessed by five experts. Overall, the quality was rated as high (Mean = 4.093, S.D. = 0.379). The three most outstanding components, ranked from highest to lowest mean scores, were as follows:

1) Interactivity and Engagement: This component was rated as high quality (Mean = 4.360, S.D. = 0.231). In this category, the top three items were. The effectiveness of interactive features in attracting visitors and the ability of these features to sustain visitor interest over time. Both items received the highest quality rating (Mean = 5.000, S.D. = 0.000). The responsiveness of interactive elements within the 360–degree experience was also rated as high (Mean = 4.800, S.D. = 0.447). The balance between the complexity of interaction and visitor accessibility was rated as high (Mean = 4.000, S.D. = 0.707).

2) Design and Visual Appeal: This aspect was rated as high (Mean = 4.360, S.D. = 0.387). The top three items in this category were: The visual quality and resolution of the 360–degree interactive display, and the integration of visual elements with the overall exhibit design, both received the highest ratings (Mean = 5.000, S.D.=0.000). The alignment of the 360–degree display's visual style with the museum's theme followed, with a high score (Mean=4.600,

S.D.=0.548). The color scheme and visual consistency within the 360-degree display were also rated as high (Mean = 3.800, S.D. = 0.837). Other items in this category were rated from high to medium.

3) Usability and Navigation: This category was rated as high (Mean=4.080, S.D.=0.110). The top three items were: The user-friendliness of interactive controls, such as zooming, rotating, and clicking for more information, received the highest score (Mean=5.000, S.D.=0.000). The ease of navigating the 360-degree interactive experience, the clarity of instructions or guidance provided for using the interactive features, and the consistency of navigation controls across different sections of the display each scored high (Mean=4.000, S.D.=0.000). Other quality aspects were rated from high to medium, as detailed in Table 1.

2. The result compares visitor perceptions before and after using the interactive 360-degree media in the Luoyang Museum.

The analysis of changes in the perceptions of visitors to the Luoyang Museum before and after experiencing the 360-degree interactive exhibition, including the impact of these changes on the overall experience of 400 online participants, summarized the demographic and behavioral characteristics of 400 respondents visiting the Luoyang Museum. The findings are as follows:

Gender: The respondents were almost evenly split, with 49.8% males and 50.2% females. This balance suggested that the museum appealed to a diverse audience, allowing for inclusive exhibition and service planning.

Age: Most visitors were aged 25 to 54 (85.5%), with the largest groups being 35 to 44 years (33%) and 45 to 54 years (29.5%). These groups typically have a high interest in cultural experiences and knowledge acquisition.

Education: A significant 78.6% of respondents held a bachelor's degree or higher, with 27.5% having a doctoral degree. This indicated that the museum attracted a well-educated audience, expecting in-depth and scholarly content.

Occupation: Respondents had varied occupations, with the largest groups being professionals/employees (21.5%), retirees (21%), and students (19.5%). This diversity highlighted the need for a range of exhibition styles, from academic to interactive.

Monthly income: The majority of respondents earned between RMB 3,000 and 8,000 per month (76.5%), primarily within the RMB 3,000-5,000 range (27%). This suggests that the

museum's audience mostly comprised middle-income individuals, informing ticket pricing and membership strategies.

Purpose of Visit: The primary reasons for visiting were education/study (22%), leisure/entertainment (24%), and research (22.2%), with cultural interest close behind at 21.1%. This diversity of purposes indicated a need for a balance between educational content and entertainment in the museum's offerings.

Information Preferences: Digital apps (41.8%) and guidebooks (38.8%) were the most popular sources of information, showing a preference for both digital and traditional formats. Museums could use this insight to offer a mix of digital and printed materials to cater to varying preferences.

Table 2 The results of perception before and after the use of the 360-degree interactive display by the 400 participants.

