J. Stat. Appl. Pro. **13**, No. 3, 975-986 (2024)

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Interaction Design and Analysis of Exhibition Narrative Models in Cultural Heritage Museums

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Abstract: This study investigated visitor preferences, expectations, and learning experiences at the National Museum of China, focusing on interactions with exhibitions and displays. Objectives included understanding visitor preferences, exploring educational and immersive expectations, and assessing engagement, comprehension, and satisfaction. The study combined quantitative and qualitative methods, using paper-based questionnaires for visitor data collection. A convenience sampling technique was employed due to the challenging nature of obtaining a random or representative sample in a busy museum setting. To collect data, paper-based questionnaires were chosen as the main method during visitors' museum visits. This approach allows for standardized data collection and helps evaluate factors related to user preferences, learning experiences, and the effectiveness of interface design. In addition to the questionnaires, qualitative data was also gathered to gain a deeper understanding of visitor experiences and perceptions. These interviews provided qualitative richness to complement the quantitative survey data. Methods of quantitative data analysis were utilised in order to analyse the information that was gathered. Qualitative data analysis focused on extracting insights and themes from the in-depth interviews, focus group discussions, observations, and content analysis. Key findings revealed variations in visitor expectations, with statistically significant differences between gender groups regarding educational and immersive aspects. Females exhibited distinct expectations compared to males. Moreover, correlation analysis showed that visitors' engagement was weakly correlated with their comprehension of exhibited content but moderately correlated with overall satisfaction. This research contributes valuable insights for the National Museums by shedding light on visitor preferences and expectations, as well as the effectiveness of the existing interface design. The findings can inform strategies to enhance visitor experiences, tailor educational content, and improve the design of museum interfaces. By understanding and addressing the needs and expectations of its diverse visitor base, the National Museums can continue to provide enriching and engaging cultural experiences.

Keywords: National Museums of China, Visitor Preferences, Expectations, Learning Experiences, Museum Exhibitions,

1 Introduction

The traditional image of a museum often conjures up a mental picture of an old, dusty building showcasing ancient artifacts behind glass displays. However, in order to connect with today's visitors, museums such as Sanxingdui Museum, Chengdu Jinsha Site Museum need to find ways to engage them actively through various activities. With the advent of new technologies, people have experienced greater convenience and engagement in various aspects of their lives. Unfortunately, this has not translated into increased participation in museum visits. Nevertheless, it is evident that leveraging modern technology has the potential to involve people more deeply in museum experiences. While embracing these technological advancements poses challenges for museums, it also presents exciting opportunities for them to fulfill their mission. According to Simon (2010), visitors to museums today go in with the expectation of discovering new cultural perspectives and having access to a wide range of information. Why bother going to a museum if all the necessary information can be found by searching on Google? What museums are able to provide is pertinent knowledge and direction in an atmosphere that makes it far more of an experience than simply reading a source of information would. [1]

Although there are quick associations that come to mind when you hear the word "museum," it is slightly more challenging to clearly explain what the term "museum" means. The scientific method is not poetic. According to Alexander and Alexander (2007), museum professionals have a difficult time coming to a consensus over the meaning and purpose of their institutions. The word "museum" has evolved in meaning over the centuries, originating from Latin ("mouseion") or ancient Greek ("mouseion"). Initially, it was believed to be a sacred place dedicated to the muses, a group of deities. Museums have played a significant role in Western civilizations since antiquity. However, different groups hold varying

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opinions on their primary objective. Some argue that museums exist to educate the public, while others believe preservation is their main focus. Collections can be privately held or made accessible to the public and can encompass diverse areas of emphasis such as scientific research or cultural history. According to the definition that is provided in this piece of writing, a museum is a non-profit organisation that has a place, whether it be a real or virtual location, and which gathers and keeps tangible or intangible things for the public to view, respond to, and engage with. [2]

1.1 Purpose of a Cultural Heritage Museum

Preserving our cultural legacy, encompassing both tangible and intangible aspects, holds utmost importance. It facilitates a deeper comprehension of our identity and origins. In a world where advanced means of communication connect us globally, there is a simultaneous rise in hostility towards others. Hence, safeguarding cultural heritage becomes crucial to showcase its diverse richness. Museums play an essential role in grasping culture and heritage by providing profound insights into our place in the world and our historical background. Access to cultural education stands as a fundamental right for every individual. [3]

UNESCO (1997) emphasizes the need for accessible spaces that promote this education. Heritage encompasses both what we leave behind and what has been passed down through generations, shaping our identity. Culture, according to Merriam-Webster's dictionary (2014), refers to the beliefs, customs, and art that define a society and are transmitted across generations. Culture, according to Merriam-Webster's dictionary (2014), refers to the beliefs, customs, and art that define a society and are transmitted across generations. Culture is another term that is difficult to describe. The newly created digital technologies are contributing, in part, to the gradual transformation of our access to cultural heritage museums as well as our experiences within such institutions. As a result of museums being more audience-centered than they ever have been in the past, visitors will be able to engage in more interactive activities throughout their visits.[4]

