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The Application and Challenges of Cross-Cultural Translation and Communication in the National Museum of China under the Perspective of Artificial Intelligence

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Abstract
This study investigates the integration of advanced technologies to improve the translation and dissemination of Chinese museum culture through multimodal approaches. The primary aim is to incorporate Artificial Intelligence (AI) and big data to enhance the quality and accessibility of cultural exhibits. Current challenges in the translation and intercultural communication of Chinese museum culture include language barriers, cultural nuances, and limited engagement through traditional methods. The research addresses these issues by employing human-computer interaction guidelines, precise service delivery via machine learning, and relevant AI corpora. The study involves 200 international and local visitors, who will freely use social media and mobile phones, allowing them to interact with and experience physical objects in the museum during their visit. Three online surveys (with 200 participants) and three interviews (with 30 international visitors from the same sample) will be conducted. The data from the surveys will be analysed using SPSS, while interview responses will be processed with Nvivo software. The research demonstrates how AI facilitates the translation and transmission of various elements of Chinese museum culture through multiple modalities. Three distinct strategies are outlined, each tailored to specific usage scenarios and goals. The randomly selected 200 international and local Chinese visitors, who have not previously visited the National Museum of China, will be invited to experience the museum both online and in person. The effective integration of several methods, particularly audio guides providing contextual information, significantly enhances visitor engagement over time. Furthermore, AI-driven overlays augment physical exhibits, positively influencing the spatial experience. The analysis of the data provides valuable insights into participant characteristics, their views on existing translation and communication methods, and their preferences for multimodal techniques in museum settings. The utilisation of AI in mediation requires ongoing exploration of linguistic data, corpus enhancement, and improvements to the AI translation system, with attention to cultural differences, individual emotions, and specific contextual factors.

Keywords: Multimodal Mediation, Translation and Communication of Chinese Museum Culture, Mediation of Artificial Intelligence.

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Introduction

China, with its rich and expansive historical and tourist culture, seeks to effectively transmit its cultural heritage to a global audience through modern methodologies. The country has systematically cultivated these cultural legacies, which serve as powerful vehicles for conveying national narratives and historical achievements, shedding light on both the nation's intricate cultural fabric and the broader human experience. The rapid growth of globalisation and the pervasive influence of the internet underscore the necessity for innovative strategies to effectively promote Chinese tourist culture (Su W, 2015). The utilisation of online platforms and artificial intelligence technologies holds significant potential to generate diverse tourist cultural materials in various formats, thereby shaping and disseminating the many facets of Chinese tourism. Likewise, museums play a vital role in collecting and exhibiting cultural heritage for global communication. The integration of artificial intelligence and big data in the digital era offers considerable promise for enhancing the content of such communications and expanding the platforms through which Chinese museum culture can be shared worldwide. Cultural displays in museums represent a predominant multimodal mode of communication, where images are key in conveying information (Chen et al 2012). Therefore, it is crucial to adopt various advanced technologies to facilitate the translation and sharing of Chinese museum culture across multiple modalities.

Problem Statement

This study investigates the integration of advanced technologies to enhance the translation and dissemination of Chinese museum culture through multimodal approaches. The primary emphasis is on incorporating AI and big data to improve the quality and accessibility of cultural exhibits. Current challenges in the translation and intercultural communication of Chinese museum culture include language barriers, cultural subtleties, and limited engagement through conventional methods. The research addresses these issues by employing guidelines for human-computer interaction, ensuring precise service delivery through machine learning, and leveraging relevant AI corpora. In the era of Artificial Intelligence, to make an effective contribution, it is essential to consider Smart AI, mobile technology, and big data as interconnected elements that can create a meaningful impact and bridge the connection between Chinese museum culture and a global audience. This objective can be achieved through the utilisation of media intelligence and the incorporation of multi-dynamic models. However, an empirical study conducted on the websites of Chinese museums and the design of exhibition halls revealed that only a limited number of Chinese museums currently adopt a multimodal approach in both their website displays and on-site exhibitions. For several years, scholars such as Shen, Othman, & Aziz (2021) and Chen Xi. (2017) have published research on the foreignization and distortion in the translation of Chinese museum culture as part of communication studies and think tank reports. While the volume of research remains relatively low, these studies have integrated the concept of multimodality within the framework of intersemiotic translation and communication. Researchers encounter challenges in focusing on multimodality due to the limited body of work addressing the translation and perception of Chinese culture in the context of Artificial Intelligence-driven communication. Chen Xi (2019) explores multimodal discourse analysis in relation to contemporary Chinese propaganda videos produced for museum purposes, particularly from the perspective of new media.

This research is grounded in the theoretical framework of multimodality in translation and communication, particularly the model of "multimodal translated texts reception" outlined by Tuominen, Jiménez Hurtado, & Ketola (2018). The aim is to explore the modalities and types of modes that are most effective, as well as the optimal methods for multimodal translation and communication. The primary objective is to refine the design of websites for Chinese national museums and bring the authentic exhibition experience to physical exhibition venues. Several surveys conducted by scholars such as Shen & Yuan (2018), Guo et al. (2021), De Gruyter. (2022) have evaluated the role of emerging technologies, including AI, mobile technology, big data, and artificial intelligence, in translation. However, there is a notable lack of research exploring how these new technologies—such as AI, mobile technology, big data analysis, and smart media—may influence the expansion or decline of Chinese museum culture. Building upon the Reception Studies theory of Multimodality in Translation and Communication, there is a clear need for further extensive research to confirm the effectiveness and appropriateness of multimodal translation and communication strategies in the context of Chinese museum culture (Paschalidis, G, 2009). Moreover, as China's commercial and economic influence continues to grow, it is expected that these advancements will further enhance and solidify China's positive image and global impact. The study demonstrates how AI supports the translation and dissemination of various aspects of Chinese museum culture through multiple modalities. Three distinct strategies are outlined, each tailored to specific usage scenarios and objectives. A random selection of 200 international and local Chinese visitors, who have not previously visited the National Museum of China, will be invited to experience the museum both online and in person. The effective integration of multiple methods, particularly the use of audio guides offering contextual information, enhances visitor engagement over time. Furthermore, AI-driven overlays enrich physical exhibitions, positively influencing the spatial experience.

