A SERIOUS GAMES PERSPECTIVE EXPLORING THE NARRATIVE ELEMENTS OF VIRTUAL INTERACTIVE EXHIBITIONS: A CASE STUDY OF THE LIGHT OF CIVILIZATION EXHIBITION AT YUNNAN PROVINCIAL MUSEUM

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มุมมองเกมที่จริงจัง ผ่านองค์ประกอบการบรรยายเรื่องราวของนิทรรศการเชิงปฏิสัมพันธ์เสมือนจริง: กรณีศึกษา นิทรรศการแสงแห่งอารยธรรม ณ พิพิธภัณฑ์ประจำเมืองยูนนาน

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BY

JINGYUAN DUAN

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IN D.A. (ARTS AND CULTURE RESEARCH) AT SRINAKHARINWIROT UNIVERSITY

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Under the background of globalization and digital development, exploring the integration of serious game narratives and virtual exhibitions can help to enhance cultural understanding and participation, and promote cultural heritage dissemination and cross-cultural exchanges, which has important research value. This study aims to explore how to use the narrative of serious games to construct virtual interactive exhibitions to enhance audience participation and comprehension by taking the Yunnan Provincial Museum the Bronze Age of Yunnan Exhibition as a case study and designing relevant applications to verify its effectiveness and promotion value. This study adopts a mixed-methods approach, with the quantitative part surveying 65 Yunnan Provincial Museum visitors through questionnaires; the qualitative part interviewing five relevant experts, and the descriptive approach summarizing the findings. As a result of this study, the effectiveness of the application of narrative serious game virtual interactive display in Yunnan Bronze Age Exhibition was evaluated, confirming that it effectively enhances audience participation, deepens cultural memory, and provides an innovative paradigm for digital heritage education and future exhibitions. The study suggests a framework for incorporating virtual interactive narrative serious games in future museum exhibitions to facilitate deeper cultural exchange and drive digital transformation of museums.

Keyword : Serious Game, Narrative Elements, Virtual Interactive Exhibitions, Yunnan Provincial Museum the Bronze Age of Yunnan Exhibition, User Experience, Cultural Understanding and Memory

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CHAPTER 1
INTRODUCTION

1.1 Background

The word "museum" originated from the Greek word "mouseion" and was first used in the Alexandria Museum, set up by Ptolemy in 300 BC (Martins, C., 2021). Initially, museums in China were primarily royal repositories. These artifacts were inaccessible to the public and largely unused by society. However, this situation underwent a significant transformation with the dissolution of feudal society, marking a shift towards a more inclusive and democratic approach to cultural heritage. The term "museum" was not used; terms like "public offices" were employed. Wang Tao was the first person to translate the English word "museum" into Chinese as "博物院" (Bówùyuàn) (Ma Jingjing, 2022).

Figure 1 Wang Tao (1828-1897)

Source: Martins, C. (2021). Was Culture a Commodity 'All' Victorians Could Afford? *Notes on the First British Public Museums.,* 19. https://doi.org/10.5334/AS.42.

The museum industry entered a new development phase after the establishment of the People's Republic of China in 1949. The government prioritized cultural advancement, resulting in a rapid increase in the number of museums and the expansion of their functions. In recent years, the number of museums in China has

steadily increased, reaching 5,788 by 2020. These institutions have significantly developed the country's cultural undertakings (Insight and Info., 2022).

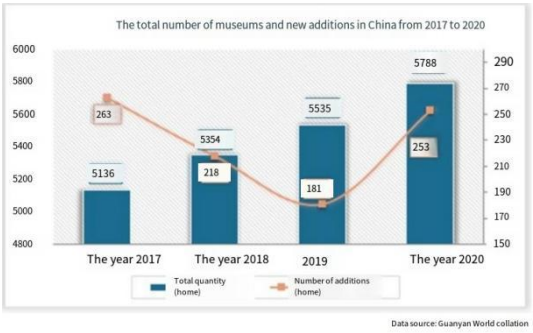

Figure 2 Total number of museums and new additions in China, 2017-2020

Source: Insight and info. (2022). China Digital Culture Industry Trend Research and Future Investment Analysis Report (2022-2029). *INSIGHT AND INFO.*

Throughout history, the presentation of museums has undergone a significant evolution. In the mid-20th century, museums primarily relied on static exhibitions. Artifacts were arranged in categories, with a strong emphasis on preservation and scientific research. These exhibits were straightforward, using text as the main information form and gradually incorporating pictures and models to enhance engagement. However, the early 21st century brought a technological revolution in museum exhibitions. The advent of touchscreens, projection technology, and virtual reality ushered in a new era of interactive displays. Some museums even went further, creating immersive exhibition halls that used sound, lighting effects, and realistic scene reconstructions to captivate visitors and enhance their experience.

With the development of information technology, Virtual Interactive Exhibitions have played an increasingly important role. They apply various digital technologies to compensate for the defects in traditional physical exhibitions and raise the audience's participation and experience through multimedia technology and interactive design to much higher levels.

Virtual Interactive Exhibitions are more than a novel way of presenting information. They represent a paradigm shift in Interactive mode, moving from passive acceptance to active engagement. By integrating the concept of serious games, Virtual Interactive Exhibitions create an immersive virtual environment for educational and entertainment purposes. This transition from passive teaching to active learning significantly enhances understanding and retention of the exhibited content, making Virtual Interactive Exhibitions a potent educational tool.

Serious games are game applications design principles for non-entertainment settings, making that setting more appealing and motivating for learning through interaction and feedback (Nico King, 2021). Audiences in Virtual Interactive Exhibitions could play an archaeologist who needs to do virtual excavations and research in a historical site to discover lost artifacts and past stories. It provides an interactive way to enhance attractiveness in exhibitions while improving how the audience understands and better memorizes cultural heritage and historical information through role-play and performance of tasks.

The exhibition emphasizes narrative elements to create a convincing and engaging story, naturally connecting various exhibits and information scattered throughout. It allows the audience to flow through time from one link to another with further emotional involvement and identification. The storyline enhances the audience's curiosity and searching nature and helps improve their learning experience and knowledge of the exhibition's theme through empathy.

What sets the study apart from previous attempts is its integration of virtual interactive exhibitions with serious games and narrative elements. This unique combination creates a highly immersive and interactive experience with significant potential for cultural communication and education. As techniques continue to develop and their scope of application expands, virtual interactive exhibitions based on narrative serious games will undoubtedly play a more prominent role in the museum arena, offering a meaningful way to present and disseminate cultural heritage.

The Yunnan Provincial Museum currently does not leverage narrative-based serious games within its exhibitions. However, the potential exists to integrate The Bronze Age of Yunnan Exhibition hall with narrative-driven serious games to create an interactive and immersive experience for visitors. This integration could potentially inspire unforeseen and captivating connections between the exhibits and the audience, enhancing the overall educational and entertainment value of the museum experience. The study presents this research work by taking The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum as a case in point to have an academic discussion on the application of state-of-the-art Virtual Reality and Augmented Reality technologies, further combined with serious game and narrative element to realize a vivid, lively, engaging virtual interactive exhibition. Such a virtual exhibition allows users to use electronic devices as entry tickets to immerse themselves in the ancient Dian Kingdom. Here, they could view the artifacts and do other extremely interactive tasks to understand better the deep history of the bronze culture of the Ancient Dian Kingdom in Yunnan.

Bronze civilization has significantly contributed to the world's cultural history, with many countries and civilizations boasting unique bronze cultures (Dario Radley, 2021). Considering the context of cultural globalization and pluralism, human culture's future development should ideally based on a model of unity in diversity and harmony in difference. To achieve this goal, respecting and protecting cultural diversity while achieving cultural unity is necessary. It underscores the importance of harmonious coexistence and mutual understanding among different cultures, ultimately striving to build a global cultural system characterized by tolerance and diversity.

The concept of harmony between unity and diversity is a cultural ideal in the context of globalization and a principle we should actively promote. Thanks to modern science and technology advancements, online exhibitions, virtual tours, interactive displays, and digital restoration of cultural relics are rapidly evolving in museum displays. These technological advancements significantly promote cross-cultural dialogue and enhance cultural understanding.

With the continuous advancement of digital technology, the digitization and virtual interactive display of global cultural heritage are expected to expand significantly. By leveraging narrative serious games virtual interactive exhibition approach, the research seeks to uncover the deeper value of The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum; through international cooperation, technological innovation, and public participation, we can achieve digital preservation and dissemination of cultural heritage, contributing to the inheritance and development of human civilization.

1.2 Objectives of the Study

1. To study how virtual interactive exhibitions can be narrated through serious games. How narrative can create compelling stories by skillfully combining elements of plot, character, setting, theme, and narrative perspective to increase audience engagement and understanding.

2. To study how to narrate in a virtual interactive exhibition from the perspective of a serious game in The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum.

3. Designing an application that combines virtual interactive exhibitions and serious games with The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum to demonstrate the validity of the results of the study and its applicability to other museums.

1.3 Significance of the Study

With the rapid advancement of digital technologies, museums, crucial venues for cultural dissemination and education, are facing a pressing need for more audience interaction. The monotony of traditional display methods is being challenged, and the integration of virtual interactive technologies offers novel solutions. Among these, serious games stand out for their potential to significantly enhance audience engagement. Our study focuses on applying serious games in museum virtual interactive displays, specifically exploring how narrative elements can amplify this engagement and improve experiential outcomes.

1. Based on the narrativized virtual interactive exhibition of serious games, attract more audiences both domestically and internationally and enhance the social influence and appeal of the Yunnan Provincial Museum. Promote the development of Yunnan's local culture, economy, education, and tourism.

2. Promote the protection of cultural heritage, enhance public awareness and participation in its protection, and promote the dissemination of ancient Yunnan bronze culture. The narrativized serious game virtual interactive exhibition lets the audience realize the importance of cultural heritage protection and encourages society to participate in its protection.

3. Reconstruct the interaction mode between visitors and museum exhibits through the virtual interactive exhibition of narrativized serious games. Unlike traditional exhibition hall visits, the narrativized serious game virtual interactive display can transcend the limitations of time and space and provide visitors with richer and more diverse learning experiences. Through the immersive historical and cultural learning process, visitors will have a profound knowledge of multiple dimensions, such as sensory, emotional, and cognitive.

4. Provide theoretical guidance and technical support for the design practice of virtual interactive museum exhibitions. A thorough analysis of practical cases in The Bronze Age of Yunnan Exhibition is undertaken within the framework of serious games, and a narrative structure is constructed to establish a series of design principles and guidelines that can serve as a valuable point of reference for the museum community. Promote the development and innovation of virtual interactive displays in the digital transformation of museums.

5. The narrativized serious games virtual interactive exhibition platform empowers the audience to independently choose and design their own viewing route and game mode. This unique feature allows viewers to tailor their experience to their interests, providing an immersive and personalized viewing experience. Interacting with other viewers in a virtual space and sharing insights and feelings enhances social connections, fosters community, and promotes shared learning.

In conclusion, this study opens up new horizons for virtual interactive museum exhibitions through narrativized elements from the perspective of serious games, holding certain academic and practical value. The research results contribute to the development of Yunnan's local culture, economy, education, and tourism and address the lack of interactivity in The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum, revolutionizing the form and content of museum exhibitions. Enhancing the audience's cultural experience and educational effect brings unprecedented cultural enjoyment and knowledge cultivation to visitors, inspiring Yunnan Provincial Museum's continuous innovation and development in the digital era. Ultimately, it paves the way for elevating the level of museum displays and their social and cultural functions, transforming how we engage with and understand our cultural heritage.

1.4 Scope of the Study

This study takes The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum as a case study and, based on the original traditional display method, researches how to apply the museum's virtual interactive display method, which is based on narrative serious games. The study will be divided into four parts:

1. Using field research, the Yunnan Provincial Museum and The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum are studied. The focus is on analyzing offline and online museums, exploring the strengths and weaknesses of the original display methods, and discussing the feasibility of the museum's virtual display methods based on narrative serious games.

2. The study delves into the practical applications of serious game theory and narrative theory in the context of virtual interactive museum displays. A literature survey and case study aim to provide valuable insights that can be directly applied in the field.

3. Interviews with staff in Yunnan Province Museum were conducted to understand their perceptions of existing displays and their views on museum virtual displays based on the narrativization of serious games. Interviews with museum virtual interaction design practitioners helped to understand their design approach and

creative thinking process. A questionnaire survey of Yunnan Province Museum visitors was conducted to understand the visitors' orientation towards serious game narrativization and their favorite display's way.

4. Based on the survey data analysis, this study will build a narrative virtual interactive exhibition application based on serious games, focusing on the display of bronzes in The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum.

1.5 Definition of Terms

1. Serious Games

The term "serious game" was first introduced in the 1970s by Clark Abt in his book Serious Games, where he provided the initial conceptual definition. Abt stated, "Serious games are neither games nor serious, but rather a combination of both." This kind of game does not take entertainment as its main purpose but adopts the form of a fun and educational game. The user receives information during the game and obtains a personalized, interactive, and entertaining new learning experience, thus stimulating the learners' creativity and innovative consciousness.

Serious games are often defined by their purpose rather than their form. They are designed to educate, train, and inform users while maintaining an engaging and enjoyable experience. This definition underscores the dual nature of serious games: they must be both educational and entertaining to be effective.

In summary, serious games do not have entertainment as their main goal but provide a personalized learning experience by achieving the desired effect through a fun and interactive game format. Serious games are used in various applications, including military, education, medical care, corporate training, cultural heritage preservation, and other fields. This study applies the concept of serious games to The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum to promote the cultural dissemination and education of ancient Yunnan bronzes. It stimulates users' creativity and knowledge memorization ability while entertaining them, better realizing the goals of cultural dissemination and knowledge learning.

2.Narrative Elements

Narrative research is a qualitative method that examines the stories of individuals or groups to comprehend their experiences and worldviews. It has evolved from anthropology, sociology, psychology, and literary studies to become an independent field of study.