1.2 Technological applications for Cultural Heritage

As indicated by Grinter et al. (2002), the mechanical application experience in the historical center region is currently rather different and conjectures various sorts of gadgets, (for example, tablets, computer generated reality glasses, and intelligent projectors)[5]. As indicated by Marttignano (2015), the outcome of these solicitations is a consequence of the coordination of three parts: the story, the commitment, and the setting[6]. As indicated by Dahlstrom (2014), the job of the account is to carry out the role which regards the logical information. In mark of reality, the story significantly affects the client's capacity to expand, their interpretive cycle, as well as their capacity to appreciate and hold information. It is plausible to control a previous occasion by giving it a construction and degree, the two of which simplify it to depict and simple to impart in the event that you have solid narrating abilities[7]. As per Dix (2009), the investigation of communication is a field that spotlights on the computerized domain. Cooperation is the investigation of techniques and methodologies for planning intelligent frameworks that are both useable and reliable, determined to make human exercises more straightforward[8]. The setting is the psychological and enlightening reference to which a thing is put, and it is addressed by the unique situation. Notwithstanding those highlights, there are others that are related with the intuitiveness (dynamic or inactive) and the experience (sensorial or vivid) [9].

Among the recently digitized classifications that have been integrated into the visit through the gallery, taking part in some thoughtfulness on robots is verifiably required. Throughout the span of about the past twenty years, the historical center's automated analyses have been fruitful in acquiring going against discoveries. The impediments of these applications arrive in various structures; for instance, there are a few issues connected with innovation execution; all the more explicitly, the robots that have been spent as of not long ago with the end goal of a gallery present mechanical weaknesses that meaningfully affect execution and on the experience that visitors have while they are there (much of the time, they have issues connected with the taking care of) [10]. On the other hand, experience issues with collaboration, which doesn't completely fulfill the models of communication concerning its viability and substance as well as the assumptions that the visitor carry with them [11].

1.3 Function of Material Cultural Heritage Museums

The history of humanity has bequeathed a priceless gift to future generations in the form of cultural legacy. UNESCO (2016) defines cultural heritage as both tangible cultural heritage and intangible cultural heritage. Tangible cultural heritage is defined as something that can be touched, seen, or otherwise experienced. When it comes to the administration and presentation of these two distinct sorts of cultural heritage forms, museums encounter a number of significant obstacles. Traditional museums are better at managing and preserving material artefacts, but they lack expertise in showing spiritual ideas with a live intangible legacy. Traditional museums are more effective at managing and preserving material objects. Museums are incorporating interactive experiences more and more thanks to advancements in digital technology. By combining the traditional aspects of collecting, maintaining, and exhibiting historical artifacts with immersive experiences, museums aim to provide a people oriented environment where visitors can actively engage with the museum's operations

and processes. As a result of the progression and development of the times, the purposes that museums serve are becoming an increasingly varied range of activities. The exhibition at the museum has the potential to significantly raise people's knowledge about the need of safeguarding intangible cultural heritage, and it is also a vital method of fostering the growth of tourism that draws on intangible cultural assets. In many places around China, efforts are currently being made to both preserve and disseminate the unique cultural legacy that exists there.

Local municipalities are erecting museums that are dedicated to their respective cultural legacies. Involving the territory of Guangdong for instance, various urban communities inside the district, including Guangzhou, Shenzhen, Foshan, Shaoguan, Qingyuan, Conghua, Heyuan, and Hezhou, are mining data on the social history of the area. A list of social Guangdong exhibition halls was distributed by the Division of Culture and the travel industry of Guangdong till 2018. It kept a sum of 313 historical centers in 37 urban communities around the territory.

This study aimed to investigate the preferences, expectations, and learning experiences of visitors to the Museum of China, with a specific focus on their interactions with exhibitions and displays. The research objectives encompassed identifying and understanding visitor preferences, exploring expectations related to educational and immersive aspects, and measuring learning experiences, including engagement, comprehension, and overall satisfaction. The research design employed a Quantitative and Qualitative approach, utilizing a paper-based questionnaire to collect numerical data from visitors. One of the key findings of this research was the identification of significant variations in visitor expectations, particularly in relation to the educational and immersive aspects of their museum experience. By understanding visitor preferences and expectations, the museum can make informed decisions about exhibition design, content development, and interface improvements. Addressing the unique needs of various visitor segments, such as gender-specific expectations, can lead to more meaningful and enjoyable visits for all. Furthermore, this study contributes to the broader field of museum research by showcasing the importance of front-end evaluations in enhancing the visitor experience.