Research Objectives

This study aims to achieve the following objectives:

RO1: To investigate the place of modern transcultural translation and communication related to Chinese Museum culture.
RO2: Focus of this research work is to define the ideal multimodal approach and implementations that could be utilized by museums in China, to upgrade the design of the two virtual and physical exhibitions, more specifically the websites.
RO3: The research objective here indicates the research work that can be done as to how newly developed technologies can be utilized to make the process of Chinese museum culture in the era of AI a success, so that its effect may be increased too.

Research Questions

This research aims to address the following research questions:

RQ1: What is the current state of translation and communication activities related to Chinese museum culture?
RQ2: What are the most effective multimodal translation and communication models and methods for improving the design of Chinese museum websites, as well as virtual and physical exhibitions?
RQ3: How are emerging technologies in the era of Artificial Intelligence being utilised to enhance the impact of translation and communication in Chinese museum culture?

Scope of Study

Through the application of a mixed-method research paradigm, including both qualitative and quantitative approaches, this study aims to examine the influence of artificial intelligence in conjunction with technologies such as mobile technology and big data on Chinese museum culture in various contexts. The focus of this research is on visitors to Chinese museums, who constitute the target group. The sample comprises 200 individuals randomly selected from the population of international visitors at Beijing Language and Culture University. The National Museum of China has been chosen as the research site due to its prominence, extensive collections, representativeness, and strategic location in Beijing.

Research Hypothesis

Hypothesis 1: The modality type will influence the translation and communication of Chinese museum culture.
Hypothesis 2: The level of coherence in the usage of modality will influence the effectiveness of translating and communicating Chinese museum culture.
Hypothesis 3: The presence of time and space will influence the translation and transmission of Chinese museum culture.
Hypothesis 4: Individual differences will affect the translation and communication of Chinese museum culture.
Hypothesis 5: The utilization of emerging technologies in the age of Articial intelligence can amplify the impact of translating and communicating Chinese museum culture.

Significance of Research

In the era of AI, it is essential to effectively integrate and synchronise Artificial Intelligence, mobile technology, and big data to translate and communicate Chinese museum culture to a global audience. This can be achieved through the adoption of AI and a multimodal approach. By leveraging network platforms and AI tools, we can generate substantial multimodal cultural content that significantly shapes and disseminates the Chinese museum cultural landscape. Interdisciplinary technologies have the potential to transform abstract concepts into dynamic, multi-dimensional images. Furthermore, dynamic virtual experiences, vibrant colours, and seamless multilingual translation enable immediate access to distant Chinese civilisations, presenting them to audiences as if they were tangible landscapes before their eyes. To effectively construct a comprehensive Chinese museum cultural environment, it is crucial to encourage information recipients to engage with cultural aspects through a variety of sensory experiences, including visual, auditory, tactile, and olfactory stimuli, as well as through diverse communication channels. The integration of emerging technologies such as Artificial Intelligence, mobile technology, and big data into AI-driven systems will facilitate the development of a sophisticated language, multimodal communication, multi-dimensional visualisation, and engaging narrative content. As a result, the translated Chinese museum culture will be enriched and vibrant, offering audiences an exceptional experience of Chinese culture, both in person and online.

The aim of this research is to provide recommendations and guidance to Chinese museums and relevant government tourism organisations to enhance the translation and communication of Chinese museum culture. The implementation of multimodal translation and communication through Artificial Intelligence is expected to attract an increasing number of domestic and international visitors to Chinese museums. This will, in turn,

deepen their understanding of Chinese history and culture, fostering a desire to visit China and engage in trade. Consequently, China's global reputation and influence are expected to grow alongside its expanding trade and economic advancements (Shan, S.-L.,2014). This study examines the role of AI in enhancing communication within Chinese museums. It focuses on AI's potential to serve as an intermediary between museum collections and society. The research will explore human-computer interaction standards, machine learning-based recommendations, and AI-driven data sets for accurate advice. The findings suggest that big data, AI, and virtual technologies could improve traditional communication methods, facilitating better translation and interaction with Chinese museum culture. The study highlights the use of digital tools like text, photography, audio, video, and 3D scanning to engage audiences both in-person and online (Shen et al., 2021). This paper explores how translating Chinese museum culture can bring vibrancy and broader appeal, highlighting China's rich past. It discusses various intermodal contact points for deeper audience engagement and supports the "bread and circus" theory with real examples from Chinese museums. The author aims to demonstrate, using evidence, that advanced technology can effectively share and display Chinese culture through diverse platforms.

Literature Review

The Role of Multimodality in Translation and Communication

The academic community has extensively researched multimodal translation and communication, given their inherent multimodal nature. Translation studies have traditionally focused on language, but Littau (2011) note that language is just one form of textual data, with "modality" as a symbolic tool for conveying meaning. Despite the close relationship between verbal and non-verbal sign systems, research on translating non-verbal indicators remains insufficient. Jakobson (1959) classified translation into three types: intra-linguistic, inter-linguistic, and inter-symbolic, the latter involving non-linguistic signs. Mayoral, Kelly, & Gallardo (1988) recognised the role of non-linguistic elements like images and music in meaning-making, though these were initially seen as obstacles in the translation process. Multimodal translation evolved slowly over the twentieth century. The development of multimodal translation is closely linked to advancements in communication science. In the 21st century, globalisation and the widespread use of the Internet have amplified mass communication. This shift, driven by clearer communication frameworks, has ushered in the media era. Technological progress has transformed information dissemination, allowing for quick and direct access to translated content. As a result, translation is no longer confined to traditional paper-based text. The content and structure of media now play a key role in how symbolic forms are communicated, presenting new challenges for translation studies.