Overall, the narrative constructs and understands individual and group experiences and worldviews by representing an event or series of events. It emphasizes the importance of language, social interaction, and subjective experience in generating meaning through symbolic systems.

The narrative element is crucial in The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum, which preserves, displays, and interprets ancient Yunnan and Yunnan bronzes. Narrative is not just a simple transfer of information but a way of storytelling that allows the audience to understand the exhibits' background, significance, and value. In the exhibition hall, narrative elements tell stories through various mediums such as text, images, and sound, which can help viewers establish an emotional connection with the exhibits and enhance their viewing experience and knowledge acquisition.

3.Museum Virtual Interactive

Contemporary museums are not merely places for displaying collections and artworks; museums today are regarded as a unique means of communication, playing a central role in disseminating culture to the public. One of the keys to reaching a broader audience is using new technologies and interactive models. These approaches bring undeniable appeal, enabling curators to tailor cultural offerings by designing diverse programs for different user groups.

Virtual interaction in museums refers to the use of technologies such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) to create interactive experiences in digital environments. These experiences enhance visitors' understanding and engagement with museum collections and exhibitions. This method of interaction goes beyond simple visual displays, incorporating multi-sensory

participation, including auditory, tactile, and olfactory elements, as well as various forms of interactive games, virtual tours, and digital restorations.

Currently, the Yunnan Provincial Museum has an online museum, a digital virtual exhibition hall displaying part of the exhibits, and a small number of virtual interactive devices, so there is still room for improvement in digital construction.

4.The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum

Yunnan Province is a frontier province that has always been regarded as a "barbarian land." However, the amazing discovery of "Yuanmou Ape-Man" in Paleolithic archaeology and the emergence of the golden seal of King Dian in the Bronze Age proved that Yunnan's ancient culture was ahead of its time and lagged behind that of the Bronze Age.

The Bronze Age of Yunnan Exhibition gathers the most representative artifacts of Yunnan's bronze culture based on significant records from "Records of the Grand Historian" and "Book of Han" about Yunnan during the Warring States and Western Han periods. It reveals the true essence of Yunnan's bronze culture from all angles and perspectives.

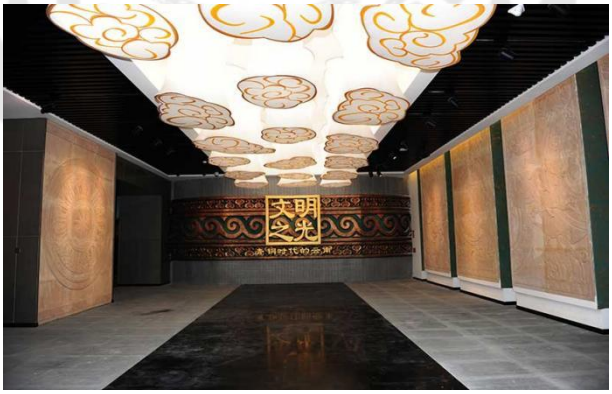

Figure 3 The Light of Civilization — The Bronze Age of Yunnan

Source: Yunnan Provincial Museum. *The Light of Civilization-Yunnan in the Bronze Age.* Yunnan Provincial Museum. https://www.ynmuseum.org/detail/644.html

CHAPTER 2
LITERATURE REVIEW

2.1 Overview of Yunnan's History and Culture

2.1.1 Overview of Yunnan History

The Yunnan Province is crucial in human civilization's history. The Yuanmou Man lived 1.7 million years ago and is among the earliest known humans in China and Asia. It was discovered in Shangnabeng, Yuanmou County, Yunnan Province. During the Xia and Shang dynasties, Yunnan was part of Liangzhou, one of ancient China's Nine Provinces. It was later known as the "Kingdom of Baipu" during the Yin and Zhou periods. In the 3rd century BCE, Zhuang Qiao, a general of the Chu State, established the Kingdom of Dian in the Dian Lake area (Yunnan Provincial Local Records Compilation Committee, 1985).

During the Qin dynasty, the "Five Foot Road" was built, and officials were appointed in Yunnan, marking the start of central government rule in the region. In the Eastern Han dynasty, the Yongchang Commandery was established in present-day Baoshan, further solidifying control over Yunnan (Yunnan Provincial Local Records Compilation Committee, 1985).

During the Wei, Jin, and Southern and Northern Dynasties periods, the present-day areas of Yunnan, Guizhou, and southwestern Sichuan were collectively known as "Nanzhong." In the Three Kingdoms period, some local slave-owning aristocrats in Nanzhong asserted dominance (Yunnan Provincial Local Records Compilation Committee, 1985).

In the Western Jin dynasty, Yunnan was reorganized as Ningzhou, directly governed by the central government, and became one of the country's nineteen provinces.

In the fifth year of the Xiankang era (339), Cuan Zhen surrendered to the Jin dynasty, which recognized his hereditary position and appointed him governor of Ningzhou. Thus, the Yi aristocratic Cuan clan began their 400-year rule over Yunnan.

During the Southern and Northern Dynasties, Liu Yu founded the Song dynasty and continued to appoint governors to rule Ningzhou (Yunnan Provincial Local Records Compilation Committee, 1985).

During the Sui dynasty, Emperor Wen of Sui appointed Wei Chong as the governor of Nanningzhou and dispatched troops to eliminate separatist forces, bringing Yunnan back under the direct control of the central government (Yunnan Provincial Local Records Compilation Committee, 1985).

In 707, the Tang dynasty defeated Tibetan forces in the Erhai region. In 738, Piluoge unified six tribes to establish the Nanzhao Kingdom, which the Tang dynasty recognized as the King of Yunnan (Yunnan Provincial Local Records Compilation Committee, 1985).

During the Nanzhao period, its territory extended east to Guizhou, west to the Irrawaddy River, south to Xishuangbanna, and north to the Dadu River. The southeastern border reached present-day Vietnam, the southwestern border reached present-day Myanmar, and the northwestern border was adjacent to Tibet. The northeastern border faced Rongzhou (present-day Yibin). This vast territory marked the significant expanse of Nanzhao's domain (Yunnan Provincial Local Records Compilation Committee, 1985).

Nanzhao internally reformed its system and expanded to build Tuodong City (present-day Kunming). The following year, it established its capital at Taihe City (present-day Dali).

In 879, Zheng Maisi assassinated the Nanzhao king and established the Kingdom of Dali. In the fourth year of the Guanghua era (901), Zheng Maisi seized power and declared himself King, renaming the state "Great Changhe." In the third year of the Tiancheng era of Later Tang (928), Yang Ganzhen established the "Great Yining" kingdom.

In the second year of the Tianfu era of Later Jin (937), Duan Siping allied with 37 tribes to overthrow the Great Yining Kingdom and established the Dali Kingdom. The history of the Dali Kingdom is divided into two periods: the first period from 937 to

1094, known as the Dali Kingdom, and the second period from 1096 to 1253, known as the Later Dali Kingdom. The Dali Kingdom maintained a subordinate relationship with the Song dynasty (Yunnan Provincial Local Records Compilation Committee, 1985).

During the Yuan dynasty, in the third year of Emperor Xianzong (1253), Kublai Khan led his army across the Jinsha River using leather rafts and entered Yunnan, conquering the Dali Kingdom. From this point, Kunming replaced Dali as the political center of Yunnan, which was fully integrated into the unified governance of the Yuan dynasty. The name "Yunnan" officially appeared as a provincial-level administrative institution from this time onwards (Yunnan Yearbook, 2023).

In the fourteenth year of the Hongwu era (1381), Zhu Yuanzhang dispatched generals Fu Youde, Lan Yu, and Mu Ying to march westward and pacify Yunnan. The mining industry rapidly developed, with Yunnan leading the nation in the production of silver and copper (Song yinxing, 1637).

In the late Ming period, the Daxi army supported exiled Emperor Yongli as they resisted Qing forces. Wu Sangui's attack forced Yongli to flee to Burma. Wu Sangui later captured and executed Emperor Yongli and his son in Kunming, marking the end of the Ming dynasty.

In the early Qing, Yunnan expanded territories and engaged in the Sino-Burmese War. After the Opium War, Yunnan fell under the French sphere of influence. In 1910, the Yunnan-Vietnam Railway was completed, and during the Republic of China, Yunnan reorganized its divisions. In 1928, Yunnan was restructured as a province, and in 1929, Long Yun was appointed governor. Kunming was established as a city in 1931.

Figure 4 Street Scene of Kunming City Gate during the Republican Period

Source: Baidu. (n.d.). Yunnan. Baidu. https://baike.baidu.com/item/%E4%BA%91%E5%8D%97%E7%9C%81/18664752?fr=ge_ala

During the War of Resistance Against Japanese Aggression, Yunnan played a crucial role in the national war effort, serving as a hub for relocating and developing wartime industries. Following the war, there were political changes, and in 1949, Yunnan was peacefully liberated and came under the leadership of the Communist Party of China (Zhou Ling, 2011).

2.1.2 Overview of Cultural Programs in Yunnan Province

Yunnan Province has hosted several prominent events, including the China International Travel Mart, the China Kunming Import and Export Commodities Fair, and the China-South Asia Expo. The province has also hosted significant international conferences and summits, such as the 1999 Kunming World Horticultural Exposition and the fifteenth meeting of the Conference of the Parties to the Convention on Biological Diversity.

By the end of 2023, Yunnan Province had 103 various art performance troupes, 149 cultural centers, 151 public libraries, and 186 museums. The province's population coverage rates for radio and television reached 99.68% and 99.70%, respectively. Additionally, there were 48 medium and shortwave relay transmission

stations and 137 radio and television broadcasting institutions (Yunnan Provincial Bureau of Statistics, 2024).

By the end of 2022, Yunnan Province had two World Cultural Heritage sites, three World Natural Heritage sites, and one World Memory Heritage item. The province boasted 105 national-level intangible cultural heritage (ICH) representative projects with 125 representative inheritors, 541 provincial-level ICH representative projects with 1,420 representative inheritors, 3,015 prefecture-level ICH representative projects with 3,568 representative inheritors, and 7,766 county-level ICH representative projects with 12,563 representative inheritors. Additionally, two projects were included in UNESCO's Representative List of the Intangible Cultural Heritage of Humanity. The province also had four national-level productive protection demonstration bases for ICH, 85 provincial ethnic traditional culture ecological protection zones, and 28 provincial ICH protection and inheritance bases (Spring City Evening News Client, 2021).

Table 1 Major Museums in Yunnan Province

Category	Name
National First-grade Museums of China	Yunnan Provincial Museum, Yunnan Ethnological Museum
National Second-grade Museums of China	Yuxi Museum, Honghe Hani and Yi Baizhi Prefecture Museum, Chuxiong Yi Autonomous Prefecture Museum, Dali Bai Autonomous Prefecture Museum, Kunming Zoological Museum, Kunming City Museum, Qujing City Museum, Baoshan City Museum

Table 2 Main Cultural Heritage of Yunnan

Category	Name
Globally Important Agricultural Cultural Heritage	Yunnan Honghe Hani Rice Terrace System, Yunnan Pu'er Ancient Tea Plantation and Tea Culture System
The Memory of the World Documentary Heritage	Ancient Naxi Dongba Script Manuscripts
UNESCO Representative Intangible Cultural Heritage	Humanity Dai Paper-cutting, Tibetan Epic Gesar
Significant Agricultural Cultural Heritage of China	Yunnan Honghe Hani Rice Terrace System, Yunnan Pu'er Ancient Tea Plantation and Tea Culture System, Yunnan Yangbi Walnut Crop Complex System, Yunnan Guangnan Babao Rice Ecosystem, Yunnan Jianchuan Rice-Wheat Cultivation System, Yunnan Shuangjiang Menghu Ancient Tea Plantation and Tea Culture System
China's National Intangible Cultural Heritage	Yi Narrative Long Poem "Ashima," Gesar epic poem, the Hani Seasonal Production Tune, the Lahu, Epic "Mupa Mipa," The Achang Epic "Chapa Ma and Chamima Ma," Yi ethnic group's Ha Cai Qiang, Hani Polyphonic Music "Planting Rice Planting Songs," Lisu folk song, Yi Smoke Box Dance, Lisu Song and Dance Azhimu Scrape, Dai Peacock Dance, Bronze drum dance of the Zhuang and Yi ethnic groups, Wa wooden drum dance, Tibetan Guo Zhuang dance, Dai opera, lantern, Dai Zhangha, Dai Paper Cutting, Naxi Dongba painting

2.1.3 Overview of Ancient Yunnan Bronze Culture

2.1.3.1 Ancient Yunnan (Dian Kingdom)

The Dian Kingdom (278 BCE—109 BCE) was an ancient separatist regime in China's southwestern border region. It was primarily centered around Dian Lake in central and eastern Yunnan. Historians commonly refer to its inhabitants as the Dian people.

According to "Records of the Grand Historian" (Shiji), in 278 BCE, the state of Chu dispatched General Zhuang Qiao to lead a force to the Dian Lake area. After conquering the local population, Zhuang Qiao remained in the Dian Lake region due to the route home being cut off by the Qin state, establishing the Dian Kingdom with its capital in present-day Jincheng Town, Jinning District, Kunming. However, whether the highly developed bronze culture of the Dian Kingdom can be attributed to Zhuang Qiao remains uncertain. Furthermore, archaeologists still need to identify clear elements of Chu culture within the Dian culture. According to historical records and archaeological findings, the Dian Kingdom existed for approximately 170 years, emerging in the late Warring States period and disappearing during the reign of Emperor Wu of Han.

Historians propose four main theories regarding the origin of the name "Dian Kingdom":

① The name derives from Dian Lake.

② The name originates from a local leader's name.

③ The name is a transliteration of a term from the local language recorded in Chinese.

④ The name comes from the ethnic name of the local dominant group, from which both the Dian Kingdom and Dian Lake derived their names (Xue Qian, 2013).