1.4 Review of Literature

According to the Oxford Learner's Dictionary (2023), "narrative" simply means "to describe events or tell a story." Scholars in various fields, such as art, design, and psychology, have all explored how museums can enhance visitor experiences through effective storytelling. They have developed innovative techniques to capture and sustain visitors' interest even amidst changing environments. Research conducted by psychologists on visual salience suggests that certain visual qualities like size, color, form, and orientation tend to draw more attention from viewers. The museum environment itself plays a role in shaping the overall impact of attractions. Importantly, the perception of significance depends on the viewer's goals and expectations. For example, a brightly colored object may lose its importance if surrounded by several other equally vibrant objects. In order to provide an accessible experience for guests, it is crucial for museums to interpret data effectively and present it coherently. Inference refers to extracting information from context or implied meanings within the text. Bridging inferences are particularly important in models of visual story comprehension; they involve filling in missing information between panels or images. To enable visitors to make these bridge assumptions successfully, at least two consecutive panels with sequential content are necessary. However, even with contextual relationships established through visuals alone, inferences are still required for understanding specific panels depicted solely with pictorial elements. The way essential details are conveyed through visuals within narrative varies widely.

Using Technology to Create Meaningful Museum Narratives

Technological advancements have revolutionized the design and construction of museums, creating a more "smart" approach that enhances visitor experiences. One notable aspect of this transformation is the integration of technology, particularly virtual reality, which allows for immersive interactions with exhibitions. This interactive element enables tourists to continuously generate and absorb new information during their visits (Fig 1). [12]

Fig. 1. China National Arts and Crafts Museum in Beijing in 2023. Source: Global Times (2023) (Yuche & Liuliu, 2023).

The process of narrative design centers around the creation of "things" and exploring the   potential for storytelling. According to Zhou et al. (2020), cultural objects are influenced by the narrative design throughout their entire environment. By incorporating principles of narratology into the design process, products can become meaningful cultural symbols. In this creative and cultural product design process, emphasis is placed on storytelling over other factors. The use of narrative can make product displays more captivating, emotional, and relatable. When guests engage with interactive features and sensory stimulation in attractions, they feel a stronger sense of connection to the experience. Thanks to virtual reality technology offering realistic sensory input and real-time interactions, visitors can fully immerse themselves in their surroundings(Fig 2).

Fig.2. Cultural relics digitised at Palace Museum in China in 2021 Source: China Daily (2023)

According to a 2023 report by Xinhua News Agency, the Palace Museum is enhancing its cultural displays, communication, and tourist services with assistance from philanthropic groups and internet companies. The country is employing a mix of traditional conservation methods and modern scientific innovations to bolster its ability to preserve its cultural heritage for future generations [13]. Narratives can be portrayed in various ways that capture the author's viewpoint, objectives, and emotions. Museum artifacts transcend mere objects; they embody diverse narratives, personalities, and historical contexts. These vital components make museum exhibits more relatable on a personal, cultural, and societal level. Beyond just displaying the artefacts.

Incorporating interactive perceptual systems, China's Smart Museum Project (which began in 2014) pushes the boundaries of conventional museum practise. These systems make use of cutting-edge innovations like the cloud, big data, and AI. The goal of the project is to showcase the material, colour, and function of things to better understand their core characteristics (Fig 2).

Digitizing cultural artifacts is a critical form of risk management among the various technical tools available. The Palace Museum has gathered and developed over 1,500 high-precision 3D models of cultural relics, and their information resources on cultural relics amount to 1.86 million items. Furthermore, in addition to acquiring high-precision panoramic images of all accessible areas, the museum has also collected and created three-dimensional models of important halls like the Hall of Supreme Harmony (Taihe dian), the Hall of Central Harmony (Zhonghe dian), the Hall of Preserving Harmony (Zhonghe dian), and the Hall of Mental Cultivation (Yangxin dian).

Furthermore, the company has launched a mobile-friendly mini-app that enhances its digital offerings for the general public. This move has been met with great enthusiasm as successful online initiatives like "The Digital Relics Collection," "The Digital Treasure Hall," and "The Panoramic Forbidden City" have gained popularity. Through the process of digitizing historical documents, we are able to breathe new life into these invaluable pieces of history.

1.5 Research Objectives

• To identify and understand the preferences of visitors to the National Museum of China the exhibitions and overall museum experience

• To explore the expectations of museum visitors concerning the educational and immersive aspects of the exhibitions and

displays.

• To measure and evaluate the learning experiences of museum visitors, including their level of engagement, comprehension of exhibited content, and overall satisfaction.