In the era of Artificial Intelligence, the presentation of museum culture has become a prominent method of communication, encompassing various forms of expression. The information systems of these displays predominantly focus on photographs, facilitating the integration of diverse new technologies to enhance the translation and sharing of Chinese museum culture through multiple media. Several scholars have contributed to discussions on multimodal translation. Littau (2011) aims to establish a theoretical framework for multimodal translation studies within the context of the "medial turn." Littau (2011) achieves this by providing a historical context and clear definition of multimodal translation studies, systematically classifying its various forms, delineating its research scope, and explaining the methodologies currently employed in the field of translation studies. Tuominen et al. (2018) propose three strategies within the realm of multimodal translation research. They argue that employing two or more modalities for translation and communication yields more effective outcomes than relying on a single mode. The concept of multi-focus multimodal acceptance theory expands our understanding of how museum visitors receive and interact with information. This theory suggests that acceptance and understanding go beyond textual explanations to encompass a range of modalities, including language variations, visual imagery, and dynamic content such as short videos. Below are several implications of this theory in a museum context:

Enhanced Engagement: By incorporating multiple communication modes—such as text, images, audio, and video—museums can engage a broader audience. Different visitors have diverse learning preferences; some may favour visual information, others auditory, and some may benefit from interactive or textual content. A multimodal approach accommodates these varying preferences, potentially increasing overall engagement and comprehension. Improved Accessibility: Multimodal content can make museum exhibits more accessible to individuals with disabilities. For example, audio descriptions can assist visually impaired visitors, while videos with subtitles can support those who are deaf or hard of hearing. This inclusive approach ensures that more people can access and benefit from museum experiences. Greater Retention of Information: Research in educational psychology suggests that individuals retain information more effectively when it is presented in multiple formats. This approach can be particularly useful in a museum setting, where the combination of text, images, and videos reinforces learning and makes complex historical or cultural concepts more understandable.

Cultural Sensitivity: The theory encourages the use of diverse linguistic and cultural representations to respect and reflect the global diversity of museum audiences. By offering information in multiple languages

and incorporating culturally relevant materials, museums can create a more inclusive environment that resonates with a wide range of visitors. Dynamic Learning Environments: The integration of short videos and interactive elements can transform static exhibits into dynamic learning environments. This approach not only makes the learning experience more engaging but also allows visitors to explore deeper layers of content at their own pace, offering a more personalised experience. Challenges in Implementation: While the benefits are evident, implementing a multi-focus multimodal approach presents challenges, such as the significant resources required to produce diverse content, and the technological infrastructure needed to support it. Furthermore, the system's design must be intuitive to enhance the visitor experience rather than complicate it. Evaluation and Adaptation: To ensure effectiveness, museums must continually evaluate how visitors interact with multimodal content and adapt their strategies based on feedback and evolving technological advancements. This includes assessing the impact of different modalities on learning outcomes and visitor satisfaction. This study aims to explore how effectively multimodality is used in translating and promoting museum culture in China. Based on the theoretical foundations discussed, it assumes that translators can transform museum content into multimodal translations. The goal is to identify precise patterns in multimodality and propose the most effective methods for translation and communication to enhance web and exhibition design for Chinese museums. Artificial Intelligence will be used as an intermediary in this process.

Mediation and Translation

Despite detailed scrutiny of the source, different authors use varying expressions for distinct occurrences. Translation Studies is a vast field, with mediation being a key topic, particularly regarding translators' roles in resolving disagreements (Luan Yimei, 2018). Studies on "multimodal mediation" are scarce, though Luis Pérez González. (2014) explores how language and communication modes mediate intercultural exchanges. The proposed study aims to use multimodal social media for translating and sharing Chinese museum culture, addressing a specific research question.

Translating and Communicating Chinese Museum Culture in the Age of Artificial Intelligence

The main study areas of Chinese scientists in the field of Chinese museum culture often focus on the translation and promotion of this culture. Scholars have examined methods used in translation and communication by local museums in China, as highlighted in the publications of Wang & Xu (2015). The second and third studies investigate the impact of translation and communication at specific museums in China. For instance, Mingyu & Xianzhu (2010) explore the application of machine translation in translating Chinese-English ancient literature collections from museums. However, there is a lack of studies addressing the integration of Chinese museums into the multimodal level of comprehension. One example is Gong and Jia's (2015) investigation of the Forbidden City in Beijing, which examined the multimodal translation of cultural assets. Recent research related to "Artificial Intelligence and Translation" has focused on areas such as "Computer-Assisted Translation" and "Automated Machine Translation." These topics were studied by scholars such as Cheng & Yang (2021), Jiang & Lu (2021), and Li (2020). Additionally, researchers like Shen & Yuan (2018), Guo et al. (2021), have explored the application of innovative technologies, including artificial intelligence, mobile technology, and big data, in translation. The work of Shen et al. (2021) centres on a multimodal discourse analysis of CCP museum propaganda videos, with a particular focus on the perspective of new media.

Research Gap

Unfortunately, despite the growing body of research on how AI can be applied to the multimodal translation and communication of modern Chinese museum culture, only a limited number of studies have been conducted on this subject. This is particularly evident in the focus on the multimodality approach, which lies at the heart of translation and communication. Furthermore, to be both relevant and engaging, future research in this field needs to be more intensive. Previous studies have noted the lack of attention to the critical issue of how to accurately translate and communicate Chinese culture within the context of museum culture, particularly regarding the translation and communication window. However, the extensive academic foundation necessary to explore the diverse communication methods that can convey and enhance understanding of Chinese museum culture in the rapidly evolving world of AI remains largely unexplored. This research design seeks to integrate the theory of multimodality in translation and communication with three core questions: What is the best way to implement multimodality? What are the ideal approaches for multimodal translation and communication? And what role do Artificial Intelligence technologies play in enhancing the website design and on-site exhibitions of Chinese museums in the context of AI? In recent years, many studies have been conducted on the translation and communication of Chinese museum culture. However, there is a lack of research on the multimodal translation and communication of Chinese museum culture. Very few have explored Chinese museum culture through the lens of multimodality in the advanced media era, which is why multimodality remains relatively uncommon in this field. This investigation will be conducted through surveys aimed at identifying the most effective modes of multimodality for translating and communicating Chinese museum culture. The surveys will also examine how digital technologies can be leveraged to enhance the aesthetics of Chinese museums' websites

and their virtual exhibitions, particularly in the context of AI.

Research Design

The objective of this article is to evaluate the current translation and communication practices within Chinese museum culture. Specifically, the research will focus on determining whether multimodality is essential and effective in translating and disseminating museum culture across China. Additionally, the study will explore multimodal translation and communication strategies that can enhance exhibition designs for both virtual and physical exhibitions on Chinese museums' websites. Another aim is to examine the industrialisation of cultural translation and communication in the era of smart media. To achieve these objectives, the research will utilise surveys as the primary instrument, with the main methods being polls and interviews. Data collection will involve three online surveys, with a total of 200 participants from Beijing Language and Culture University in China. These participants, who have not previously visited the National Museum of China, will be randomly selected to engage in both online and offline cultural tours at the museum.