In 122 BCE, an envoy from the Han Dynasty reached the Dian Kingdom. The Dian King retained the Han envoy and dispatched people to find a route to the west, aiming to establish a connection with India (Huang Yilu, 2004).

Han troops arrived at the Dian Kingdom in the second year of Emperor Wu of Han's Yuanfeng era (109 BCE). The Dian King surrendered and requested the appointment of Han officials. Emperor Wu of Han granted the Dian King a seal and allowed him to continue ruling his people. Subsequently, historical records no longer mention the Dian Kingdom.

2.1.3.2 Ancient Yunnan Bronze Culture

Yunnan Province, known as the "Kingdom of Non-ferrous Metals," is one of China's major mineral resource provinces with abundant mineral resources. Due to the unique availability of resources, bronze artifacts are frequently utilized in ancient Yunnan. The Han Dynasty bamboo slips found at the Hepo site also mention the "Dian Kingdom," among other records (Globe and Mail, 2023). Archaeologists customarily call the bronze culture that appeared in the Dian Lake area from the Warring States Period to the Eastern Han Dynasty "Dian Culture."

During the Warring States period through the Qin and Han Dynasties, bronze products created by ethnic groups in the southwest of Sichuan and the Yunnan-Guizhou region showcased distinct ethnic features, imaginative designs, and mysterious shapes. Their bronze objects often featured engraved decorative paintings and three-dimensional sculptures, with many depicting a bull symbolizing wealth and numerous war scenes. These intricate and layered artworks were widely utilized in various aspects of production, daily life, and social activities.

In 1972, a Bronze Table with Tiger and Oxen Motif from the Warring States period was excavated from Tomb No. 24 at the Lijia Mountain ancient tomb site in Jiangchuan County.

Figure 5 Jiangchuan County Lijia Mountain Ancient Tomb Group Site

Source: Baidu. (n.d.). Jiangchuan County Lijia Mountain Ancient Tomb Group Site. Baidu Encyclopedia. https://baike.baidu.com/item/%E6%9D%8E%E5%AE%B6%E5%B1%B1%E5%8F%A4%E5%A2%93%E7%BE%A4/6213197?fr=ge_ala

The table, also known as the "chopping board," is a kind of ancient Chinese ceremonial instrument for placing meat offerings. Bronze Table with Tiger and Oxen Motif was used to put sacrificial cattle and animals, the most important sacrifice in ancient rituals, because of the cattle in the sacrifice of "three animals" in the first place. Tiger in the Dian culture has a high status, often in the Dian rituals on the top of the copper column for the object of worship. The Bronze Table with Tiger and Oxen Motif represents the highest craftsmanship of ancient Yunnan bronze casting, now in the Yunnan Provincial Museum.

Figure 6 Bronze Table with Tiger and Oxen Motif

Source: Yunnan Provincial Museum. (n.d.). Bronzes. Yunnan Provincial Museum. https://www.ynmuseum.org/detail/161.html

Spreading out with Dian Lake as the center, the bronze culture is widely distributed, northeast to Qujing, south to Yuanjiang, west to Lufeng, north but the Jinsha River, involving the area for Kunming, Jinning, Chenggong, Jiangchuan, Chengjiang, Anning, Lufeng, Shilin, Luliang, Qujing, and other 14 counties and cities in more than 60 locations. The most important locations are Shizhai Mountain in Jinning, Lijia Mountain in Jiangchuan, Eight Pagodas in Qujing, Temple of the Son of Heaven in Chenggong, Shibei Village in Chenggong, and Taiji Mountain in Anning.

Ancient Yunnan culture of bronze ware variety, according to the relevant aspects of the statistics of up to 90 kinds of different shapes, beautifully made, from the type of points, there are musical instruments, ceremonial weapons, weapons, production tools, textile tools, living utensils, decorative utensils and so on. Ancient Dian Kingdom subjects already knew how to use mold casting (Fan mold casting method, fill mold casting method, etching wax casting method at that time, very advanced casting process) casting bronze, and the bronze alloy has been skilled in the use of and successful experience.

The artisans of Dian were good at making bronzes and often combined them with the daily life of the Dian people. As a result, most of Yunnan's bronzes were made in various shapes, colors, and forms. In addition, bronze reverence for God and

the programmed and symbolic ritual were different in the Shang and Zhou periods of the Central Plains. The Dian people, in fully extracting the essence of a variety of cultures based on the realism of the approach, the skillful smelting and casting skills, and a variety of cultures of casting into a piece of bronze art masterpieces, can be said to be the world's history of the bronze art of a rare and unrepeatable case. They are like a "three-dimensional picture scroll" made of bronze and a "history book without words" that no historian can compile.

2.2 Development of Contemporary Museum

2.2.1 Development of Contemporary Museums in the International Context

Contemporary Museums preserve and display cultural heritage and historical artifacts and provide opportunities for the public to learn and understand the past. They are important places for education and research, promote cultural exchange and community cohesion, and enhance people's sense of cultural identity and social responsibility.

The development of contemporary museums in the international context is characterized by significant transformations influenced by sociocultural, technological, and economic changes. This evolution has seen museums transition from traditional, collection-centric institutions to dynamic, user-centric spaces that engage diverse audiences through innovative practices.

The new museum definition reflects the paradigm shift from collection-centric to user-centric that has been taking place in the past decades (Giannini, T.; Bowen, J.P.,2022) (Li, C.; Ghirardi, S., 2019) (Simon, N., 2010). The new definition was approved by the Extraordinary General Assembly of the International Council of Museums on 24 August 2022, after an open and long process of consultation about the Standing Committee of the Museum Definition with the National Committees, International Committees, Regional Alliances, and Affiliate Organizations. The definition states that:

"A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets, and exhibits tangible and intangible

heritage. Open to the public, accessible, and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing."(International Council of Museums, 2024).

The new definition illustrates how museum work strives to follow an inclusive and democratic human-centered approach to sustaining a range of movable and immovable assets. It is also open to different voices of interpretation and provides visitors with meaningful experiences through active engagement with the collections (Leoni, L.; Cristofaro, M, 2022) (Simon, N, 2010) (Martins, L.C. et al., 2021). Digital technologies enhance museums' new role by making them more accessible, engaging, fun, and attractive, creating a unique and memorable experience. This value of technologies in museums is distinctive of our time, in which museums have shifted from "being about something to being about someone." (Weil, S, 1999). Technologies entered the world of museums in the second half of the twentieth century, with the first conference on museums and computers in 1968 at the Metropolitan Museum of Art in New York (Chan, S, 2022). In this early stage, technologies were used for recording, cataloging, and researching collections; by the end of the century, their use was expanded to digitizing museum collections (usually through funded projects) (Zuanni, C, 2022). At the turn of the 21st century, "new technologies" were introduced in exhibitions to increase visitor interaction (Bounia, A.; Catapoti, D.,2022).

With the advent of Web 2.0 and the ensuing sociocultural transformations, consumers have become active participants in producing cultural value and meaning through digital infrastructure (Bounia, A.; Catapoti, D., 2022). Felix Stalder (Stalder, F, 2017) refers to the "digital condition," which has three characteristic forms: referentiality, communality, and underlying algorithms. Referentiality denotes how users can "inscribe themselves into cultural processes and constitute themselves as producers." (Stalder, F,2017); commonality is "understood as shared social meaning." (Stalder, F, 2017), where meaning-making processes take place in a larger communal framework; algorithmicity refers to the facets of cultural processes that are mediated and

transformed from "big data" to "small data" by algorithms before reaching human perception (such as Google's search algorithm). The literature is growing in its discussion of how museums respond to this sociotechnical and cultural context brought by the "digital condition" and the many functions—such as tool, platform, content, and format—of digitality (Russo et al., 2021) (Giannini,T., et al., 2019) (Bounia, A., 2023). propose a model consisting of four components or key meanings for defining the active relationship of an individual with the "digital" in the museum context, and these are:

① how the digital is used either as software or hardware;

② how the digital is managed as a process entailing vision, strategy, and protocols;

③ how the digital is understood in terms of motivation, behavior, and impact;

④ how we create with the digital in our contemporary circumstances.

This model is not intended to be rigid but to help people think about the "digital condition" in their specific context. Along this line, Jenny Kidd et al. (AHRC Policy and Evidence Center) have shown that the "digital" has brought a fundamental shift in how museums engage with their audiences and communities, not only in terms of formats and platforms but also in how the digital is considered a mindset characterized by collaboration, participation, and audience-centricity.

Despite these advancements, contemporary museums face several challenges. These include addressing issues of representation and inclusivity, adapting to rapid technological changes, and ensuring financial sustainability. Museums must also navigate the complexities of cultural diplomacy and the ethical implications of displaying contested artifacts.

The development of contemporary museums in the international context requires innovating and adapting to changing societal needs. This includes embracing new technologies, fostering community partnerships, and advocating for social and environmental justice. By doing so, museums can continue to serve as vital cultural institutions that educate, inspire, and connect people across the globe. Embracing

inclusivity, digital innovation, and community engagement, museums redefine societal roles and contribute to a more interconnected and culturally aware world. The future of museums depends on their ability to remain relevant and responsive to the dynamic needs of their audiences, ensuring that they continue to be spaces of learning, reflection, and inspiration.

2.2.2 Development of Contemporary Museums in China

The development of contemporary museums in China has been marked by rapid expansion, significant modernization, and increasing global engagement. Over the past few decades, China has transformed its museum landscape to reflect its rich cultural heritage, growing socio-economic status, and technological advancements.

Examining the history of contemporary museums in China, four distinct phases can be identified: the preparatory phase, the initial phase, the early stages of development, and the developmental phase.

1.The Preparatory Phase (Mid-19th century to the end of the 19th century)

This phase began in the mid-19th century when political and cultural exchanges intensified between China and the West. Scholars and diplomats who studied in or visited Europe, the United States, and Japan observed capitalist societies and wrote extensively about museums. Notable works from this period include Binchun's "Chengcuo Notes," Zhang Deyi's "Narrative of Sea Travel," and Wang Tao's "Travel Records." (Leung, J.S.,1985).

It is important to highlight that China was still in the early stages of understanding Western museums. Accounts of museums were seen as general local customs, with little special attention or dedicated study. Despite some recognition of the value of museums in 'broadening horizons and increasing wisdom,' the urgency to establish museums in China still needed to be felt.

Guangxu supported the Restorationists' advocates for the establishment of a museum. However, these good wishes could not be realized due to the failure of the bourgeoisie's modernization and reform movement. Under the

bourgeoisie's active advocacy, the social influence of museums was expanded to a certain extent, and the foundation of public opinion was laid for establishing modern museums in China.

2.The Initial Phase (The early 20th century)

In the early 20th century, China's national capitalist industry developed rapidly, and museums gradually gained social acceptance. In 1905, Zhang Jian established the country's first modern private museum. Following the Xinhai Revolution, museums experienced significant growth. The 1911 revolution led by Sun Yat-sen ingrained democratic ideals deeply into society, promoting the recognition and establishment of museums. By 1921, there were 13 museums nationwide. (Leung, J.S.,1985).

During this period, some foreigners also established museums in China. For instance, Father Pierre-Marie Heude founded the Museum of Natural History in Xujiahui, Shanghai, which housed collections of plant and animal specimens as an adjunct to St. Ignatius College. The museum's collection of Père David's deer was particularly notable. Later, the museum incorporated an extensive collection of Chinese art and artifacts gathered by missionary Emile Licent. Due to space constraints, the museum relocated in 1930 to a new site on Lumbini Road (now Chongqing South Road) near Aurora University. The university managed it, and the Aurora Museum (Heude Museum) was renamed.

Figure 7 Aurora Museum (a.k.a. Hande Museum)

Source: Jang-ja. The life and times of the Shanghai Insect Museum. The past and present life of the Shanghai Insect Museum. http://project.lyqiao.cn/xhwh/wap/news.php?id=99#

3.Early Stages of Development (early twentieth century to 1949)

After the 1920s, the development of museums exhibited two distinct characteristics: first, museums gradually gained independence from their subordinate status to libraries; second, several large national and provincial museums were established.

The Palace Museum was founded in the mid-1920s. It is responsible for the preservation, public access, and dissemination of the Forbidden City, its buildings, artifacts, books, and archives. Other notable museums, such as the Henan Museum, the Lanzhou Municipal Museum, and the Zhejiang West Lake Museum, were also established during this period (Ma Jingjing et al., 2011).

4.Development Phase (After the founding of the People's Republic of China)

After the founding of the People's Republic of China in 1949, the museum industry entered a new development phase. The government prioritized cultural advancement, resulting in a rapid increase in the number of museums and the expansion of their functions.

Table 3 Major Events in the Development of Museums after the Founding of the PRC

Period	Main events
1949-1978: Initial development of the museum business	
1949	The People's Republic of China was founded, and museums increased rapidly.
1950	The Interim Regulations on the Protection of Cultural Relics and Monuments were promulgated.
1956	The first national conference on museum work was held, proposing the "three characteristics and two services" of museums.
1960	The State Administration of Cultural Heritage was formally established.
1966-1976	During the "Cultural Revolution," the museum business was seriously affected.
1978-1992: Recovery and Development in the Early Period of Reform and Opening Up	
1978	The Third Plenary Session of the Eleventh Central Committee of the CPC was held, and the museum career ushered in a new opportunity for development.
1979	The State Administration of Cultural Heritage held a symposium on museum work and drafted the Regulations on Museum Work in Provinces, Municipalities, and Autonomous Regions (draft).
1982	The Chinese Museum Association was founded; the People's Republic of China Law on the Protection of Cultural Relics was passed.

Table 3 (Continu)

Period	Main events
1992	Deng Xiaoping's Southern Tour Speech, the museum business entered a period of rapid development.
1998	Implementation of the "National Key Cultural Relics Protection Project."
2002	Revision and supplementation of the Law on the Protection of Cultural Relics.
2002 to the Present: a new stage of Modernization and Internationalization	
2003	Enacted the Implementing Rules of the Law on the Protection of Cultural Relics and started the construction of digital museums in China.
2006	The 11th Five-Year Plan for the Protection of Cultural Relics was launched.
2011	The number of museums in China exceeded 3,000.
2015	The State Council issued the Guiding Opinions on Further Strengthening Cultural Relics Work.
2020	The rapid development of virtual museums and online exhibitions.