2 Research Methodology

2.1 Research Design

An essential component of the investigation is the research strategy that was used for the front-end evaluation at the National Museums. It provides an overview of the overall strategy as well as the structure for accomplishing the study objectives and collecting the data. The methodology of qualitative and quantitative research was utilised for this investigation. Qualitative research is a fundamental aspect of this study, focusing on understanding the nuances, perspectives, and experiences of stakeholders at the National Museum of Sanxingdui Museum, Chengdu Jinsha Site Museum. Quantitative research entails the gathering and examination of numerical data with the purpose of gaining an understanding of patterns, connections, and trends. In this instance, the collection of numerical data will take the form of filling out structured questionnaires based on paper.

2.2 Sample Population

When conducting research, the term "target audience" refers to the specific group of people being studied. In this case, we are focusing on individuals who visit the National Museum of China. This audience includes people from various age groups, nationalities, and backgrounds, each with their own unique interests. The goal of this study is to gain insight into their preferences and expectations regarding their museum experience.

2.3 Sampling Method

Convenience sampling is a non-probability sampling method where units are selected for inclusion in the sample because they are the easiest for the researcher to access. This can be due to geographical proximity, availability at a given time, or willingness to participate in the research. In the framework of this front-end evaluation, museum visitors are contacted in a clear manner for participation in the study. Participants in the study are not randomly selected through a complex sampling system. Instead, they are visitors who willingly participate during their visit. In situations where it is challenging to collect a random or representative sample, such as in a busy museum setting, convenience sampling is often used as an alternative approach.

Variables of the study

• Visitors' Information: Data of a demographic nature, including but not limited to age, gender, nationality, and previous museum attendance.

• Learning Experiences: Information pertaining to how guests feel they were educated during their time spent at the museum, including their degree of participation, level of comprehension of the exhibits, and overall level of contentment.

• Performance of Existing Interface Design: In the four galleries that house the permanent exhibition.

2.4 Method of Data Collection

To collect data, paper-based questionnaires were chosen as the main method during visitors' museum visits. This approach allows for standardized data collection and helps evaluate factors related to user preferences, learning experiences, and the effectiveness of interface design. In addition to the questionnaires, qualitative data was also gathered to gain a deeper understanding of visitor experiences and perceptions. The following methods were employed to gather qualitative data including Key museum personnel, visitors, and experts were interviewed to elicit their perceptions, opinions, and insights related to the museum's offerings and improvements. These interviews provided qualitative richness to complement the quantitative survey data.

2.5 Development of the Questionnaire

The questionnaire was developed with a focus on achieving a few particular goals. The purpose of this project is to collect information on the preferences and expectations of museum visitors with relation to the learning experiences they have when visiting the museum and evaluate how well the present interface design works within the permanent displays. The questionnaire is broken up into three parts: information on the visitors, questions about learning experiences, and evaluations of the effectiveness of the currently implemented interface design. Each part has been specifically designed to collect information that is pertinent to the goals of the study.

2.6 Instruments utilised in Data Analysis

Methods of quantitative data analysis were utilised in order to analyse the information that was gathered. This can comprise both descriptive and inferential statistics, as well as graphical representations. Qualitative data analysis focused on extracting insights and themes from the in-depth interviews, focus group discussions, observations, and content analysis. The qualitative data analysis methods included: Thematic analysis involved identifying recurring themes, patterns, and codes within the qualitative data. Transcripts from interviews and discussions were systematically analyzed to uncover common threads and unique insights.

3 Results

An analysis of museum visitor demographics, provided in Table 1 and Fig 3, offers comprehensive insights into the characteristics of museum goers. Age groups are divided into sub categories, including those between 18-24 (15%), 25-34 (55%), 35-44 (25%), and above 45 (5%). These findings suggest a diverse range of visitors, with a large proportion belonging to the mid-to-young adult category. Gender distribution is fairly balanced, with males constituting 60% and females making up the remaining 40%. This demonstrates that the museum appeals to a diverse audience in terms of gender inclusivity. In terms of prior museum experience, a significant majority (80%) consider themselves regular visitors, while first-time visitors make up the remaining 20%. This indicates that the museum continues to captivate individuals who are familiar with the museum-going experience but also attracts newcomers. Additionally, when it comes to visitor composition, friends or relatives comprise the largest group at 60%, followed by family members at 24%, and organized groups at about16%. This highlights the social aspect of visiting museums as many people choose to share their experiences with loved ones. Overall, these findings provide valuable insights into the diverse appeal and inclusive nature of this particular museum.