Research Method
Survey

This study aims to assess the current state of translation and communication in Chinese museum culture, exploring the role of multimodality in these activities. It will also investigate effective methods for improving the design of museum websites and exhibitions, both virtual and physical. Additionally, the study will examine how new technologies, and artificial intelligence can enhance translation and communication in Chinese museum culture in the AI era. A survey method, including questionnaires and interviews, will be employed to gather data.

Questionnaires

Quantitative approaches offer the advantage of generating accurate, reliable, and generalisable results. In this study, the primary data collection method will be questionnaires. These surveys will be distributed to 200 respondents currently enrolled at Beijing Language and Culture University in China, who have not previously visited the National Museum of China. The respondents will be asked to participate in both online and in-person visits to the museum.

Target Population
International and Local Chinese Visitors to Chinese Museums

International visitors, with their professional skills, can actively promote Chinese civilisation, build bridges of friendship, and serve as key envoys for exchanges between China and the rest of the world. By visiting Chinese museums, they gain a deeper understanding of China's rich history, culture, and art, establishing a strong platform for cultural and artistic exchanges. This fosters a quicker and more effective promotion of Chinese culture worldwide and encourages friendly interactions between Chinese and foreign youth.

Access Population

200 random samplings from international and Local visitors.

Sampling Technique

Judgmental or Purposive Sampling (to select the questionnaire and interview respondents according to their nationalities.

Interviews

The advantage of interviews lies in their ability to explore complex issues through proper explanation, guidance, and follow-up, enabling the collection of new and in-depth information. The 10 interviewees will be randomly selected from among the 200 questionnaire respondents, including both international and local visitors to the museum.

Data Collection

The results from the three questionnaires will be analysed using SPSS, while the findings from the three interviews will be examined using the Nvivo programme.

1. The first step will assess the current state of translation and communication activities in Chinese museum culture. The first questionnaire and interview will focus on the National Museum of China, evaluating its website design, virtual exhibitions, on-site exhibitions, and services, examining their characteristics, quality, impact, benefits, and drawbacks.
2. The second questionnaire and interview will explore the necessity and advantages of multimodality in translation and communication for Chinese museum culture. This will investigate the effectiveness of multimodal translation and communication in enhancing museum website designs for both virtual and

physical exhibitions. The focus will be on single modality (such as visual elements or audio) and multimodality (combining objects, words, and audio-visual narration), including the cohesion of modality and the influence of time and space.

3. The third questionnaire and interview will focus on the role of Artificial Intelligence in improving translation and communication in Chinese museums. This will cover the use of AI technologies, including VR, AR, and 3D, and explore whether tools like ChatGPT are part of the visitor experience. It will also examine the use of new technologies and media during visits and browsing.

Results and Data Analysis

Data analysis will be conducted using SPSS software, primarily employing Frequencies and Descriptive Statistics to examine the questionnaire results. Correlation Analysis will also be performed to assess the significance of the relationship between two variables. The interview data will be analysed using Nvivo software, with additional reasoning and analysis by the researcher. The responses from both the questionnaire and interview were positive. According to the questionnaire, 81% of respondents found the field trip highly beneficial for enhancing their understanding of Chinese culture, while 19% considered it useful. No respondents indicated the trip was unhelpful. During the interview, overseas visitors expressed gratitude for the chance to visit China, immerse themselves in its culture and history, and engage with locals. They highlighted the enjoyment the experience provided and noted the growing importance of tour guides in explaining museum collections, Chinese culture, and history. After administering a pretest and posttest, the researcher analysed the data and identified a significant difference in visitors' comprehension of Chinese culture before and during the field trip. The statistical significance was 0.016 ($\alpha \leq 0.05$), and the average difference was 9.8. This result meets the criteria for a successful educational excursion as outlined by the teacher. According to the teacher's evaluation, all participants were highly satisfied with the field trip and reported a noticeable improvement in their learning experience compared to the classroom setting. This finding aligns with assertion that enhancing the curriculum through activities such as field trips is one of the most effective methods for promoting lifelong learning. Based on these observations, the teacher can confidently conclude that the field trip was a resounding success.

The museum provides visitors with a unique educational environment that stimulates multiple senses, allowing them to engage with both the natural world and aspects of human culture through sight, sound, and, in some cases, touch, smell, and taste. The goal of school field trips is to achieve academic objectives that align with the curriculum, as well as several supplementary goals designed by educators. School excursions offer students a fresh perspective and deepen their understanding of the world around them. Moreover, a well-planned educational excursion is considered one of the most effective ways to integrate the curriculum and foster a lifelong love of learning the researcher expects that following the excursion, international students will demonstrate a significant improvement in their understanding of Chinese culture. The importance of field trips in the learning process should not be underestimated, as they provide numerous benefits that extend beyond the classroom. Field visits, which involve direct interaction with the subject of study, are the most effective way to facilitate comprehension. These excursions introduce a sense of novelty and refreshment to students' routines. According to Tuominen et al. (2018), learning that occurs outside the classroom has a more profound impact, as it enables students to actively engage with their surroundings. The questionnaire demonstrated a high level of reliability, with a Cronbach's Alpha coefficient of 0.912, well above the 0.7 benchmark. This suggests the questions were clear and participants understood them. Removing any questions would lower the reliability below 0.7, indicating no poorly formulated or redundant items. However, the small sample size ($N<30$) could slightly affect the Cronbach's Alpha, leading to further data runs to verify consistency. Run 1 results were retained if they matched those of Run 2. Additionally, the Corrected Item-Total Correlation test showed all questions had a satisfactory score (>0.3), indicating coherence and no inconsistencies.

Nvivo Analysis of Interview Results

The duration of time spent assessing a location can significantly influence the evaluation outcome. Respondents can choose the time for assessment, and the longer they spend in a location, the easier it becomes for them to evaluate it. However, a shorter duration makes evaluation more challenging. A prolonged assessment doesn't always result in a positive evaluation. Wagele and colleagues noted that as visitors acquire more knowledge, their interest in the location tends to decrease. For example, an exchange student from Thailand described feeling hot and thirsty at Taman Sari, where he struggled to find a drink, leading to diminished interest and dissatisfaction. He had difficulty finding information about the site and repeatedly asked questions. The interviews show that individual experiences and values greatly affect the judgement of a location.