The development of contemporary museums in China reflects the country's dynamic cultural landscape and commitment to preserving and promoting its rich heritage. Chinese museums are evolving into world-class institutions through government support, technological integration, and a focus on inclusivity. The future of Chinese museums lies in their ability to balance tradition with modernity, ensuring they remain relevant and inspiring spaces for cultural education and public engagement.

2.2.3 Development of Yunnan Provincial Museum

2.2.3.1 Yunnan Provincial Museum Basic Information

Established in 1951, the Yunnan Provincial Museum is the largest comprehensive museum in Yunnan Province. It spans 150 acres, with an area of 60,000 square meters and an exhibition hall of 16,500 square meters. It is one of the first national first-class museums. The museum is a hub for Yunnan's history, culture, and art, a must-visit tourist destination, and an important educational venue for young students (Yunnan Provincial Museum, Overview).

Figure 8 Old Yunnan Provincial Museum

Source: Baidu. (n.d.). Yunnan Provincial Museum. Baidu Encyclopedia. https://baike.baidu.com/item/%E4%BA%91%E5%8D%97%E7%9C%81%E5%8D%9A%E7%89%A9%E9%A6%86/1628007?fr=ge_ala

Figure 9 New Yunnan Provincial Museum

Source: Yunnan Provincial Museum. Overview. Yunnan Provincial Museum. https://www.ynmuseum.org/survey.html#section=2

Since its establishment, the Yunnan Provincial Museum has been dedicated to protecting and inheriting excellent historical culture. It combines the collection, preservation, research, exhibition, education, and service of cultural relics, making it the largest cultural relics collection unit in Yunnan Province. The museum is also the province's most powerful research and appraisal institution for movable cultural relics. As a cultural landmark, the museum attracts thousands of visitors who come to appreciate Yunnan's rich history and world-class cultural art, serving as an important window for people to understand Yunnan's history and culture (Yunnan provincial museum, 2021).

Over the years, the museum has amassed a vast collection through archaeological excavations, investigations, social acquisitions, and donations. The collection includes bronze artifacts, ancient coins, ceramics, ancient paintings and calligraphy, inscriptions, stamps, and various crafts.

In terms of exhibitions, the Yunnan Provincial Museum actively introduces and independently designs and produces excellent exhibitions annually. Starting with the "1 August Construction Festival Exhibition" organized by the Yunnan Provincial Museum Preparatory Committee on 1 August 1952, the museum has hosted

over 400 exhibitions. These have included works by masters such as Xu Beihong, Zhang Daqian, Pan Tianshou, Li Zijian, and Liu Ziming, as well as international exhibitions like the French "Treasures of the Deep Sea" tour, Master Hsing Yun's "One-Stroke Calligraphy Exhibition," "Embroidered Clouds and Southern Styles: Haipai Cheongsams and Yunnan Costumes Exhibition," "Ancient Tea Horse Road: Special Exhibition of Cultural Relics from Eight Provinces," and "Southern Overlord: Zhuang Qiao's Kingdom of Chu Cultural Relics Exhibition." Each exhibition has attracted numerous visitors and received high praise from all sectors of society. Additionally, several exhibitions from the museum have been displayed in countries such as the United States, Germany, France, Switzerland, and Japan (Yunnan Provincial Museum, 2014).

Over 70 years of construction and development, the Yunnan Provincial Museum has achieved remarkable results. It is dedicated to protecting cultural heritage and disseminating excellent culture, striving to build a large comprehensive museum that is first-class domestically, leading in the southwest, and influential in South and Southeast Asia.

2.2.3.2 Yunnan Provincial Museum Historical Development

The Yunnan Provincial Library was established in 1909, and a museum was planned for the following year. 1911 saw the formal establishment of the Yunnan Book Museum, designed to display ancient and modern objects for public viewing and assist in education. At this stage of the museum, which is attached to the library, resources and management are more limited.

Since the 1950s, the Yunnan Provincial Museum has conducted hundreds of scientific archaeological excavations, trial digs, and surveys throughout the province:

1951: The Yunnan Provincial Museum was established (Yunnan Provincial Museum, 2014).

1955–1960: Conducted four large-scale archaeological excavations at the Shizhai Mountain ancient tomb complex in Jinning. This site has become a typical

representative of the bronze culture in the Dian Lake region, known internationally as the "Shizhai Mountain Culture" (also called "Dian Culture"). A total of 50 tombs from the Western Han period were excavated, and four artifacts were unearthed, including the golden "Seal of the King of Dian" found in Tomb No. 6, corroborating the records in the "Records of the Grand Historian" regarding the Dian Kingdom.

1972: Excavated the Lijiashan ancient tomb complex in Jiangchuan, another important site of the Shizhai Mountain Culture. A total of 27 tombs were unearthed, revealing over 1,300 artifacts from the Warring States to the Han Dynasty periods. Among these, a collection of bronze textile tools, including warp beams, brush-shaped tools, shuttle knives, bow-shaped tools, spindles, needle boxes, tubes, awls, needles, and winding boards, are significant for studying the history of textiles in Yunnan.

1975–1976: Excavated 79 ancient tombs at Wanjia Dam in Chuxiong, dating from the Spring and Autumn period to the Western Han period. One thousand two hundred forty-five artifacts were unearthed, including five bronze drums from the Spring and Autumn period, the earliest bronze drums discovered worldwide.

1977–1982: Conducted seven consecutive excavations at the Baguatai ancient tomb complex in Zhujie, Qujing. The site, a large mound over 7 meters high, contained tombs from the Eastern Zhou to the Ming Dynasty. Over 200 artifacts were found in tombs dating from the Eastern Zhou to the Han Dynasty, including bronze drums, cauldrons, buckles, spears, ge (daggers), swords, and pottery tripods. Although fewer in grave goods, the cremation tombs from the Nanzhao to the Ming periods had diverse forms of cremation urns, providing scientific evidence for the chronology of cremation tombs in Yunnan. The Baguatai tomb complex spanned nearly two thousand years and multiple dynasties, a rare phenomenon in Chinese archaeological history.

18 May 2007: The Bronze Age of Yunnan Exhibition won the "Seventh National Top Ten Museum Exhibitions Award." The same year, the State Administration of Cultural Heritage awarded the museum the "National Advanced Collective for Cultural Heritage Protection" title and listed it as one of the "Fifteen Key National Museums."

18 May 2008: The museum opened permanently for free to the public.

18 May 2015: The new museum building was officially opened.

2016: The exhibition "Ancient Tea Horse Road—Special Exhibition of Cultural Relics from Eight Provinces" won the Excellence Award at the "Thirteenth National Top Ten Museum Exhibitions Award." (Chai Jing, 2024).

26 January 2024: The Yunnan Provincial Museum officially inaugurated the "Digital Technology Innovation Center." The center aims to implement the national cultural digitization strategy deeply, enhance the innovation capacity of digital cultural tourism in Yunnan, and improve the digitization level of the museum's cultural relics (Chai Jing, 2024).

The development of the Yunnan Provincial Museum reflects a broader trend in China towards modernizing cultural institutions while preserving and celebrating regional heritage. Yunnan's museum has become a vital cultural hub through expansion, technological integration, and a focus on inclusivity and education. Addressing ongoing challenges and continuing to innovate will ensure that the Yunnan Provincial Museum remains a dynamic and engaging institution for future generations.

2.2.3.3 The Bronze Age of Yunnan Exhibition Hall and Exhibits

China began to enter the Bronze Age around 2000 BC, during the Xia Dynasty. Bronze ware in the Shang Dynasty involved almost every aspect of social life, and the casting technology was extremely exquisite, which was the heyday of the development of bronze culture. After the Western Zhou Dynasty, it gradually entered a period of transition, and the bronzes changed from the “emphasize ritual” system of the Shang Dynasty to the “emphasize practicality” system, and the system of tripods, bells, and the habit of giving orders to make artifacts were already formed. After the Spring and Autumn and Warring States period, the powers were in strife, and the bronzes excelled in their own styles and reflected each other, and the regional characteristics were obvious, and the development of the bronze art formed the final climax. With the advent of the Iron Age, Qin, Han only for the history of bronze development of the afterglow, and in the southwest border, the Warring States, Qin and Han period, Yunnan

bronze culture burst out of the brilliant light, in the history of the development of Chinese bronze culture has left a glorious new chapter.

Yunnan is a highland mountainous province, the terrain of the province from the northwest to the southeast is stepped down step by step, the altitude difference is great, the geomorphology type is diverse, the climate type is complex. Mountainous semi-mountainous area occupies the main area, the dam (plain) area accounts for only 6%, numerous lakes like a jewel scattered among them. The lakeside plains and mountain dams have already nurtured diverse cultures as early as the Stone Age. Archaeological excavations proved that more than 3,000 years ago, Yunnan began smelting and casting copper, slowly opening the curtain of the Bronze Age.

The end of the Warring States period to the beginning of the Eastern Han Dynasty is the peak of the development of bronze culture in Yunnan. Taking the bronze culture of Dian Kingdom as a representative, including west Yunnan, south Yunnan, east Yunnan and other places, bronzes occupied the most important position in the society, with a wide variety of colors and shapes. On the basis of fully absorbing the essence of many cultures, the people of Yunnan cast a large number of precious artifacts with outstanding creativity, leaving a wealth of material and spiritual wealth to the descendants. They depicted all aspects of the ancient Yunnan society with realistic strokes, which can be called a rare and unrepeatable wonderful chapter in the history of world bronze art.

Exhibition Part I: The Beginning of the Bronze Age in Yunnan

Haimen site is located in jianchuan county diannanhai mouth village. in April 1957, yunnan provincial museum cleanup excavation, unearthed artifacts in stone, pottery and other objects, and there are 14 pieces of copper, and used to make the axe of the ceramic model. According to carbon 14 determination, the age of the site is comparable to the time of China's Shang and Zhou dynasties. 1978 April, Yunnan archaeologists carried out a second excavation of the site of Haimen. 2008 Yunnan Institute of Cultural Relics and Archaeology carried out the third excavation of the site of Haimen, revealing the site of more than 50,000 square meters, and there is a huge

group of dry bar type building remains. According to the research, the earliest copper ware found at the site is about 3,800 years old. This is one of the important birthplaces of Yunnan's bronze civilization that has been scientifically excavated.

In recent years, Ludian wild stone mountain, Gengma stone Buddha cave, Dali Yinshuo Island, Longling Dahuashi and other early Bronze Age site excavations, for the origin of Yunnan bronze civilization provides new, scientific evidence, the birth of Yunnan bronze civilization is not a one-dimensional but diversified, Yunnan's special historical and geographic factors, the special ethnic and cultural colors destined to be full of stars type pattern, it Yunnan's special historical and geographic factors and special ethnic and cultural colors predetermined its starry sky pattern, and its development process also showed many different paradigms.

Figure 10 Distribution of Bronze Culture Sites in Yunnan Province

Source: Image by the researcher

Exhibition Part II: Yunnan Bronze Age Overview

According to the latest research, Yunnan bronze culture sprouted at the time of Xia and Shang, gradually matured in the Spring and Autumn and Warring States Periods, reached its peak in the Western Han Dynasty, and then gradually declined with the great unification of Han culture, and withdrew from the stage of history in the Eastern Han Dynasty. During this long period, according to the geographical scope of Yunnan bronze culture and the types of bronze culture sites, it can be divided

into the following several zones northwestern Yunnan; western Yunnan; central Yunnan; eastern Yunnan, northeastern Yunnan; southern Yunnan, southeastern Yunnan. Northwest Yunnan region close to Sichuan and Tibet, and the popular Qiang nomadic culture is similar; Western Yunnan region has more early sites, is an important birthplace of Yunnan bronze culture: Dianzhong region is recognized as the highest representative of Yunnan bronze culture; east Yunnan, northeast Yunnan is in the junction of the three provinces of Yunnan, Guizhou and Sichuan cultural landscape is more complex; south Yunnan, southeast Yunnan region is not only affected by the influence of the bronze culture in Dianzhong, but also due to the proximity of the two Vietnam, both Cultural commonality is more.

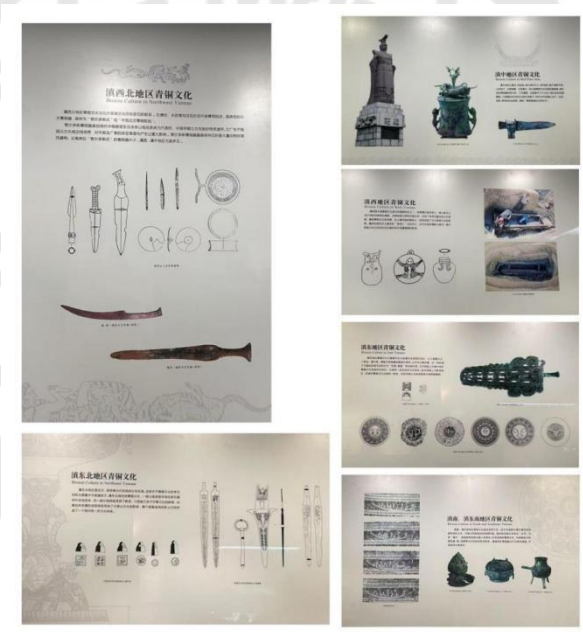

Figure 11 The *display of bronze culture in Yunnan in different directions*

Source: Image by the researcher

As early as the Shang and Zhou dynasties, Yunnan has appeared bronze casting technology. Warring States, Qin and Han dynasties, Yunnan's bronze casting, processing technology has matured. Fan casting using a single-sided model,

double-sided model; implementation of separate casting, mixed casting; casting model materials are stone model, mud model, pottery model, copper model, etc.. It is worth mentioning that, during the Warring States period, yunnan has appeared in the mold casting method (lost wax method). The bronze buckle ornaments of bull sacrifice unearthed in Lijiashan of Jiangchuan were made by the lost-wax method, which is also an early example in the whole country. Yunnan bronze surface processing technology is very developed, there are gilt, gold, tin plating, line engraving, lacquer inlay, and so on, and even appeared in the surface of the bronze artificially applied to the oxidized coating technology (commonly known as black lacquer ancient).