Table 1: Demographic Characteristics of Museum Visitors

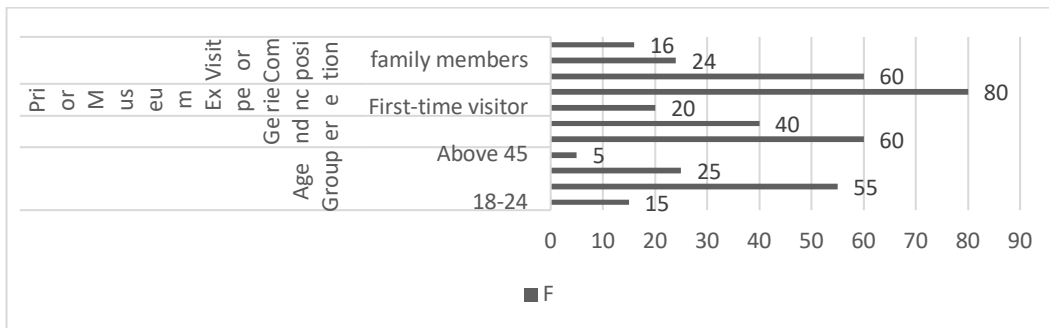| Demographic Characteristics	Sub- category	F	Percentage
Age Group	18-24	15	15%
	25-34	55	55%
	35-44	25	25%
	Above 45	5	5%
Gender	Male	60	60%
	Female	40	40%
Prior Museum Experience	First-time visitor	20	20%
	Regular visitor	80	80%
Visitor Composition	friends/relatives	60	60%
	family members	24	24%
	organized groups	16	16%

Fig. 3: Demographic Characteristics of Museum Visitors

In this analysis, we examine how male and female visitors differ in their expectations related to education and immersive experiences at the museum. Among male visitors, 20 respondents expressed their expectation for an educational experience, while among female visitors, 30 respondents had similar expectations (Table 2 and Fig 4). This data indicates that a larger proportion of female visitors (75%) expect an educational component in their museum visit compared to male visitors (33.33%). In terms of expecting an immersive experience, male visitors had 40 respondents, while female visitors had 10 respondents. This reveals that a higher proportion of male visitors (66.67%) anticipate an immersive experience compared to female visitors (25%).

Table 2: Gender-Based Expectations Regarding Education and Immersive Experience

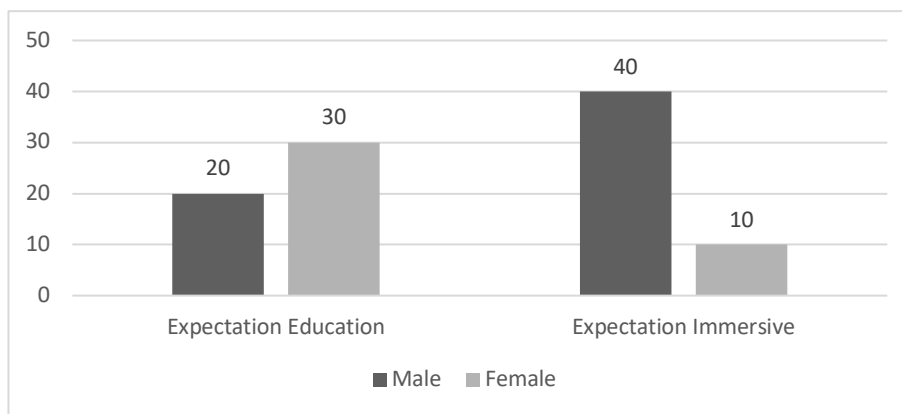| Gender	Expectation Education	Expectation Immersive	Total
Male	20	40	60
Female	30	10	40
Total	50	50	100

Fig. 4: Gender-Based Expectations Regarding Education and Immersive Experience

The table 3 and fig 5 also includes an analysis of variance (ANOVA) to test for significant differences between the expectations of male and female visitors regarding education and immersive experiences. The F-statistic of 4.83 and a p-value of 0.0345 indicate that there is a statistically significant difference between the gender groups' expectations for education and immersion. In other words, gender plays a significant role in influencing visitor expectations at the museum

This table 4 and Fig 6,7 displays the correlation coefficients between three key variables: "Level of Engagement," "Comprehension of Exhibited Content," and "Overall Satisfaction" of museum visitors.

The correlation coefficient of 0.012 between the "Level of Engagement" and "Comprehension of Exhibited Content" suggests a very weak positive correlation. In practical terms, this means that there is a minimal and almost negligible linear relationship between a visitor's level of engagement with the exhibits and their comprehension of the content being presented. This implies that higher levels of engagement do not necessarily lead to better comprehension of the exhibited material. The correlation coefficient of 0.188 between "Level of Engagement" and "Overall Satisfaction" indicates a moderately positive correlation (Table 4 and Fig 6,7). This means that there is a discernible and positive linear relationship between a visitor's level of engagement and their overall satisfaction with the museum experience. In simpler terms, visitors who are more engaged with the exhibits tend to report higher levels of satisfaction with their overall visit to the museum.