1. Impact of National Museum Visit on International Visitors

The National Museum provides a unique learning environment that differs from traditional classrooms.

All participants agreed that the museum excursion positively impacted their cultural knowledge of China and their understanding of Chinese artefacts and history. For 86% of respondents, the visit increased their knowledge of China and its culture. This was further supported by unprompted comments indicating that the visit significantly enhanced their prior understanding. 67% acknowledged that the museum visit improved their understanding of China, especially aspects they had limited knowledge of previously. This direct impact from a tour programme is uncommon, warranting further investigation to determine if such outcomes can be consistently replicated. Overall, the museum effectively met its goals as a cultural institution, fostering cultural education. Regarding changes in perceptions about China, 74% of respondents agreed, with 39% strongly agreeing, highlighting the significance of this outcome.

2. Comparison of Online and Spot Visit Experiences

The experiences of visitors during virtual and in-person museum visits can differ significantly based on their behaviour, prior knowledge, and level of engagement with the content. In general, most visitors consider field trips to be the best way to experience the national museum. This is reflected in the fact that 56% of visitors opted for a physical visit. A key reason for this preference is that an in-person visit provides a unique atmosphere and experience that cannot be replicated online. Visitors can observe and interact with relics and objects in person, an experience that online visits cannot offer. This allows them to gather information that may not be adequately conveyed through the limited digital resources available on the museum's website. Based on visitor behaviour, conducting a guided tour or encouraging visitors to complete preparatory readings before exploring the exhibits could enhance their understanding during on-site visits. In the context of the national museum, most people prefer a physical visit for a more direct and tangible experience with history, rather than relying on online resources. However, international visitors face a distinct set of circumstances and must weigh various options when deciding whether to visit in person.

This research aims to compare the experiences of online and in-person visits. Non-Chinese visitors sometimes struggle to grasp the significance and historical context of Chinese exhibits. This challenge can be addressed by providing English guide maps or organising dedicated guided tours for international visitors. One cost-effective solution would be to recruit and train a small group of Chinese visitors to provide explanations in English. The increasing number of international visitors to China underscores the importance of giving them direct exposure to Chinese culture and history. This is essential not only for their personal educational development but also for fostering improved global communication and understanding of China. The cultural experience remains the most important aspect of the visit. Based on the research findings, the following recommendations are proposed to enhance the cultural experience during visits to the National Museum.

Table 1: *Participant Demographics.*

Demographic Variable	Participants
Gender	Male: 100 Female: 100
Age	18-20: 50 21-23: 100 24-26: 50
Nationality	China: 50 Other: 150
Field of Study	Humanities: 100 Sciences: 50 Arts: 50
International	299
Smartphone Ownership	Yes: 200
Social Media Usage	Daily: 200

The demographic characteristics of the research participants are presented in Table 1, which includes information on gender, age, country of origin, area of study, frequency of museum visits, smartphone ownership, and social media usage. The sample was balanced in terms of gender, with participants ranging from 18 to 26 years of age. Most participants were international visitors from countries outside China, representing a broad spectrum of academic fields, predominantly within the humanities. All participants were visitors to the National Museum of China and reported using smartphones and engaging with social media daily.

Table 2: *Summary of Questionnaire Responses - Current Situations of Translation and Communication.*

Aspect	Average Rating (Out of 5)
Features of National Museum	4.2
Quality of Exhibits	4.5
Effectiveness of Communication	4.3
Advantages	Interactive Exhibits, Informative Signage
Disadvantages	Limited Foreign Language Support, Overcrowding

Table 2 presents an overview of the questionnaire responses regarding the current state of translation and communication at the National Museum of China. Participants provided positive evaluations, with scores averaging above 4 out of 5, for the features, quality of displays, and effectiveness of communication. Respondents highlighted the advantages of interactive displays and informative signage. However, they also identified areas for improvement, including a lack of sufficient foreign language support and issues with overcrowding in certain sections of the museum.

Table 3: *Summary of Interview Responses - Current Situations of Translation and Communication.*

Theme	Summary of Responses
Websites Design	User-friendly layout, but lacking in multilingual support and interactive features
Virtual Exhibition	Engaging content, but limited accessibility for non-Chinese speakers
Spot Exhibition	Immersive experience with tangible artefacts, but challenges with overcrowding
Other Services	Friendly staff, but long queues for certain attractions

Table 3 provides an overview of the key themes drawn from interview responses regarding the current state of translation and communication at the National Museum of China. Participants praised the museum's website for its user-friendly design but suggested improvements in its multilingual capabilities and interactive features. The virtual exhibition was appreciated for its engaging content but faced criticism due to limited accessibility for those who do not speak Chinese. The on-site exhibition received positive feedback for offering an immersive experience with physical artefacts, though overcrowding was identified as a challenge. While services like staff politeness were well-received, there were concerns about long waiting times for certain attractions.

Table 4: *Summary of Questionnaire Responses - Multimodality in Translation and Communication.*

Aspect	Percentage of Agreement
Importance of Multimodality	85%
Preferred Modality	Multimedia (Audio-Visual)
Influence of Time	Enhances Understanding
Influence of Space	Creates Immersive Experience

Table 4 summarises the results from a questionnaire aimed at determining the significance and preferred methods of multimodal translation and communication. A substantial majority of respondents (85%) agreed on the importance of multimodality in enhancing the museum experience. Participants favoured multimedia elements, particularly audio-visual components, noting that the application of multimodal techniques helped improve understanding and created immersive experiences by effectively utilizing both time and location aspects.