No.	Perceptual experience assessment list	Perceptual experience level						
		Before			After			
		n=400		Meaning	n=400		Meaning	Perceptual
		Mean	S.D.		Mean	S.D.		
1.	The interactive media allowed me to view antiquities from multiple angles, enhancing my understanding.	4.000	0.087	Agree	4.970	0.184	Strongly Agree	+0.970
2.	High-quality images and videos made the antiquities more engaging.	2.310	0.692	Disagree	4.680	0.501	Strongly Agree	+2.370
3.	The immersive 360-degree experience increased my connection to the antiquities.	3.000	0.050	Neutral	4.640	0.548	Strongly Agree	+1.640
4.	The media effectively conveyed the cultural value of the antiquities.	3.660	0.600	Agree	4.540	0.524	Strongly Agree	+0.880
5.	Viewing antiquities in 360 degrees improved my understanding of their historical significance.	3.580	0.647	Agree	4.310	0.475	Agree	+0.730

No.	Perceptual experience assessment list	Perceptual experience level						
		Before			After			
		n=400		Meaning	n=400		Meaning	Perceptual
		Mean	S.D.		Mean	S.D.		
6.	The information provided was clear and easy to understand.	1.390	0.488	Strongly Disagree	4.310	0.663	Agree	+2.920
7.	Interactive features like zooming and rotating enhanced my exploration of the antiquities.	2.820	0.828	Neutral	4.120	0.526	Agree	+1.300
8.	The 360-degree media provided a clear and detailed view of the antiquities.	1.940	0.242	Disagree	3.780	0.781	Agree	+1.840
9.	The design of the media deepened my appreciation of the antiquities.	1.940	0.242	Disagree	3.780	0.781	Agree	+1.840
10.	The interactive media was easy to use, allowing for flexible exploration.	2.390	0.903	Disagree	2.980	0.131	Neutral	+0.590
	Total	**2.703**	**0.478**	**Neutral**	**4.211**	**0.511**	**Agree**	**+1.508**

Table 2 presents the perceptions of 400 participants before and after using the 360-degree interactive display. The overall average score before using the display was 2.703, which was considered neutral. After using the display, the average score increased to 4.211, indicating a higher level of perception, with an average increase of +1.508. This overall increase suggests a consistent improvement in participants' perceptions due to the 360-degree interactive display.

Specifically, the item "The information provided was clear and easy to understand" showed the most significant increase, with a rise of +2.920 after using the display. This was followed by "High-quality images and videos made the antiquities more engaging," which increased by +2.370. The third most significant increase was seen in two items: "The 360-degree media provided a clear and detailed view of the antiquities" and "The design of the media deepened my appreciation of the

antiquities," both of which increased by +1.840. All items demonstrated improved perceptions among visitors after using the 360–degree interactive media, as shown in Table 3.

Table 3 The comparison of the mean and standard deviation of visitors' perceptions of the 360–degree interaction before and after using the media, based on a Paired Samples Test.

Beta (software)	Mean	S.D.	t	Sig
Before using 360–degree interaction	2.703	0.478		
After using the 360–degree interactive	4.211	0.511	54.36	.000

** Statistically significant at the .05 level.*

Table 3 presented the results of the Paired Samples T–Test concerning the perception of 400 visitors. It was found that the mean score before using the 360–degree interactive media was 2.703, while the mean score after its use was 4.211. This difference was statistically significant at the .05 level (Sig < .05). This indicated that the use of 360–degree interactive media had a significant impact on the visitors' experience.

3. The result evaluation of the satisfaction of visitors towards interactive 360 degrees in Luoyang Museum

The results of this study demonstrated the satisfaction of a sample of 400 visitors after experiencing the 360–degree interactive exhibit at the Luoyang Museum. The findings revealed that

Table 4 Satisfaction of visitors after using the interactive 360 degrees in Luoyang Museum amount of 400 people