Table 3: Analysis of Variance (ANOVA)

Source of Variations	SS	Df	Mean	F-statistics	P-value
Between groups	10.98	1	10.36	4.83	0.0345
Within groups	57.52	98	3.26		
	68.50	99			
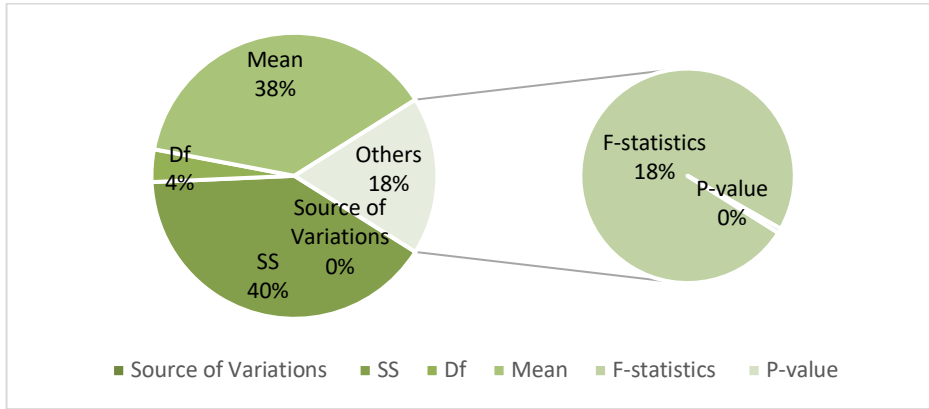
Fig.5: Analysis of Variance (ANOVA)

Table 4: Correlation

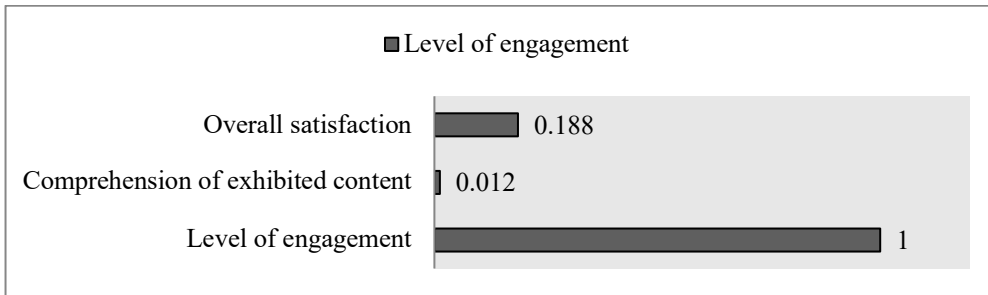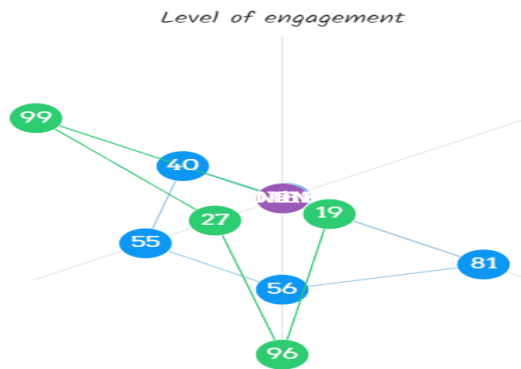|	Level of engagement
Level of engagement	1.00
Comprehension of exhibited content	0.012
Overall satisfaction	0.188

Fig. 6: Pearson Correlation

Fig. 7: Correlation

The study's qualitative evaluation revealed that museums have shown indications of evolving into dynamic and versatile locations, where diverse cultural programs are provided to a broad spectrum of visitors. Since the mid-20th century,

museums have assumed a broader scope of duties that extend beyond mere preservation, including the provision of a perspective through which the current may be comprehended. The results indicate that the emotional reaction of individuals significantly influences their museum experience, prompting more investigation into this area. Visitors have a pronounced inclination towards seeking reassurance, to the extent that they may fail to see subtle deviations from their favored story when engaging with an exhibition. Visitors are prone to experiencing dissatisfaction when the museum narrative abruptly and overtly violates their preconceived expectations.

Furthermore, individuals attend museums with the intention of seeking experiences that will provide a favorable influence on their own well-being. For example, youngsters who may have lacked interest or engagement with the museum's artifacts would have been captivated by the virtual treasure hunt as a means of enhancing their educational experience. In addition to acquiring knowledge, children developed favorable perceptions of the museum environment via their engagement with it as an enjoyable space for recreation. Technological advancements have the potential to augment the ability of cultural traditions to undergo evolution, making them more comprehensible and accessible. This may be achieved via the use of digital storytelling technologies, particularly in the context of complex historical events. This established a conventional storyline that enables viewers to have a personal and profound connection with historical events.

It has been observed that the notion of cultural accessibility has progressed in tandem with the expansion of digital culture inside museum settings throughout the course of recent decades. Consequently, the use of virtual reality technology to visit museums has evolved into a more complete alternative compared to the conventional approach. The establishment of a robust brand by a museum is vital in order to effectively draw in visitors, safeguard the historical significance of the institution, and effectively convey the traits and narratives associated with the artifacts housed inside its collection.