Yunnan's ancient bronze production after more than 2000 years of evolution to develop a white copper, patinated copper, silver inlaid in the black copper and other crafts. The white copper and lost wax methods have spread from Yunnan to all parts of the world, making a great contribution to the development of world civilization.

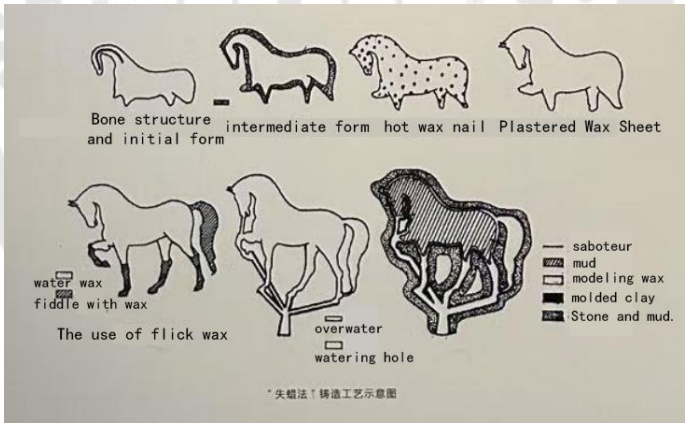

Figure *12 Lost wax casting process schematic*

Source: Image by the researcher

Although the division of Yunnan's bronze culture is influenced by different regional characteristics and other cultural factors, these different bronze culture areas can basically find their origins in the local Neolithic culture. Its main cultural characteristics are still gradually formed on the basis of local Neolithic culture.

From the perspective of time, Yunnan Bronze Culture is a kind of regional bronze culture that matured late and died early. Late maturity, means that its maturity time is relatively late compared to the central plains. In the Central Plains has entered the Iron Age, its climax has just opened the curtain; early death, is that it is in the peak of development, because of the Western Han Empire's policy of unification, quickly replaced by the Han culture.

Exhibition Part III: The Leader of the Southwestern Barbarians-Dian Kingdom

According to the Records of the Grand Historian and the Book of Han, at the end of the Warring States period, Zhuang Yue, a native of Chu, led his troops to the Dianchi area to open up new territories. Later, because the Qin army blocked the way back, Zhuang stayed behind, changed clothes to follow local customs, and became a generation of Dian King. This thing, there are many mysteries, but the rise of Dian Kingdom in the Warring States period is an indisputable fact.

In recent years, the Yunnan Provincial Institute of Cultural Relics and Archaeology, in cooperation with the University of Michigan, conducted an archaeological survey of the Dian Lake area. Archaeologists from both countries found that in the center of Jinning Township, Jinning County, there are relics of large buildings exposed on the ground, which are considered artifacts from the Han and Jin dynasties. The archaeologists speculated that this might be the site of the ancient Yizhou County, which the archaeological community has been searching for decades. Through the Heposho - Shizaishan region of the shell mound site investigation, it also found that the Heposho shell mound site is huge, and the site is very close to the excavation of the “Dian Wang's seal” Shizaishan cemetery, this area is likely to be more than 2,000 years ago, the political center of the Dian State - that is, the Dian Wang ruled the center of the region. The current archaeological survey seems to be that the southeast bank of Dianchi is the main sphere of influence of the “Dian Kingdom”.

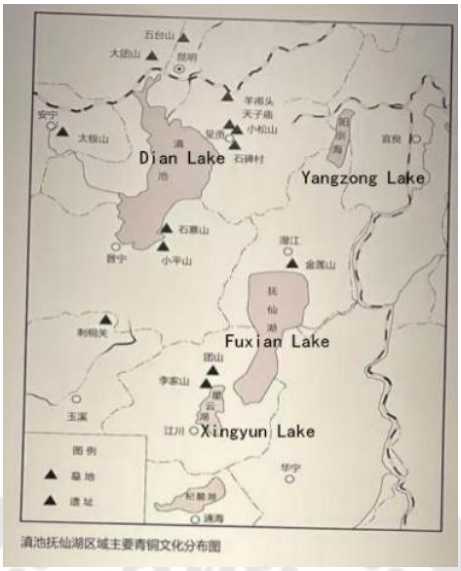

Figure 13 Distribution of major bronze cultures in the Fuxian Lake area of Dianchi Lake

Source: Image by the researcher

Shizaishan Cemetery is located in Shangliang Township, Jinning County, on the southeast bank of Dianchi Pond, where four archaeological excavations were carried out from 1955 to 1960, and the fifth salvage archaeological excavation was carried out in 1996, with a total of 87 tombs cleared in the five excavations. The second excavation of M6 unearthed a “seal of the king of Yunnan”, which can be corroborated with the relevant records in the “Records of the Grand Historian - Legend of the Southwest Barbarians”, thus confirming that the cemetery was a cemetery for the nobility of the Dian State or even the royal family, and thus linking the Shizaishan culture with the culture of the Dian people as the main body of the culture. With the continuous enrichment of archaeological materials, academics have a new definition of Shizaishan culture, that is, the remains represented by the cultural landscape reflected in the Shizaishan cemetery are the typical Shizaishan culture. The Shizaishan culture is the

main culture of the Bronze Age in central Yunnan, and is the key to the study of the history of central Yunnan in the Warring States-Qin and Han periods.

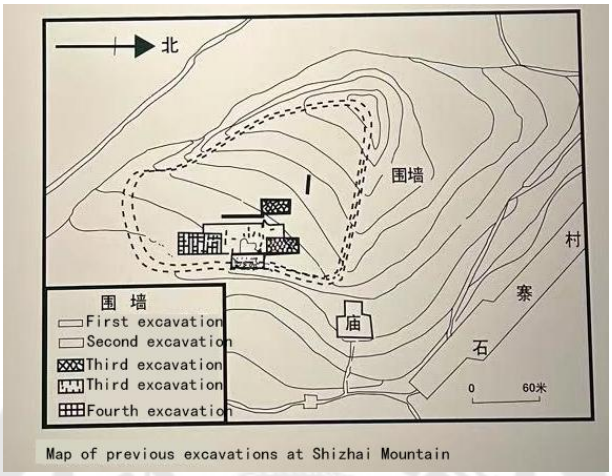

Figure 14 Schematic diagram of the excavations at Shizhai Mountain

Source: Image by the researcher

One day in March 1955, the Yunnan Provincial Museum of archaeologists came to Dianchi Dianning County Shizhai mountain, the first exploratory excavations on the discovery of two tombs, unearthed the textile shellfish, killing sacrificial column shellfish, such as precious bronze artifacts, was Guo Moruo, Mr. Zheng Zhenduo known as the shock of the world's archaeological discoveries. 1956 carried out a second excavation, in the sixth tomb out of the Dian King of Seal “The second excavation was carried out in 1956, and the seal of the King of Yunnan was found in Tomb No. 6, which reflected the social outlook of ancient Yunnan, and a large number of precious cultural relics vaguely recorded in the literature of the disappearing kingdom were shown in front of the people, and the people were stunned by the wealth of the ancient Dian State and the glorious civilization it once was. Yunnan is not a barbaric land, she once had a highly developed ancient civilization.

① Dian People's Dress and Ornaments

Dian men's costumes are mostly long shirt with lapel, shorts underneath, shoulder cape, belt. Chest and abdomen hanging round buckle ornaments for decoration, stock hanging sword, Dian women's clothing also with lapel long shirt, draw shorter. Inside the round neck short corset, the lower body with a short skirt, the same shoulder cape, girdle, decorated with round buttons. Dian was national regardless of noble disability down feet, some nobles also tattoo, head inserted pheasant's tail feathers and cow's tail as ornaments, appearing in the Dian bronze on the character image is also much to see the braided hair braiders, they are recorded by Sima Qian “braided hair” of the people of Kunming, Kunming people often use the steel head basket of the nationality of the hair, historically known as the “curved head”.

Figure 15 Dian People's Dress and Ornaments

Source: Image by the researcher

② Dian People's Decorations

Dian people head insert hairpin, earrings made of jade or copper, neck beads, the whole body wearing with gold, copper, jade, onyx, turquoise, malachite, and other materials made of armlets, hand tin, buckle ornaments, rich and noble elegant and generous. Wearing a striped lapel long shirt, but also to pick flower embroidery embroidered on the top of a variety of different geometric patterns, and animal prints for

decoration, vivid and natural. Dian bronze culture tombs unearthed a large number of exquisite gold, jade, onyx, and bronze jewelry, reflecting the Dian rich, reflecting the rich and colorful life of the Dian people.

Figure 16 Dian People's Decorations

Source: Image by the researcher

③ Dian People's Hairstyles

Dian people is a beautiful people, and good at dressing up the most common male hairstyle for the bun, the first silk, hemp or cotton hair bands on the top of the head, and then knotted into a bun, similar to the hammer of the drum, known as the “brown bear bun”. The women's hairstyles are more varied, some of which are “vertebral buns”, others are “silver ingot buns”, “saddle buns”, etc., and some are free to hang on their backs without being combed, which is a distinctive style. Others are pulled into a spiral shape and coiled in the center of the top of the head, or tied at the side of the neck or knotted at the back of the head, etc. They are all different.

Figure 17 Dian People's Hairstyles

Source: Image by the researcher

④ Dian People's Worship

Religious activities is an important affair of the Dian State, a variety of religious rituals is both the means of administration and the maintenance of kingship and aristocratic power system is an important way, these features in the surviving bronze shell storage and buckle decoration patterns reflect particularly distinctive. Dian worship can be generally divided into two categories of nature worship and ancestor worship, the specific object of worship: the sun (sky god) worship, ancestor (ghost) worship, animal worship, fertility worship.

Figure 18 Dian People's Worship

Source: Image by the researcher

⑤ Dian People's Sacrificial Rites

There are many sacrificial rituals of the Dian people, such as contribution sacrifice rituals, murder rituals, dance and music rituals, etc. Some of the rituals seem to be for entertainment, but in fact, they may still have a special religious theme, such as bulls, bullfighting, hunting and boat-operating activities, etc., which appeared many times, and the Dian people's rituals are diversified and rich in content, which are closely related to their lives. Dian bronze culture images show some complex, complete large-scale sacrificial activities to prove that the Western Han Dynasty, Dian's sacrificial activities have become a special spiritual ties to maintain the rule of the king of Dian, it may also be a special way of social wealth concentration and exchange, in the major occasions, people from all over the world to gather together, sharing, just like today's ethnic minorities of Yunnan “Catching up with the market”, “catching up with the street”.

Figure 19 Dian People's Sacrificial Rites

Source: Image by the researcher

⑥ Dian People's Music and Dance

The Dian people live a colorful life, they can sing and dance well, and they are good at using all kinds of musical instruments, such as copper drums, Yu, chimes, bells, xiao, gourd sheng, gourd silk and so on. In the festivals, they beat the bronze drums, singing and dancing, using music, singing and dancing to express their joy.

Dian music to percussion instruments, supplemented by wind instruments, Dian people's dance can be divided into unarmed dance and dance with props two kinds. The unarmed dance has standardized movements and a strong sense of rhythm. The dance with props or holding feather flags and lagenaria shengs implies the celebration of victory; or holding shields and axes, which has the effect of motivating the morale before the battle.

Figure 20 Dian People's Music and Dance

Source: Image by the researcher

⑦ Warfare between Dian People and Kunming People

Dian and Kunming people are two major groups in Yunnan during the Bronze Age. Geographically speaking, Kunming people mainly lived in the western part of Yunnan centered on the Erhai Sea, while Dian people mainly lived in the central part of Yunnan centered on the Dianchi Pond; culturally speaking, these two groups also have different characteristics. According to the historical record - southwest barbarians biography of the record, the Dian people is “farming, there is a eupju” farming culture, while the Kunming people is “with the animal migration, no permanent place, not the king long, the place can be a few dry miles” of nomadic culture. Due to the different cultural personalities and the great contradictions in the interests of the two sides, fierce wars often broke out between the Yunnanese and the Kunming people, which is fully reflected in the large number of unearthed bronzes.

Figure 21 Dian People (Left) and Kunming People (Right)

Source: Image by the researcher

⑧ Bronze Weapons of Dian Kingdom

The use of bronze weapons had a decisive role in the end of the war in ancient Yunnan, and in that era of frequent wars, the number of weapons in Yunnan bronze was particularly large.

Dian bronze weapons can be divided into six categories: hooks and thorns class weapons: go, spear, and, peck, sword; chopping class weapons: axe, battle-axe, hammer, chi; peculiar weapons: wolf tooth stick, eight-pronged copper rod, hollowed out copper hammer; long-distance shooting class weapons: crossbows, copper arrowheads; protection class weapons: helmets, armors, shields; special rituals: double battle-axe-shaped copper rituals and so on.