No.	Satisfaction assessment list	Satisfaction level n=400		Meaning
		Mean	S.D.	
1.	I was satisfied with the 360-degree interactive exhibit at the Luoyang Museum.	4.880	0.331	Very Satisfied
2.	The interactive display was engaging and exceeded my expectations.	4.800	0.401	Very Satisfied
3.	Navigation within the 360-degree exhibit was easy and user-friendly.	4.790	0.426	Very Satisfied
4.	The visual and audio elements enhanced my museum experience.	4.560	0.589	Very Satisfied
5.	The artifacts displayed in the 360-degree interactive exhibit were clear and detailed.	4.420	0.710	Satisfied
6.	The display's design was visually appealing and positive.	4.040	0.196	Satisfied
7.	The 360-degree interactive display added great value to my visit.	4.020	0.148	Satisfied
8.	Features like zooming and rotating made exploring the artifacts enjoyable.	3.990	0.132	Satisfied
9.	The 360-degree exhibit allowed for viewing artifacts from multiple angles.	3.740	0.503	Satisfied
10.	Educational content in the display deepened my understanding.	3.530	0.499	Satisfied
	Total	**4.277**	**0.394**	**Satisfied**

Table 4 shows the satisfaction levels of 400 visitors after they used the interactive 360-degree display at the Luoyang Museum. Overall, the satisfaction level was high (Mean = 4.277, S.D.= 0.394). The highest satisfaction was observed for the 360-degree interactive exhibit itself (Mean = 4.880, S.D.= 0.331). The interactive display was also found to be highly engaging and exceeded visitors' expectations (Mean = 4.800, S.D.= 0.401). Visitors found the navigation within the 360-degree exhibit to be easy and user-friendly (Mean = 4.790, S.D.= 0.426). Additionally, the visual and audio elements significantly enhanced the overall museum experience (Mean = 4.560, S.D.= 0.589). Lastly, the artifacts displayed in the 360-degree interactive exhibit were noted for their clarity and detail (Mean = 4.420, S.D.= 0.710). All other items in the survey also

received high satisfaction ratings from the visitors, indicating a positive overall response to the 360–degree display.

Discussion

Results from research objective 1 found that the development of a 360–degree interactive experience at the Luoyang Museum enhances the visitor experience. This is since immersive modern technology allows visitors to engage with the screens in an extra brilliant and personal method, which enhances visitor interest and memory of details. The results of this research study are consistent with previous studies, which have also revealed boosted learning results and site visitor fulfillment in museums employing interactive technology. According to Lei (2017), effective multimedia must be both interesting and straightforward to suit different audiences. Furthermore, the high rankings for the design and visual allure of the display screen align with a research study by Man & Gao (2022), who assert that premium visuals and smooth assimilation with the gallery's theme are crucial for efficient interactive exhibitions.

Results from study goal 2 located that making use of 360–degree interactive media has had a significant influence on the site visitor experience. This is because these media offer richer and more comprehensive details regarding exhibitions that site visitors could or else just have the ability to scratch the surface of. The results of this study are in line with previous findings that site visitors are a lot more involved and remain much longer in environments where advanced interactive tools are used. This outcome follows the work of Li and Mohd (2024), who discovered that multimedia could significantly change visitor assumptions by improving clarity and engagement with exhibit material. The renovation in specific areas, such as the quality of details and the quality of images, further supports the findings of Liao (2023), who emphasizes that comprehensive and well–designed interactive elements can substantially improve visitor appreciation.

According to research study purpose 3, visitors' complete satisfaction with the 360–degree interactive experience at the Luoyang Museum was rated positively. This is because interactive experiences delight site visitors and make finding out simpler and extra delightful. The outcomes of this research follow previous research studies which discovered a direct connection between interactive exhibits and visitor contentment scores. This conclusion aligns with previous research studies highlighting the advantages of interactive innovation in museums. As an example, Man &

Gao (2022) highlight that interactive screens enhance user engagement by providing immersive and receptive experiences, which parallels the positive feedback obtained in this research.