Table 5*: Summary of Interview Responses - Multimodality in Translation and Communication.*

Theme	Summary of Responses
Types of Modality	Audio guides, interactive touchscreen displays, AI
Cohesion of Modality	Seamless integration enhances visitor engagement
Influence of Time	Audio guides provide contextual information, enhancing comprehension
Influence of Space	AI overlays enrich physical exhibits

Table 5 presents the themes identified from interview responses regarding the use of various modes in translation and communication. Participants highlighted several modalities, including audio tours, interactive touchscreen displays, and artificial intelligence, as being particularly beneficial in enhancing the museum experience. The effective combination of multiple methods was found to improve visitor engagement, with audio guides being especially recognised for offering contextual information that enhanced understanding over time. The integration of artificial intelligence overlays was also shown to enrich physical exhibitions, positively affecting the spatial experience. Table 5 provides a comprehensive summary of the data collected from the study, offering valuable insights into participant characteristics, their views on current translation and communication methods, and their preferences for multimodal techniques in museum settings.

Assessment of Qualitative Data

The Mediating Role of Artificial Intelligence in Multi-Mode Translation for Communication and Translation in Chinese Museum Culture

This research paper explores the influence of multimodal mediation on translation and communication in Chinese museum culture during the era of AI. The focus is on museums operated by the National Museum of China, drawing on the results from on-site surveys conducted at these institutions. The paper is framed within the theoretical context of Multimodality in Translation and Communication. AI is considered

indispensable for managing museums, both at the operational level (serving visitors and optimizing processes) and in enhancing the visitor experience. While this research mainly examines the translation process that typically occurs behind the scenes, it also touches on front-end interactions. These are particularly important in different museum settings, including smaller indoor museums, larger outdoor cultural and educational facilities, and virtual spaces where visitors engage during their leisure time.

The Position Where AI is Located in the Fields of Translating and Interpreting Chinese Museum Culture Textual Works in Multiple Forms

The significant advancements in machine translation technologies such as Google Translate, Youdao Translate, and Sogou Translate have led to notable improvements in translation accuracy, particularly with the integration of AI. These AI tools now serve as valuable advisers in the translation process, assisting human translators in refining their work. As a result, translation efficiency and accuracy have significantly increased. However, to fully understand and harness the potential of translation technology, it is crucial to focus on advanced tools and methods such as big data technology, pattern recognition, and algorithm modelling. These techniques enable a more detailed mapping of the translation technology landscape, improving the depth, neutrality, and flexibility of analysis. Cultural artefacts, which serve as vessels of historical and cultural knowledge, play an essential role in disseminating information about past epochs and societies. The vocabulary surrounding these subjects is rich and expansive (Wang, N 2009). Therefore, AI's role in enhancing translation efforts is crucial, as it not only aids in translating the words but also helps in conveying the deeper cultural nuances inherent in these artefacts.

Creating a Chinese Museum Culture Translation Corpus using Artificial Intelligence

The integration of AI in translation technology, particularly for cultural and museum-related applications, has significantly enhanced the accuracy and efficiency of translating historical and cultural texts. By combining neural machine translation and internet technologies within a networked infrastructure, AI can effectively examine and understand data from various historical periods, including guiding and explanatory texts from museums and cultural heritage sites. This technology serves as a dynamic repository of language, capable of managing and interpreting the vast lexicon shared across different cultures. Cultural and festival documents, which are often made from diverse materials such as wood, papyrus, and silk, present unique challenges in both preservation and translation. These documents, like many Chinese cultural artefacts, reflect complex linguistic features—from lexical and syntactic structures to entire narratives within books. Over the past 5,000 years, Chinese society has produced an immense volume of literature and cultural objects, necessitating the incorporation of AI for effective translation and preservation (Fang L, & Ziyun F. 2020).

While AI plays a functional and supportive role in the translation process, the application of these technologies within the context of Chinese museum culture is still evolving. A crucial next step is the development of a Chinese English word-for-word translation system, which will serve as the foundational corpus for AI-powered machine translation. This will help refine translation techniques, enable the creation of meaningful international communication content, and provide a competitive edge in the global cultural exchange. The goal is to develop a more sophisticated AI system capable of translating and interpreting Chinese culture in ways that are accessible to a global audience, thereby promoting cultural understanding and communication across linguistic and cultural barriers.

AI offers opportunities that were previously unattainable by human translators, particularly when it comes to processing large volumes of documentation. By utilizing Artificial Intelligence to initially translate cultural and archaeological texts, the process can be significantly expedited. Human translators then refine and edit these translations to enhance their quality, ensuring that the final product is accurate and suitable for global dissemination. Additionally, the use of AI in creating a Chinese museum culture corpus can support scholars in conducting more efficient research on relevant genres. This corpus would provide a factual basis for improving future translations, ultimately contributing to a broader and more accurate global understanding of Chinese culture. The synergy between AI and human expertise has the potential to greatly enhance the global spread of Chinese cultural knowledge.

Application of Multimodal Mediation in Translation and Communication for Chinese Museum Culture

The investigation into "Multimodality in Translation and Communication" highlights the significant impact of combining various forms of communication on target audiences (Liu, 2021). Similar effects have been observed in both virtual and real-life museum experiences. Museums utilize a wide range of communication methods, including historical artefacts, images, written information, exhibition spaces, and other cultural heritage elements, to engage the intellectual and emotional needs of the public through educational visits (Wang et al, 2018). Plato's political philosophy emphasized the principles of justice, equality, and recognition of people's worth, which can also be applied to museums as establishments that convey diverse and multifaceted aspects of culture. Instead of relying solely on text, many modern museums

combine video, Artificial Intelligence, and other communication tools to present culture in a multi-layered way, moving beyond one-way communication. Today, museums employ text, images, audio, video, 3D exploration, and digital recording techniques such as scanning to create immersive and engaging experiences. These advancements support the cultural development of museums by offering online virtual browsing versions that are not only entertaining but also highly interactive and immersive for global audiences.

Additionally, museums display authentic cultural artefacts alongside accompanying textual information in both the original language and its translated version. This includes recorded data about the location where the artefact was found and the circumstances surrounding its discovery, which helps to strengthen the narrative of the exhibit. The exhibition not only showcases the physical artefacts but also incorporates contextual information in multiple languages, as well as audio-visual elements, to create an immersive and comprehensive cultural learning experience. This approach allows visitors to engage with the meticulously preserved cultural treasures in a hands-on, multidimensional way, enhancing both their understanding and appreciation of the exhibits.