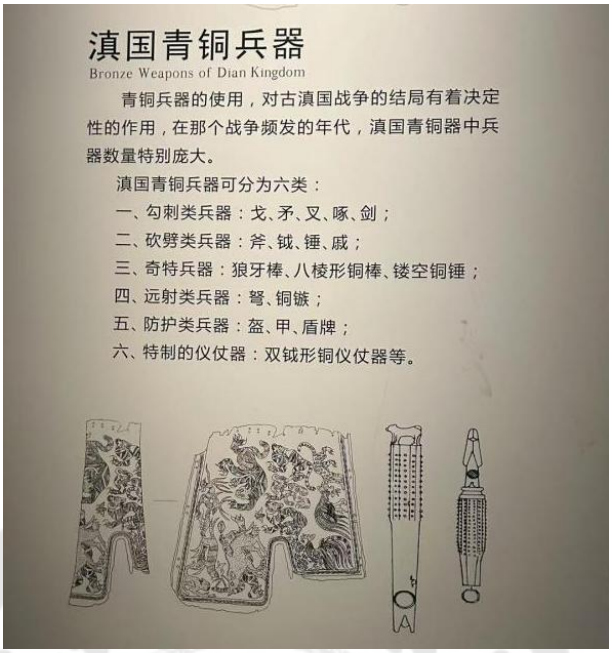

Figure 22 Bronze Weapons of Dian Kingdom

Source: Image by the researcher

⑨ Dian People's Appliances

The living utensils of the Dian people were varied and made of different materials such as bronze, stone, pottery, lacquered wood, bamboo and wood. The shapes include kettle, tripod, pot, goblet, spoon, bean, case, pillow, box, pot, zun, cup, etc. In the late period, there are also Han-style lifting pots, wash, cauldron, helmet, case, mirror, ear cups and other artifacts.

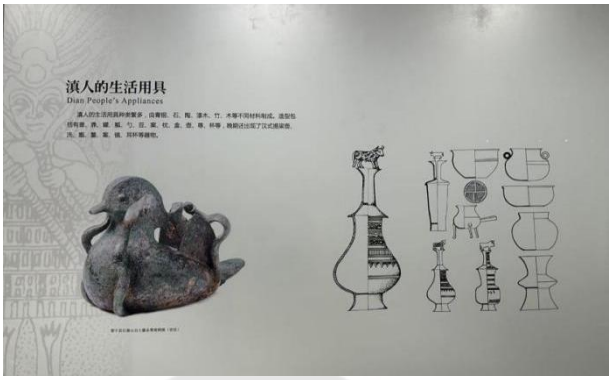

Figure 23 Dian People's Appliances

Source: Image by the researcher

⑩ The Rise and Fall of Fores around Dian Lake and Fuxianhu Lake

During the Warring States period, the power of Tianzimiao and Yangfutou on the east bank of Dianchi developed faster, and at the end of the Warring States period, the Lijiashan around Fuxian Lake and Xingyun Lake gradually rose up in the dining hall, and in the early Western Han Dynasty, Shizaishan's power was greatly developed, and later came to the top, and unified the Dianchi area, and after the establishment of counties and prefectures by Emperor Wu of the Han Dynasty, the power of Shizaishan reached its peak, and then gradually declined, and basically there was not much left after the Eastern Han Dynasty, and the splendor of the Lijiashan continued to be continued to the beginning of the Eastern Han Dynasty. The relationship between Tianzimiao and Yangfutou tombs and Pu people is more obvious, and there are more commonalities between the tombs in Lijiashan and Shizaishan. The early tombs in Lijiashan have more obvious local characteristics, while the tombs in Shizaishan are more mature and diversified, and show more contact with the culture of horse-riding people, while the tombs in Yangfutou and Shizaishan gradually declined in the late Western Han Dynasty, presumably due to the establishment of counties and counties by Emperor Wu of the Han Dynasty to strengthen the rule.

At the beginning of the Han Dynasty, Liu Bang successively divided a group of meritorious officials and their sons and nephews into princes and vassals. Later, the power of the kings with the same surname gradually grew, which became an obstacle to the consolidation of centralized power, and finally the “Rebellion of the Seven Kingdoms” occurred during the reign of Emperor Jingdi, marking the complete obsolescence of the feudal system, and the power of the vassal states was greatly weakened after the pacification of the “Rebellion of the Seven Kingdoms”. The implementation of other conscious measures to strengthen centralization made the localities.

The county system was finally implemented successfully, the political pattern of great unification was formed, and the centralized political system was established.

Table 4 The Chronology of the History of Yunnan Warring States - the Western Han Dynasty

Common unit	Dynastic era	National affairs	Events in Yunnan
286 BC	21 years of King Zhaoxiang of Qin		Zhuangwei entered Yunnan
250 BC	The first year of King Xiaowen of Qin	Li Bing let Shu Shao Shou	Li Bing started to build a road to the northeast of Huaihe in Fandao, which was the beginning of the Wushu Road.
246 BC	The first year of the first Emperor of Qin	The throne of Qin	

Table 4 (Continued)

Common unit	Dynastic era	National affairs	Events in Yunnan
221 BC	Emperor Qin Shi Huang 26 years	The king of Thailand unified China, establishing a centralized unified multi-ethnic state for the first time	
220 BC	Emperor Qin Shi Huang 27 years		Qin “set up officials” in and around Yunnan.
206 BC	Emperor Gaozu of Han Yuan	Death of Qin	
202 BC	Emperor Gaozu 5 years	Liu Bang unified the country and established the Western Han Dynasty	
140 BC	The first year of Emperor Wudi's Jianyuan	Han Wu Bei Liu Che ascended the throne	
139 BC	Emperor Wudi Jianyuan 2 years	Zhang Qian was sent to the Western Regions	
135 BC	West Han Wudi Jianyuan 6 years	Tang Meng served as an envoy	Establishment of Gandan County, part of northeastern Yunnan, came under the direct rule of the Han Dynasty.

Table 4 (Continued)

Common unit	Dynastic era	National affairs	Events in Yunnan
122 BC	West Han Emperor Wudi Yuan Kui first year		Zhang Qian suggested passing to Daxia through the Southwest Barbarians and Body Poison to fight against Xiongnu. Emperor Wu of Han sent envoys to Yunnan, but they were blocked by the Kunming People.
119 BC	West Han Emperor Wudi Yuan hunting 4 years	Han wanted to attack Kunming, chisel Kunming pool in Chang 'an, the water war	
109 BC	West Han Emperor Wudi Yuan seal 2 years		The king of Dian surrendered to the Han Dynasty and set up Yizhou County, gave the king of Yunnan the seal, and restored his people.
86 BC	Emperor Zhaodi of Han began the year of Yuan Yuan		Liantou in Yizhou, Gusei rebelled, and 24 euphonies in Yanghe area responded.

Table 4 (Continued)

Common unit	Dynastic era	National affairs	Events in Yunnan
81 BC 61 BC	Emperor Zhaodi of Han Dynasty began 6 years The first year of Emperor Xuandi of Han	Salt-iron dispute	Jurchen Hou Hou Bo became the king Wang Bao traveled to Yizhou to seek the god of Golden Horse and Bird.

Yunnan's foreign exchange conditions are unique, from Yunnan to the west there is access to India's body poisonous road; northwest of the Hengduan Mountains canyon connecting the Gan-Qingyuan Plateau; the northeast can be connected to the Ba, Chu; southeast of the Red River down to the crossroads of the South China Sea. The rich Dianchi region of the lake flat is not only an important cradle for the growth and development of indigenous peoples culture, but also Yunnan and the east and west, north and south of the cultural melting pot of exchanges. The Yunnan Bronze Culture is a typical representative of multicultural co-development, drawing on the cultural factors of many different ethnic groups. More and more archaeological evidence shows that it not only reflects the light of civilization in the South Asian subcontinent and Southeast Asia, but also serves as an important cultural hub connecting the Chinese civilization and the Indian Ocean civilization.

Exhibition Part IV: Ihe End of the Bronze Age in Yunnan

The Records of the Grand Historian - Ping Zhunshu recorded that the Emperor of Han Dynasty “through the Southwest Barbarians, is a collection of the great people of the field of the South Barbarians, into the corn county officials, and within the recipient of the money in the capital”. The influx of a large number of immigrants, to Yunnan brought advanced production tools and production experience. The popularization of ox plowing, paddy fields, and the development of the construction of

reservoirs and ponds are marked by the rapid development of productivity. The Han immigrants to Yunnan and the Sinicization policy adopted by Han officials in Yunnan greatly advanced the speed of Sinicization of Yunnan's local culture. The long Bronze Age drew to a close.

After the Eastern Han Dynasty, the people of Yunnan in the cities and on the main transportation routes had gradually adapted to the ways of the Central Plains culture, while some ethnic groups in the high mountain valleys still held fast to their own cultural traditions, forming the so-called “Upper Barbarians” and “Lower Barbarians”. The Dian people, who had created a brilliant bronze culture for a while, gradually moved away from their original living areas and began to migrate southward, merging with the southwestern border peoples over a long period of time and becoming the ancestors of some modern Yunnan minorities.

2.3 Development and Application of Virtual Interactive Displays

2.3.1 Development of Virtual Interactive

Key Milestones in the development of virtual interaction technology include the following:

Origins of Virtual Reality (VR): The technology dates back to the 1960s. During this period, Morton Heilig invented the Sensorama, a multi-sensory simulation device capable of delivering visuals, audio, touch, and smells (Holly Brockwell, 2016).

Early History: With new advancements in computer graphics and interactive technology, the development of virtual interaction continued in the 1970s and 1980s; Ivan Sutherland developed his Sword of Damocles head-mounted display as an early device (John Werner, 2024).

Major Development of the 1990s: Virtual reality technology was all set to make its commercial appearance in the 1990s. This ultimately paved the way for more advanced gadgets like virtual reality headsets and data gloves, allowing users to interact more hands-on with the virtual world. On the other hand, Augmented Reality began to manifest itself by allowing the superimposition of virtual information into the real world.

Progress in the 21st Century: Huge strides have been made in developing virtual interaction technology for the 21st century due to the rapid advances in computer power and graphical processing technology. Improvements in display resolution, more accurate motion capture technology, and higher computing power make virtual and augmented reality devices even more popular and practical.

Modern Virtual Interaction: Practical applications of virtual and augmented reality technology have only recently manifested in various domains, such as gaming, education, healthcare, exhibition Industry, and manufacturing. The real-world utility of virtual interaction technology does not limit itself to vision and hearing. It extends to haptic feedback, motion capture, and biometrics for a superior immersive and interactive experience.

Future Outlook: The future of virtual interaction technologies is quite promising. We can expect even deeper integration of artificial intelligence and machine learning to enhance the intelligence and personalization of interaction. The development of high-speed network technologies like 5G will make it easy to fulfill high bandwidths and low-latency virtual interaction experiences. Brain-computer interface technology now opens up new frontiers, allowing users to interact directly with virtual environments through their thoughts.

The continuous development of technology has made the user experience richer with each new wave of virtual interaction and introduced new opportunities and challenges for various industries.

The following are applications of virtual interaction in different scenarios:

1.Artwork Presentation

"Language of Stones" by Jiayu Liu Studio is a new media installation art piece set in a natural valley. The piece features two carefully placed screens in the valley's meadow, ingeniously combining technology and nature to create a flowing virtual river that symbolizes cultures' continuous blending and flow. This river does not exist in the physical world. However, it flows clearly in the viewers' perceptions,

transcending the physical and virtual boundaries and meandering through the vast green meadow (Liu Jiayu Liu Studio, 2024).

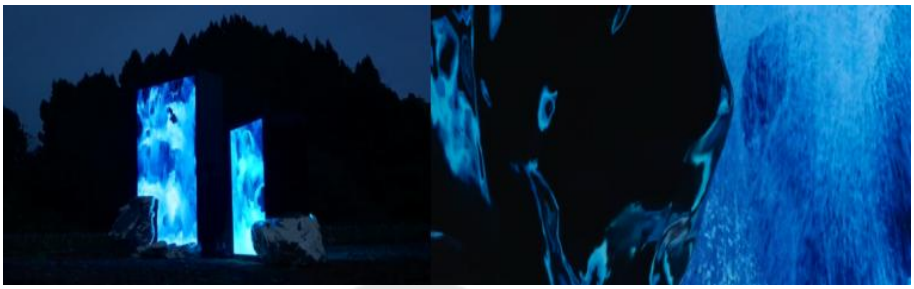

Figure 24 Stone Language

Source: Liu Jiayu Liu Studio. The Language of Stone Original. MANA, https://www.manamana.net/video/detail?id=2451896#!zh

2.Science Centers

From July 1 to October 31, 2023, Nanjing Toshi provided interactive touch wall installations and related services for the "Wonderful Journey of a Drop of Oil" exhibition at the China Science and Technology Museum. The exhibition disseminated scientific knowledge through immersive, multi-sensory interactive experiences and evoked emotional responses and rational thinking among the audience (Nanjing Throwing Stone Technology Co, 2023).

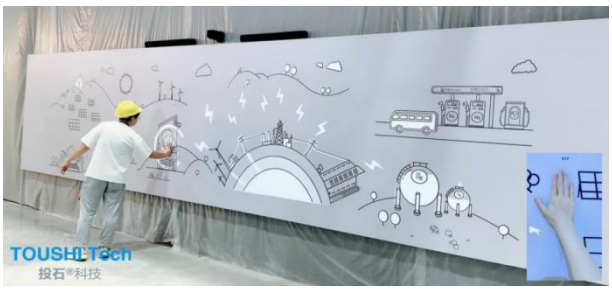

Figure 25 2023 China Science and Technology Museum "The Wonderful Journey of a Drop of Oil" Exhibition

Source: Nanjing Throwing Stone Technology Co. 2023 China Science and Technology Museum 'The Wonderful Journey of a Drop of Oil' Exhibition-Energy Interactive Touch Wall. MANA,

https://www.manamana.net/video/detail?id=2251636#!zh.

3.Community Centers

"Chinese Peking Opera: Farewell My Concubine" is a stage design that merges conceptual staging, immersive audio-visual elements, and the fusion of traditional intangible cultural heritage with modern technology. Interactive participation with the audience allows them to touch on the depth of history and the wonders of modern digital technology, shaping time and space in the moment and invoking reflections on history, technology, art, and intangible cultural heritage. "Chinese Peking Opera: Farewell My Concubine" uses the small stage and rising curtains to explore culture's past, present, and future with profound ambiance and emotion (Art Digital China CTC Lab, 2024).