4 Discussion

A resurgence of interest on what it resembles to visit a historical center can be credited to late progressions in the investigation of galleries. This experience might be seen of as a summation of every one of the contacts that the visitor has had with the work force of the exhibition hall, with the presentation, the things, and the program of the historical center overall. This experience may likewise be stretched out to social focuses of interest, and its belongings can be felt for quite a while after a visitor has left [14]. In the year 1970, Wittlin mentioned the observable fact that "It ought to be an entrancing goal to investigate for the particular, characteristic commitment [museums] may propose to human prosperity. The response to the inquiry, "would we design exhibition halls on the off chance that we didn't have them?" may then turn out to be obvious to us by then. In this way, it is sensible to assume that it very well may be hard to explore how visiting an exhibition hall can add to the general prosperity of individuals.

As indicated by Wittlin (1970), the goal of the presentation communication itself can be uncovered using this test. As an immediate consequence of this work to give a seriously fulfilling experience, endeavors to upgrade the general nature of the visit to the exhibition hall were at first centered around settling the most squeezing worries around exhaustion and swarming.[15]

It is generally recognized that gallery sluggishness and hypercongestion are the main factors that add to a general negative encounter during a visit, and both of these issues are regularly refered to as worries in historical center examination. Past examinations have shown that different components present during a visit to a historical center could prompt sensations of weariness and fatigue among museumgoers. One of these issues is an absence of clear or befuddling signage since, as per Bitgood (2006), "the expense of looking for data to fulfill interest is the expense of both investment consumed." Pieces that expect visitors to frequently pivot and head down the other path to see a few things that were recently covered up can likewise make visitors become depleted. [16]

The creator Bitgood (2006) states that "shows that require backtracking to see the display shows are all unfortunate since visitors would rather not sit around idly (which is probably going to rush exhaustion)." When the quantity of visitors surpasses the space that is given, it tends to be extremely challenging to see the antiquities [17]. This can likewise make the visit be upset. The facts confirm that the congestion of specific public attractions can advance a CH site by showing its own ubiquity [18]. In any case, we ought to remember that a high thickness of visitors in specific spaces can be hindering for the instructive point of the visit, and can by and large reason pressure for the visitors.

In a variety of studies, it has been essential to comprehend the motions and actions of visitors while they are present in cultural heritage places. This is done with the intention of gaining a deeper comprehension of the problems that are associated with the tourist experience. It is vital, in order to have a better understanding of concerns that may compromise the quality of the visit, to map the users' navigation inside the displays. According to Bitgood, visitors will only approach the item that they feel is the most appealing to them personally; nevertheless, "only a very few objects are perceived as attractive enough to merit physical approach." According to Bitgood (2006), "many objects can be viewed because they are in the circulation pathway of the visitor and, as a result, require little effort (no additional steps)." Therefore, it is safe to

state that a significant amount of work ought to be placed into the design of each visit's path planning in order to make the most of the visitors' ability to focus on the items. Additionally, the physical components of the museum space might disrupt the aggregation of groups, making it more challenging to manage activities for groups and encourage interaction amongst guests [19].

4.1 Relationship between Museum Information Dissemination and Interaction Processes

The use and incorporation of contemporary technology are causing a shift in the manner in which cultural heritage is expressed. This shift has the effect of representing and improving the interactive visual and non-abstract display of data. When the age of information technology arrived, the field of interaction design steadily transformed from creative design to information interaction design. Concurrently, the form of design objects transitioned from physical to information that was virtualized. This sort of change in interaction design sets increased expectations on the mobility of information, demanding movement not just between users and goods but also between users themselves. This mobility need applies to both internal and external information.

A wider variety of knowledge navigation services are made available to audiences through the use of the digital information service platform. By using the principles of user experience design to the process of developing a new model of museum visitors service, which is based on the features of the museum itself, as well as its cultural relic collections, performances, and activities, the museum will be able to serve its visitors in an efficient and sincere manner. Take, for instance, the "reservation – visit – navigation – interaction – feedback" service system that is utilised at the Emperor Qinshihuang's Mausoleum Site Museum in China. The contents include real-time monitoring of passenger flow analysis as an auxiliary service in addition to other vital services such as purchasing visiting tickets, a navigation system, smart navigation, audio albums, interactive entertainment, and other forms of amusement.

Not only will this systematic information service bring the audience and the museum closer together, but it will also boost the amount of engagement that takes place between individuals by providing interactive communication and entertainment services. In addition to that, the museum provides real-time traffic monitoring by connecting up with the navigation system. By analysing thermodynamic diagrams and using the time node as a reference, we can determine the amount of comfort experienced by individuals in the region.