The Role of Artificial Intelligence in Enhancing Visitor Interaction Experience

Several studies have explored the integration of Artificial Intelligence into museum visitor experiences and the enhancement of engagement. Researchers in education and machine learning have developed software capable of predicting the amount of time visitors will spend at specific exhibits. Innovations like smart-talking robots, or chatbots, are increasingly featured in Chinese museums to stimulate curiosity and maintain visitor interest. These chatbots, designed to mimic natural communication via text or voice, aim to assist visitors by fulfilling specific tasks. Despite advancements, the limited functionality of monolingual conversational robots, which cater mainly to Chinese-speaking visitors, restricts their effectiveness for a broader international audience. To improve this, we recommend implementing multilingual chatbots that can translate responses into various languages, offering information about Chinese museum culture to a larger population of foreign visitors. The widespread use of AI language tools and multilingual subtitles could further enhance the global appeal of Chinese art and culture.

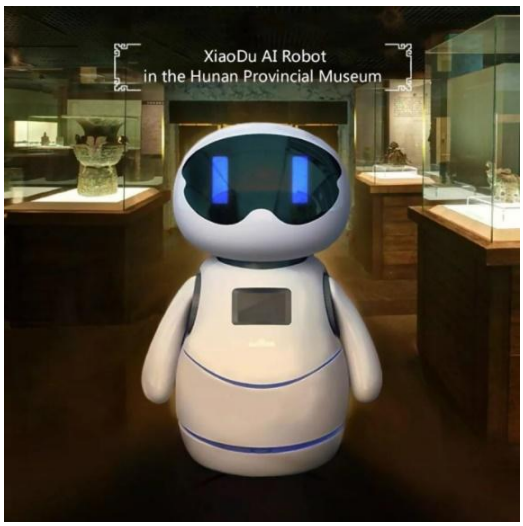

Figure 1*: Smart Guidance System at Museu.*

In late 2017, the Shanghai National Museum introduced smart navigation to accommodate the growing number of international visitors, a trend spurred by the success of the first China International Import Expo. On October 1, 2020, the English version of the smart guide system was launched. This version merges with the original guide, offering English translations of the content on the same flatbed guide. The system showcases 50 prominent cultural objects, a major attraction in the museum. It integrates multimedia animations alongside English interpretations, allowing for interaction between visitors and the system. An innovative feature, a speech bubble, enables international visitors to communicate with the system's chatbot to explore additional facts, while demonstrations recorded by experienced artists are also translated into various languages. The ancient sculptures, which have stood for centuries, are brought to life by presenting facts and stories directly to visitors. Instead of merely telling them, the experience encourages active engagement. For example, when discussing the decorative patterns on ancient bronze items, visitors can click on images to examine the patterns closely and even attempt to replicate them. This interaction not only sparks curiosity but also enhances their understanding of the patterns. The display of objects is complemented by animated visual demonstrations of assembly processes and a specialised user interface for historical machinery. Busy visitors can enjoy clicking through a step-by-step animation showing the restoration process, offering an immersive way to learn about the complex industrial techniques. This approach helps create a more comprehensive and nuanced appreciation of the past.

Figure 2: *Tea Preparation During the Song Dynasty.*

Figure 2 illustrates the process of flavouring tea by a Song Dynasty cook, with an animation showing the step-by-step procedure: crushing tea leaves, filtering the powder, measuring the tea, pouring hot water, and whisking. This demonstrates how human-machine interaction in museums is evolving, transitioning from traditional, one-way tours to more interactive cultural experiences. Through multimodal translation, visitors from China and around the world can explore museum content via websites, films, and audio, gaining valuable insights into Chinese culture. This approach broadens the reach, allowing a larger audience to engage with and learn about China's heritage.

Enhancing User Understanding and Service Accuracy via the Utilisation of Artificial Intelligence and Big Data

In the era of mobile internet and artificial intelligence, a user-centric approach remains at its peak and must be embraced. Customer data, which reflects consumer demands and preferences, serves as a prime example of service design focused on meeting user needs. Big data technologies allow for a shift from casual to relevant thinking, helping to identify customer interests and demands. This is achieved by conducting detailed assessments and categorising cultural resource alternatives for various user groups, both existing and potential. Oittinen, R. (2008). The use of big data technology facilitates the collection of vast amounts of information, enabling deeper insights into consumer behaviour and preferences. The cognitive processes of individuals seeking cultural services can be enhanced by analysing user experience data, cultural resources, and user clustering. This mechanism identifies key elements in user profiles by examining behavioural patterns and preferences. It then recommends personalised cultural resources tailored to these models, with a focus on the cognitive structure related to user behaviour and preferred features. This approach aims to improve the overall user experience by offering culturally relevant content that aligns with individual preferences and needs. The WeChat public platform for the Longmen Grottoes is divided into three primary functional categories: "audio explanation," "ticket booking system," and others. It also includes additional sections such as "area carrying capacity," "hot tips," and "Biggoes mall," with various departments supporting each function. By leveraging big data to analyse common user service choices and navigation patterns, vital features can be identified and tailored to meet the needs of different user groups. The platform is also capable of disseminating timely information to the public, such as during the Spring Festival, "peonies bloom," or other significant cultural events, ensuring the communication of essential data while maintaining historical accuracy and relevance to contemporary audiences.

The construction of a user model is crucial for integrating AI, enabling both the general improvement and augmentation of services through DL. In recent years, the rapid development of cloud computing and big data technology has facilitated the practical application of deep learning, one of AI's major achievements. This system systematically assesses user characteristics and considers specific criteria. Deep learning, which mimics the neural connections of the human brain and learns from extracted features of data, is a key strength of AI. This technology allows for precise user segmentation in museum services, reducing the time required for cultural asset management and enhancing the overall user experience. After the Longmen Grottoes WeChat public service group partnered with Tencent Map, they developed the "Smart Tour Longmen" miniApp. This app uses a parameter model driven by user characteristics, supported by a wealth of audio-visual data, to optimise the user experience. It integrates real-time GPS location features and 5G network speed, enabling faster interactions. The app establishes a connection between the user's personality, resources, and environment. It provides a custom route based on the user's current location within the park and displays map overlays that highlight nearby historical attractions. Additionally, it facilitates the gathering of audio and visual information for a more immersive experience.