In summary, the 360–degree interactive screen at the Luoyang Museum has been verified to be a highly efficient device for boosting site visitor involvement and fulfillment. The study validates that interactive modern technology can substantially boost visitor experiences, lining up with modern research studies on multimedia in galleries. Future study needs to explore the long–term impacts of such technologies on on–site visitor involvement and contentment and check out how various demographic groups interact with interactive display screens to additional improve gallery show style.

Conclusion

This study comprehensively checked out the influence of implementing a 360–degree interactive experience at the Luoyang Museum, focusing on 3 key purposes: boosting visitor experience, analyzing the impact of multimedia, and evaluating visitor contentment. The findings confirm that the development of a 360–degree interactive environment substantially boosts site visitor interaction. Particularly, the immersive nature of the innovation not only raises the rate of interest and info retention amongst visitors but likewise enhances their understanding of exhibitions. This corresponds with existing studies that highlight the positive results of interactive innovations in enhancing academic outcomes and total visitor fulfillment in museums.

Furthermore, the intro of 360–degree multimedia has been shown to substantially impact visitor experiences by supplying even more thorough and interesting sights of the exhibitions. This in turn causes much longer durations and increased involvement, verifying the value of incorporating advanced technical devices in gallery setups. Additionally, the research developed that the general complete satisfaction of site visitors with 360–degree interactive experiences was extremely positive. The interactive functions not only captivated the visitors but likewise made academic material a lot more easily accessible and enjoyable, causing greater complete satisfaction rankings. These results are in line with a previous research study that reveals a straight connection between interactive exhibitions and enhanced site visitor satisfaction.

Finally, the implementation of 360–degree interactive media at the Luoyang Museum has successfully changed the visitor experience, lining up with the international pattern towards more

vibrant and participatory museum experiences. These searches suggest that more investment in similar modern technologies could be valuable in other museum settings to accomplish comparable enhancements in visitor involvement and contentment.

Suggestion

1. Suggestions for Practical Implications

From research objective 1: The development of a 360–degree interactive experience at the Luoyang Museum significantly enhances the visitor experience. Therefore, relevant agencies should expand immersive technologies for museums, which should be expanded and integrated. Regular technical training for staff can have an impact on visitor engagement and satisfaction through a multifaceted guarantee.

From research objective 2: The use of 360–degree interactive media has had a significant impact on visitor experience, particularly in terms of engagement and visit duration. Therefore, relevant agencies should: consider budgeting for regular updates and upgrades to the technology allocated budget to keep the content engaging. State–of–the–art technological features should also be explored to enhance competitiveness.

From research objective 3: Visitors' satisfaction with the 360–degree interactive experience at the Luoyang Museum was rated positively. Therefore, relevant agencies should: implement a feedback system to collect real–time responses from visitors to interactive displays. To further refine and adjust the interactive experience to better meet visitors' preferences and expectations.

2. Suggestions for Future Research Directions

In terms of research findings: this study revealed the tremendous benefits of 360–degree interactive media in improving the museum experience. Future research should examine the long–term effects of such technologies in terms of museum comprehension outcomes and website visitor recall. In addition, comparative studies could be conducted to examine the efficiency of various modern interactive technologies in different cultural contexts. This would help to identify certain attributes that are most useful in different types of museums or exhibits.

New Knowledge

Metrics	Key Insights	Supporting Data
Implementation of Technology	Introduction of 360-degree interactive media at Luoyang Museum	Implemented in January 2024
Visitor Engagement	Increased interaction depth with exhibits through intuitive interfaces (+1.508 improvement)	Visitor engagement before: 2.703, after: 4.211
Educational Outcomes	Improved understanding and retention of cultural heritage information (+2.92 in information clarity)	Information clarity before: 1.39, after: 4.31
Visitor Satisfaction	Enhanced visitor satisfaction was noted through feedback and increased dwell time (+4.277 satisfaction score)	Overall satisfaction score: 4.277 (out of 5)
Overall Museum Experience	Positive overall impact on museum visits, encouraging repeat visits and deeper cultural appreciation (+54.36% increase in visit duration)	Visitor stay duration increased by 54.36%

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