Figure 26 Chinese Peking Opera - Farewell My Concubine

Source: Art Digital China CTC Lab. "Chinese Peking Opera - Farewell My Concubine: A Virtual Digital Preview of Multimedia Stage Art." MANA, https://www.manamana.net/video/detail?id=2414570#!zh

4.Convention Center

Silk Road Vision produced Taizhou's convention center, "Strongest City Brain" (Silk Road Vision, 2022). It combines various virtual interactive technologies and venues to create a futuristic and technological city convention center.

Figure 27 Taizhou City Brain Operation Center

Source: Silk Road Vision. "Taizhou's Netflix 'Strongest City Brain'!." MANA, https://www.manamana.net/video/detail?id=1934004#!zh

Figure 28 Taizhou City Brain Convention Center Inside the Exhibition Hall

Source: Silk Road Vision. "Taizhou's Netflix 'Strongest City Brain'!." MANA, https://www.manamana.net/video/detail?id=1934004#!zh

5.Libraries

On December 27, 2023, Beijing City Library opened its mountain reading area. The ART+TECH team was invited to create the "Knowledge Hill" video installation project. This project utilizes data visualization technology to transform the mountain into a peak of thought and wisdom. Through "Knowledge Hill," readers can experience the vastness and richness of knowledge from a new perspective, embarking on a journey of wisdom and co-writing new chapters of human civilization with the hill of knowledge (A Certain Collective ART+TECH, 2024).

Figure 29 Exterior of the "Hill of Knowledge" complex

Source: A Certain Collective ART+TECH. "Beijing City Library 'Knowledge Hill' Large Mountain Installation." MANA, https://www.manamana.net/video/detail?id=2440440#!zh

Figure 30 Inside the venue

Source: A Certain Collective ART+TECH. "Beijing City Library 'Knowledge Hill' Large Mountain Installation." MANA, https://www.manamana.net/video/detail?id=2440440#!zh

6.Historical Sites

On February 10, 2024, the Capital Museum reopened after more than a year of upgrades and renovations. Among the newly revamped exhibits is the "Powerful Witnesses of Chinese Civilization—Beijing General History Exhibition," marking the first major overhaul in 18 years. In the newly arranged exhibition, Fishfruit collaborated with the exhibition team to enhance the space with multimedia designs that integrate historical and cultural context (E-GO, 2024).

Figure 31 Powerful Witnesses of Chinese Civilization--Beijing General History Exhibition

Source: E-GO. "Fishfruit Culture Technology | Capital Museum Digital Exhibit Upgrade." MANA, https://www.manamana.net/video/detail?id=2430046#!zh.

The "Five Stars Rise in the East, Benefiting China—Hotan Historical and Cultural Exhibition" at the Hotan Museum uses various display and interactive methods to subtly and quietly showcase Hotan's art, artifacts, and history from the Paleolithic era onwards. Through these means, it promotes the enduring legacy of Chinese civilization and provides visitors with an experience of transcending time and space to dialogue with history (TZONE, 2021).

Figure 32 Exhibition Hall of "Five Stars Out of the East and Benefiting China--Hotan History and Culture Exhibition."

Source: TZONE. "Digital Images | Exhibition on the History and Culture of Wada." MANA, https://www.manamana.net/video/detail?id=1678844#!zh.

Figure 33 Five Stars Out of the East and Benefiting China -- Hotan Historical and Cultural Display Exhibition

Source: TZONE. "Digital Images | Exhibition on the History and Culture of Wada." MANA, https://www.manamana.net/video/detail?id=1678844#!zh.

7.Universities and Research Institutions

The Key Laboratory of Interactive Light and Shadow Service Technology for the Ministry of Culture and Tourism is established at Huazhong University of Science and Technology. It aims to provide technical support for developing night tourism and the digital creative industry. It guides the industrialization innovation model of key technologies and services for light and shadow interaction in cultural and tourism night tours (Global Digital Light and Shadow Art Innovation Network, 2022).

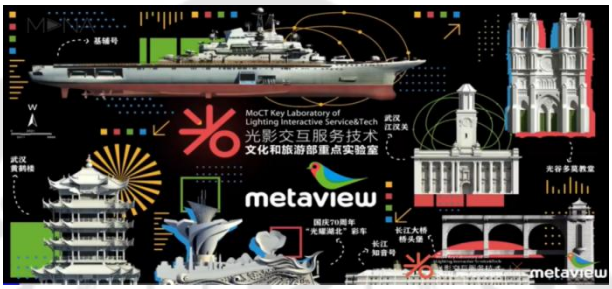

Figure 34 Light and Shadow Interactive Service Technology-Key Laboratory of the Ministry of Culture and Tourism

Source: Global Digital Light and Shadow Art Innovation Network. "Introduction of the Key Laboratory of the Ministry of Culture and Tourism of Light and Shadow Interactive Service Technology at Huazhong University of Science and Technology and the METAVI Technology Team." MANA, https://www.manamana.net/video/detail?id=1904722#!zh.

Figure 35 Huazhong University of Science and Technology seminar site

Source: Global Digital Light and Shadow Art Innovation Network. "Introduction of the Key Laboratory of the Ministry of Culture and Tourism of Light and Shadow Interactive Service Technology at Huazhong University of Science and Technology and the METAVI Technology Team." MANA, https://www.manamana.net/video/detail?id=1904722#!zh.

8.Commercial

Designed and produced by Wonderlabs, the Coach 2021 Spring Collection draws inspiration from the positive energy of nature. It visually presents the past, present, and future design concepts, aiming to return to the origins and uphold the classics. While in the installation, customers are surrounded by music, plants, dreamlike mirrors, and the scents of nature, creating an immersive experience. In the natural experience of the Coach Forever Mirror Forest, they perceive beauty and discover joy (Wonderlabs, 2021).

Figure 36 Coach 2021 "Mirror Forest"

Source: Wonderlabs. "Coach Forever 'Mirror Forest' Outdoor Art Installation." MANA, https://www.manamana.net/video/detail?id=1578178#!zh.

Figure 37 "Forest of Mirrors" Interactive Site

Source: Wonderlabs. "Coach Forever 'Mirror Forest' Outdoor Art Installation." MANA, https://www.manamana.net/video/detail?id=1578178#!zh.

The wide application of virtual interactive display technology improves work efficiency and effectiveness in various fields and provides people with a more intuitive and immersive experience. With the continuous progress of technology, the application prospect of virtual interactive display technology will be more broad.

2.3.2 Virtual Interaction in Museum Display

Contemporary museums are not just repositories of collections and artworks; they are unique communication channels, serving as vital conduits for disseminating culture to the public. Utilizing new technological interactive modes can greatly enhance museums' cultural dissemination and educational role and engage a wider audience.

Virtual interaction in museums refers to the use of technologies such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) to create interactive experiences in digital environments. These experiences enhance visitors' understanding and engagement with museum collections and exhibitions. This method of interaction goes beyond simple visual displays, incorporating multi-sensory participation, including auditory and tactile elements, as well as various forms of interactive games, virtual tours, and digital restorations.

Here are some examples of online as well as offline virtual interactive museums:

1.Online Museums

Recently, under the guidance of the National Cultural Heritage Administration, many museums have been leveraging existing digital resources to launch a series of excellent online exhibitions. They have also collaborated with various social forces to innovate communication methods, providing the public with safe and convenient online services.

① Celebrating the New Year in the Forbidden City

The Palace Museum

https://www.dpm.org.cn/subject_hesui/guide.html (Palace Museum).

Figure 38 Celebrating the New Year in the Forbidden City

Source: Palace Museum. "Celebrating the New Year in the Forbidden City." Palace Museum, https://www.dpm.org.cn/subject_hesui/guide.html.

Panoramic Forbidden City

The Palace Museum

http://webapp.vizen.cn/gugong_app_pc/index.html (The Palace Museum).

Figure 39 Panoramic view of the Forbidden City

Source: The Palace Museum. "Panorama of the Forbidden City." National Palace Museum, http://webapp.vizen.cn/gugong_app_pc/index.html.

② Return of Lost Cultural Relics from Italy Exhibition

National Museum of China

https://webapp.vizen.cn/backhome/index.html (National Museum of China).

Figure 40 Return-Italy Returns Chinese Displaced Cultural Relics Exhibition

Source: National Museum of China. "The Return--Italy's Return of Chinese Displaced Cultural Relics Exhibition." National Museum of China, https://webapp.vizen.cn/backhome/index.html.

2.Offline Museums

① Inverted Globe, Giant Connecting Block Town:

A space that feels as if the world has been turned inside out. Make the city come to life by placing giant building blocks of houses and stations, running various vehicles such as cars and trains, and developing transport systems.

When blocks of the same kind are placed nearby, they are connected to let the vehicles move along the routes created. Connect the blocks, and the vehicles will evolve more and more. Helicopters fly from the building, and the world seen from the helicopter is projected on the screen in the sky.

The world has a river running through it. When it rains, the river floods and water enters the city. However, building a waterway with pond blocks and connecting it to the sea will prevent flooding (Teamlab, 2018).

Figure 41 Inverted Globe, Giant Connecting Block Town

Source: Teamlab. (2 B.C.E.). Inverted Globe, Giant Connecting Block Town. TeamLab. https://www.teamlab.art/w/inverted-globe

teamLab, 2018-, Interactive Digital Installation, Sound: Hideaki Takahashi

② OUTPUT

This project is an immersive interactive light and sound experience. Sensors in the installation sense the audience's brain waves and heart rate changes, thus changing the light's color and intensity. OUTPUT artist Nick Verstand is from the Netherlands. His works have been exhibited at Paris Fashion Week and the Amsterdam

City Museum. He has collaborated with top international fashion designers and celebrities such as Iris van Herpen (Output, 2020).

Figure 42 OUTPUT

Source: Output. (2 B.C.E.). Immersive Interactive Devices. MANA. https://www.manamana.net/video/detail?id=244211#!zh

③ Living Crystallized Light

Like an organic entity created from crystallized light, the work shines iridescently from its center as it moves around, merging and dividing continuously.

People can walk into the artwork; even if they do so, its existence will remain unharmed. If people touch the artwork, they realize they see ordinary water. The artwork's existence is not independent but is a unique phenomenon, intriguingly created by its environment (Teamlab, 2022).

Figure 43 Living Crystallized Light

Source: Teamlab. (2022). Living Crystallized Light. TeamLab.

https://www.teamlab.art/zh-hans/w/living_crystallized_light/

2.3.3 Virtual Interactive Display in Yunnan Provincial Museum

1. Online Yunnan Provincial Museum

A virtual tour of the Yunnan Provincial Museum allows visitors to explore the museum, view exhibitions, appreciate artifacts, and learn about history, all from the comfort of their homes. In addition to the convenience of visiting the museum without leaving their homes, virtual exhibitions also enable visitors to see classic temporary exhibitions that have already ended.

① Rooted in Earth—Jianshui Purple Pottery Art Exhibition

Figure *44 Rooted in Earth—Jianshui Purple Pottery Art Exhibition*

Source: Yunnan Provincial Museum. (2022, June 22). A guide to "traveling" to the Yunnan Provincial Museum. Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247517161&idx=1&sn=561febf766fd2ecb3892f9ba4ffe0552&chksm=e976187cde01916a5f57201608cfebaa6210

Jianshui Purple Pottery is a product of the mutual nurturing and enrichment between the Han culture of the Central Plains and the local frontier culture. Its emergence not only reflects the cultural heritage of Jianshui, a thousand-year-old historic city known as the "Zoulu of Southern Yunnan" and a "Land of Literature," but also represents a microcosm of Yunnan's role in the progress of Chinese civilization. The exhibition uses 28 artifacts from the Yunnan Provincial Museum collection and 304 pieces of purple pottery to tell three stories: "A Thousand Years of Kilns," "Pursuit of Excellence in Carving," and "My Clay Expressions." This shift moves the audience's focus from the singular "material" aspect to the "intangible" cultural Logic, showcasing the past, present, and future of Jianshui Purple Pottery from multiple perspectives (Yunnan Provincial Museum, 2022).

② Moso: Family, Marriage, Dialogue

Figure 45 Moso: Family, Marriage, Dialogue Exhibition

Source: Yunnan Provincial Museum. (2022, June 22). A guide to "traveling" to the Yunnan Provincial Museum. Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247517161&idx=1&sn=561febf766fd2ecb3892f9ba4ffe0552&chksm=e976187cde01916a5f57201608cfebaa6210

The special exhibition will focus on the Mosuo people's perspective, highlighting their matriarchal extended families and walking marriages. It will feature precious artifacts, photographs, interviews, and video materials, providing a comprehensive, authentic, and in-depth look at the Mosuo people's history, lifestyle, and family and marriage practices. Additionally, the exhibition will incorporate interpretations of the Mosuo by contemporary artists, using their artworks to initiate dialogues and discussions between the Mosuo and the audience (Yunnan Provincial Museum, 2022).

③ Warmth of the Cloud Cliffs—The Long March of the Red Army through Yunnan

Figure 46 Warmth of the Cloud Cliffs—The Long March of the Red Army through Yunnan Exhibition

Source: Yunnan Provincial Museum. (2022, June 22). A guide to "traveling" to the Yunnan Provincial Museum. Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247517161&idx=1&sn=561febf766fd2ecb3892f9ba4ffe0552&chksm=e976187cde01916a5f57201608cfebaa6210

The exhibition recreates the arduous battles fought by the Red Army in Yunnan, highlighting their journey's significant and transformative moments. It vividly portrays the heroic efforts, sacrifices, and unwavering support of the Yunnan people during the Long March, showcasing their remarkable contributions and dedication to the Red Army's cause (Yunnan Provincial Museum, 2022).

④ Blood and Glory—The Yunnan Army's 60th Army Expedition to Fight Against Japan

Commemorates the 60th Army's expedition during the anti-Japanese war, later reorganized as the 50th Army of the Chinese People's Liberation Army (Yunnan Provincial Museum, 2022).