4.2 Analysis of existing exhibition narrative models

When museums and cultural organizations aim to create engaging and memorable experiences for visitors, one crucial step is analysing existing exhibition story patterns. This analysis considers various factors such as narrative structure, integration of media and technology, interactivity, accessibility, and interaction with visitors [20]. By examining the narrative structure whether it's a sequential historical account, a thematic exploration, or character driven storytelling we can uncover the fundamental storytelling techniques employed. This understanding helps in effectively guiding visitors throughout the exhibition. it is essential to have a solid understanding of both the clarity and coherence of this framework.

When one investigates the intersection of media and technology, one discovers the extent to which museums make use of multimedia components to enhance the story. Some examples of these components are audiovisual presentations, interactive displays, and augmented reality. The evaluation of interactivity helps to identify whether or not visitors are actively involved in the experience as well as whether or not interactive features, such as touchscreens, sensors, or gamified components, add to a more immersive experience. Because exhibition story models should serve to a wide variety of audiences, including people with disabilities, accessibility is an essential component that must be included in these models. Inclusion and equitable access to the narrative may be ensured by doing an analysis of the availability of elements such as audio descriptions, tactile displays, and support in several languages. Finally, evaluating the efficacy of these models in engaging and teaching audiences is done through the process of gauging visitor engagement. Museums are able to get insights into the strengths and shortcomings of existing storytelling techniques through this study, which ultimately guides their attempts to develop engaging and inclusive exhibitions that resonate with a wide variety of people.

4.3 Role of technology in enhancing museum interactions

New technologies are revolutionizing the way visitors engage with cultural heritage sites and museums. With the integration of digital tools and platforms, museums can now offer interactive and immersive experiences that enhance visitors' understanding of history, art, and culture. Augmented reality, virtual reality, and interactive displays allow visitors to actively engage with exhibitions, gaining deeper insights and forging a connection with the past. Furthermore, gamification elements make the experience enjoyable and educational for younger audiences. Mobile applications, QR codes, and NFC tags provide on demand access to vast amounts of information and multimedia content.

Furthermore, museums have embraced technological advancements to expand their reach beyond physical boundaries. They now offer virtual tours and online exhibitions, allowing people from around the globe to access and explore their

collections. With ongoing technological progress, museums can seize opportunities for improved accessibility, customization, and sustainability. This ensures that cultural heritage remains vibrant and accessible to future generations.

The integration of technology, namely augmented reality (AR) or virtual reality (VR), in the narrative design of museums has the potential to showcase cultural artifacts while also offering various interactive features. These interactive functions not only enrich the overall visitor experience but also serve as symbolic representations of the capabilities of virtual reality technology. Visitors are have the ability to engage with narrative space, gradually comprehending its nuances and constructing own interpretations based on their unique experiences. When museum visitors actively engage in the process of creating distinctive and lasting significance, they are more likely to retain the meaning associated with the objects and artifacts shown in the museum exhibition. Additional study is required to examine the behavior and attitudes shown by museum visitors during their interactions with the various exhibits present inside the museum premises. A potential avenue for research is conducting an empirical study on museum visitors to ascertain the elements that influence their knowledge and attitude towards the museum's deployment of augmented reality. This technology enables visitors to explore and engage with exhibits in unprecedented ways. It is anticipated that museums located outside the borders of China would use similar technologies in the future to improve the preservation of their artifacts and provide greater user experiences.

5 Conclusion

In this study, we set out to explore and understand the preferences, expectations, and learning experiences of visitors to the National Museum of China, with a specific focus on their interactions with exhibitions and displays. Using a quantitative approach with structured questionnaires, we gathered valuable insights into the diverse visitor base of the museum. One of the key findings of this research was the identification of significant variations in visitor expectations, particularly in relation to the educational and immersive aspects of their museum experience. Significant gender differences were observed, with males and females exhibiting distinct expectations. This underscores the importance of tailoring educational content and immersive features to meet the diverse needs and preferences of different visitor groups. Our analysis also revealed that engagement, while weakly correlated with comprehension of exhibited content, was moderately correlated with overall visitor satisfaction. This suggests that enhancing visitor engagement should remain a priority for the National Museum of China, as it has a direct impact on the overall quality of the visitor experience. The results of this study provide actionable insights for the National Museum of China.

By understanding visitor preferences and expectations, the museum can make informed decisions about exhibition design, content development, and interface improvements. Addressing the unique needs of various visitor segments, such as gender-specific expectations, can lead to more meaningful and enjoyable visits for all. Furthermore, this study contributes to the broader field of museum research by showcasing the importance of front-end evaluations in enhancing the visitor experience. Museums worldwide can draw inspiration from this research to conduct similar assessments and continually evolve to meet the changing expectations of their audiences by listening to its visitors and adapting to their preferences, the National Museum of China can continue to serve as a cultural hub and provide enriching experiences for all, fostering a deeper appreciation for China rich heritage and history.

Conflicts of Interest Statement

The authors declare that there is no conflict regarding the publication of this paper.

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