Enhancing Chinese Museum Culture Communication via Digital Forms

Museums have greatly enhanced the tourist experience with the integration of technology, but the recent

coronavirus pandemic has imposed significant limitations on museum operations, such as restricted hours and reduced visitor capacity, with international tourism also being hindered by restrictions. In this context, digital museums, supported by AI as an intermediary, have emerged as a solution. Two prominent cultural centers in China, the Palace Museum and the Longmen Grottoes, have showcased exemplary digital museum integration in various areas. For instance, the Palace Museum's WeChat application "Digital Palace" serves as a powerful tool for visitors, offering extensive information about museum visits and providing access to "The Online Digital Heritage Library," which hosts over 83,000 digital materials. These materials, available in multiple languages, allow both Chinese and international visitors to explore images and detailed information about cultural artifacts while transmitting summaries to various other systems. The digital collection has solved the problem of overwhelming visitors by offering a cloud-based browsing system, where content can be filtered based on criteria like age, category, or color of objects. The website also offers diverse forms of cultural display, ensuring a more engaging experience. One feature, "Daily Palace," acts as a recommendation calendar, suggesting specific objects for visitors to explore each day, thereby enhancing their engagement and overall experience.

Figure 3: *Daily Palace Column Serves as a Calendar that Suggests Various Artefacts for Each Day,*

The Palace Museum offers visitors a unique and immersive experience, transforming their visit into a mysterious journey. One of the highlights is the cartoon Palace Museum zone, where visitors can collect materials to create classic Palace items, such as incense-burners, stone streetlights, and gold pillars (Graburn, et al, 2017). Using their eyes to navigate and fingers to click on cartoon figures, visitors engage in building these items. Each phase of the game provides a brief explanation, allowing visitors to embody the culture, regardless of whether they are fully aware of the learning process. This interactive experience falls under the category of "Tactile Applications," as it encourages learning through touchscreens for aesthetic exploration. The touchable applications aim to enhance understanding by offering personalized engagement and varying types of interaction, thus making the experience more immersive. According to research by N Oittinen, (2003), the screen serves as a mediator, fostering interactive engagements that cater to individual preferences, increasing exposure to cultural and museum topics and helping learners progressively understand new ideas.

Another example is the online museum "E-Dunhuang," which serves as a successful tool for communicating cultural information in multiple modes. The website effectively illustrates how to relate to cultural issues and museums, presenting the rich cultural heritage of the Mogao Grottoes and its surrounding areas through digital technologies (Zan, L et al, 2013). This digital collection, accessible globally via the internet, offers users an immersive experience. "E-Dunhuang" is a virtual, interactive exhibition that allows users to visit the grottoes online, explore wall paintings and on-site writings, and access multimedia in multiple languages. By transporting users to a realm vastly different from the real world, the exhibition provides an engaging and enriching cultural experience, encapsulated in an interesting tagline. Moreover, "E-Dunhuang" has the remarkable ability to digitally recreate the primary components of artefacts that are absent in the physical world. Due to the extensive historical background of the Dunhuang Mogao Grottoes, both natural and human factors have led to varying levels of deterioration of certain cultural artefacts. Through the application of artificial intelligence technology, "E-Dunhuang" employs digital restoration methods to restore and reconnect elements of the legacy that no longer exist in reality. This includes the restoration of potential colours, gestures, and other details that the paintings and grottoes may have originally featured, offering a more complete and immersive view of these cultural treasures.

Figure 4*: E-Dunhuang.*

In addition, "E-Dunhuang" reconstructs the entire carving process of the Mogao Grottoes, enabling people from around the world to embark on a virtual journey through time and space. These artefacts have served various purposes for thousands of years, catering to tourism, leisure, and scholarly analysis, spanning across different types and sizes. "E-Dunhuang" and other promotional efforts use visual elements to highlight Gansu's cultural resources, such as the Silk Road and Jiayuguan, as well as characters like the "Camel Caravan" and the "National Dancer." The platform offers the ability to translate the desired language into a variety of symbols, including navigation, interaction, and virtual representations. By integrating various materials, it provides a unique perspective on Gansu culture, enriching visitors' understanding of this region's heritage (Zhang et al, 2020). Furthermore, artificial intelligence, together with collaborative technologies such as internet platforms and emerging tools, can assist cultural institutions and museums in developing diverse interactive experiences. The use of captivating virtual exhibitions and multilingual translation infuses cultural content with lasting significance, helping to promote Chinese cultural heritage. This approach not only attracts more visitors but also enhances the effectiveness of various interpretative methods in Chinese museums. Thus, these findings suggest that using multiple translation and communication methods is far more effective than relying on a single approach (Tuominen et al., 2018).

Conclusion

During a period of rapid technological advancement, both the tech industry, which is focused on innovation, and the cultural domain, particularly traditional museums, are being profoundly impacted by the digital age. Recently, Chinese museums have embraced modern technologies such as virtual reality, artificial intelligence, 3D printing, and holographic projection, significantly enhancing the overall visitor experience. The role of museum exhibitions in creating an immersive, multi-level experience for audiences cannot be overstated. This is achieved through the strategic use of advanced technologies. For example, the Qingpu District Museum employs guided animation and virtual tours supported by big data, while the Longmen Grottoes utilize new media. Virtual reality and artificial intelligence-driven interactive online exhibition spaces, such as Digital Palace and E-Dunhuang, further enhance the experience. These technologies foster an immersive environment by integrating important audio-visual elements. As a result, the heightened multi-sensory experience enables visitors to gain a deeper understanding of the diverse cultural practices embedded in these displays, no matter how varied these cultures may be.

Limitations

Despite the advancements in technology, the challenge of accurately conveying cultural nuances remains. There is a risk of oversimplification or misinterpretation, which can diminish the depth of understanding artefacts. This is particularly relevant when presenting Chinese heritage to international audiences. While

AI has improved the translation of Chinese culture, limitations persist due to inaccuracies in AI-translated content. AI systems may not fully grasp the historical, cultural, and contextual subtleties needed for effective communication. Current AI technology is mainly designed for Chinese-speaking users, struggling to address the multimodal diversity required for global accessibility. To overcome this, ongoing research, system updates, and collaboration with professional translators are essential. The future of AI in cultural translation holds promise for improved functionality, aided by neural networks, expanded language datasets, and emotional computing. This integration could significantly enhance the global reach and dissemination of Chinese museum culture, benefiting both physical and virtual audiences.

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