Figure 47 Blood and Glory—The Yunnan Army's 60th Army Expedition to Fight Against Japan Exhibition

Source: Yunnan Provincial Museum. (2022, June 22). A guide to "traveling" to the Yunnan Provincial Museum. Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247517161&idx=1&sn=561febf766fd2ecb3892f9ba4ffe0552&chksm=e976187cde01916a5f57201608cfebaa6210

⑤ Mystic Buddhist Land—Yunnan Buddhist Art Exhibition

⑥

Figure 48 Mystic Buddhist Land—Yunnan Buddhist Art Exhibition

Source: Yunnan Provincial Museum. (2022, June 22). A guide to "traveling" to the Yunnan Provincial Museum. Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247517161&idx=1&sn=561febf766fd2ecb3892f9ba4ffe0552&chksm=e976187cde01916a5f57201608cfebaa6210

This exhibition spans a millennium and showcases artifacts from the Nanzhao and Dali kingdoms, Han Chinese Mahayana Buddhism, Tibetan Vajrayana Buddhism, and Theravada Buddhism (Yunnan Provincial Museum, 2022).

⑦ Permanent Exhibition and Ancient Tea Horse Road Exhibition

Figure 49 Permanent Exhibition and Ancient Tea Horse Road Exhibition

Source: Yunnan Provincial Museum. (2022, June 22). A guide to "traveling" to the Yunnan Provincial Museum. Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247517161&idx=1&sn=561febf766fd2ecb3892f9ba4ffe0552&chksm=e976187cde01916a5f57201608cfebaa6210

The "Ancient Tea Horse Road — Joint Exhibition of Cultural Relics from Eight Provinces and Regions," at the new museum's opening (Yunnan Provincial Museum, 2022).

The six online exhibitions were expertly filmed using virtual restoration techniques to generate immersive 360-degree panoramic views of the six offline exhibitions at the Yunnan Provincial Museum. These captivating visual renderings were then meticulously edited for online viewing, allowing viewers to explore the exhibits in stunning detail from anywhere with an internet connection. Due to the technical limitations of panoramic photos, it is not possible to show the exhibits comprehensively

and detailedly. In addition, since the online showroom is a one-to-one reproduction of the real showroom, the interactivity is limited.

2. Digital Exhibition Hall of Yunnan Provincial Museum's Exquisite Artifacts

In January 2023, the Yunnan Provincial Museum's digital exhibition hall of curated artifacts officially went online. The exhibition is divided into four sections: "Bronze Artifacts," "Revolutionary Relics," "Calligraphy and Paintings," and "Religious Artifacts." It primarily showcases bronze artifacts unearthed in Yunnan, featuring 38 curated items from the museum's collection.

Figure 50 Digital Exhibition *Hall Interface*

Source: Yunnan Provincial Museum. (2023, January 18). Yunnan Provincial Museum Collections of Fine Cultural Relics Digital Exhibition Hall Online Today! Yunnan Provincial Museum.
https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247525295&idx=1&sn=f139c25b562dfac05e8cfe4e8727a19b&chksm=e976f83ade01712ca186ba6058d0

The artifacts displayed in this exhibition can be freely rotated and enlarged, allowing visitors to examine rare ancient calligraphy and paintings at any time closely. This exhibition also offers interactivity and engagement that cannot be provided in a physical gallery, meeting the needs of general visitors and artifact researchers and enthusiasts.

Figure 51 Digital Exhibition Hall Interface

Source: Yunnan Provincial Museum. (2023, January 18). Yunnan Provincial Museum Collections of Fine Cultural Relics Digital Exhibition Hall Online Today! Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247525295&idx=1&sn=f139c25b562dfac05e8cfe4e8727a19b&chksm=e976f83ade01712ca186ba6058d0

This exhibition hall is one of the research outcomes of Yunnan Province's major scientific and technological project, "Research on Key Technologies of Digitization and Intelligence for Cultural Tourism" (Project Number: 202002AD080001). It focuses on Yunnan's curated artifacts' digitization and 3D display applications. It aims to share Yunnan's unique historical and cultural heritage with a broad online audience and create a "parallel world" of the Yunnan Provincial Museum (Yunnan Provincial Museum, 2023).

Figure 52 Digital Exhibition Hall Interface: Bronze Artifacts

Source: Yunnan Provincial Museum. (2023, January 18). Yunnan Provincial Museum Collections of Fine Cultural Relics Digital Exhibition Hall Online Today! Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247525295&idx=1&sn=f139c25b562dfac05e8cfe4e8727a19b&chksm=e976f83ade01712ca186ba6058d0

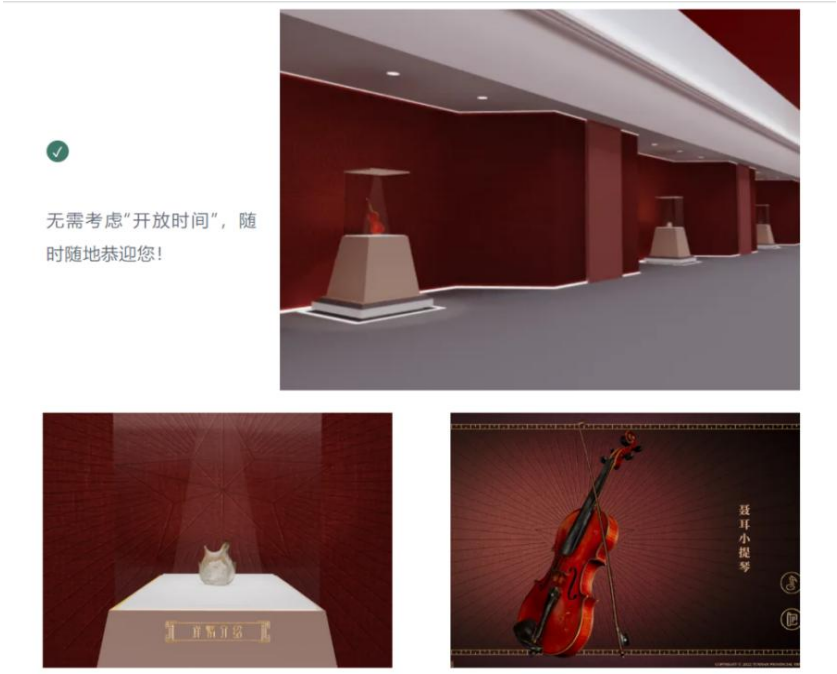

Figure 53 Digital Exhibition Hall Interface: Red Artifacts

Source: Yunnan Provincial Museum. (2023, January 18). Yunnan Provincial Museum Collections of Fine Cultural Relics Digital Exhibition Hall Online Today! Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247525295&idx=1&sn=f139c25b562dfac05e8cfe4e8727a19b&chksm=e976f83ade01712ca186ba6058d0

Figure 54 Digital Exhibition Hall Interface: Calligraphy and Paintings

Source: Yunnan Provincial Museum. (2023, January 18). Yunnan Provincial Museum Collections of Fine Cultural Relics Digital Exhibition Hall Online Today! Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247525295&idx=1&sn=f139c25b562dfac05e8cfe4e8727a19b&chksm=e976f83ade01712ca186ba6058d0

Figure 55 Digital Exhibition Hall Interface: Religious Artifacts

Source: Yunnan Provincial Museum. (2023, January 18). Yunnan Provincial Museum Collections of Fine Cultural Relics Digital Exhibition Hall Online Today! Yunnan Provincial Museum. https://mp.weixin.qq.com/s?__biz=MzI0MjkyOTQwMg==&mid=2247525295&idx=1&sn=f139c25b562dfac05e8cfe4e8727a19b&chksm=e976f83ade01712ca186ba6058d0

In a museum that never closes, visitors can fully appreciate exquisite bronzes, scrutinize precious ancient paintings and calligraphy, and zoom in on artifacts in as much detail as they like. However, this kind of exhibition still needs to get rid of the traditional virtual interactive display; it has virtually restored the real exhibition hall and exhibits, and it does not provide the vivid and coherent narrative, and a rich variety of interactions. Although it achieves the effect of virtual interactive display, the educational function and memory enhancement for the audience still needs to be strengthened.

3. Offline Yunnan Provincial Museum "Fantasy Yunnan - China and Southeast Asia Digital Art Exhibition"

On September 5, 2023, the "Fantasy Yunnan - China and Southeast Asia Digital Art Exhibition" opened at the Yunnan Provincial Museum. The exhibition is organized into four sections: "Symbiosis: Where Science Meets Art," "Creation: From Image to World," "Connection: Digital Art as a Method," and "Reformation: Reflections on the Machine." It showcases the works of over 40 artists from China and Southeast Asia, including cutting-edge digital algorithm art and artificial intelligence art (Nian Xinhong, 2023).

Figure 56 Fantasy Yunnan - China and Southeast Asia Digital Art Exhibition Art Exhibition Hall

Ding Ning. (2023, September 5). "*Fantasy Yunnan - China and Southeast Asia Digital Art Exhibition*" opens in Kunming. Xinhua. http://www.yn.xinhuanet.com/20230906/c1b54bbef21441c7bae60bb0ace69544/c.html

Wan Fan, Dean of the Design School at Yunnan Arts University, points out that this exhibition aims to popularize the innovative expression of technology combined with art. "Currently, AI technology and ChatGPT are very popular. High technology is not cold; it can closely integrate with human emotions. The combination of technology and art is the closest to people's daily lives." Wan Fan introduced that the participating artists come from multiple countries, including China, Malaysia, Bangladesh, and Thailand. "Yunnan aims to establish itself as a radiating center for

South and Southeast Asia, and art should take the lead in this initiative. We hope that through such exhibitions, the development of Yunnan's art can coordinate internally and radiate externally to South and Southeast Asia, transforming Yunnan's border location into a central advantage of an open platform." (Nian Xinhong, 2023).

Figure 57 Fantasy Yunnan - China and Southeast Asia Digital Art Exhibition: Spice Princess

Source: Ding Ning. (2023, September 5). "Caihuan Nanyun - China and Southeast Asia Digital Art Exhibition" opens in Kunming. Xinhua. http://www.yn.xinhuanet.com/20230906/c1b54bbef21441c7bae60bb0ace69544/c.html

The "Fantasy Yunnan - China and Southeast Asia Digital Art Exhibition" is jointly organized by the Yunnan Provincial Museum and Yunnan Arts University, with academic guidance from the China Society of Cinematic Art. The exhibition ends on November 30, 2023. It is co-hosted by the China Society of Cinematic Art, with support from its CG Art Committee and Higher Education Committee, the Animation and Digital Media Art Committee of the Yunnan Artists Association, the Digital Media Art Department of the Design School at Yunnan Arts University, and the Le Yi ArtPage International CG Art Incubation Platform. (Nian Xinhong, 2023).

Figure 58 Fantasy Yunnan - China and Southeast Asia Digital Art Exhibition Poster

Source: Ding Ning. (2023, September 5). "Caihuan Nanyun - China and Southeast Asia Digital Art Exhibition" opens in Kunming. Xinhua. http://www.yn.xinhuanet.com/20230906/c1b54bbef21441c7bae60bb0ace69544/c.html

Most offline virtual interactive exhibitions are related to art exhibitions, rich in interactive forms and strong in sensory stimulation. However, the exhibition's main purpose is to exhibit artworks highlighting the need for aesthetics, with no particularly obvious educational significance, and mainly focusing on entertainment rather than seriousness in terms of display content.

2.4 Development and Application of Narrative Elements

2.4.1 Development of Narrative Theory

The theoretical development of narrative theory is a complex and multilayered field of study that involves several disciplines, including anthropology, sociology, psychology, literature, education, history, and philosophy. The following is a brief overview of the theoretical development of the narrative element, categorized into several key phases and contributions from important scholars:

1. Early theories

In the work Poetics, Aristotle proposed a basic narrative structure for tragedy and epic poetry, emphasizing the importance of plot, character, and theme. He

believed that the plot was the narrative's core and must have a beginning, a middle, and an end (Aristotle, 1996).

In Russian Formalism, Viktor Shklovsky proposed the concept of "strangeness," which emphasizes the innovation of narrative techniques by making the commonplace unfamiliar to arouse the audience's attention and thoughts (Tomáš, 2016). Boris Eichenbaum analyzes narrative techniques and literary forms, emphasizing the structure and function of literary works (Lee t.lemon; Marion J. reis., n).

2. Classical Narratology

In Vladimir Propp's Morphology of the Folktale: By analyzing Russian folktales, Propp proposed 31 types of narrative functions, constructed a formal model of narrative structure, and emphasized the functional elements of the storyline (Wikipedia, n).

In Algirdas Julien Greimas's Symbolic Matrix Theory: Greimas developed the symbolic matrix theory and proposed the "actuarial model," which focuses narrative analysis on the relationship between characters and functions (Louis hébert, n).

3.Structuralism and post-structuralism

In Roland Barthes's S/Z: By analyzing Balzac's Saracen, Barthes proposed five narrative codes, including puzzle, symbol, action, semantics, and cultural code. These codes emphasize the text's multiple meanings and the reader's role in interpretation (Roland Barthes, n).

In Gérard Genette's Narrative Time and Narrative Levels: Gérard Genette's theory states that narrative time includes order, duration, and frequency, as well as narrative levels and focalization, systematizing the method of narrative analysis (John Pier, 2010).

4. Narrative psychology

In Jerome Bruner's Life as Narrative: Bruner studies narratives through the lens of cognitive psychology, emphasizing the role of narratives in constructing self

and cultural meanings and proposing that people make sense of the world and themselves through narratives (Jerome Bruner, n).

In Peter Brooks's Seduced By Story, the author explores the importance of desire and endings in narratives and proposes the "schema of desire" theory, which argues that narratives attract audiences by stimulating and satisfying desires.

5.Culture and media studies

Transmedia storytelling: Jenkins discusses transmedia narratives in the new media environment in Convergence Culture, exploring the extension and interaction of narratives in different media forms and emphasizing the audience's active participation in the narratives (Henry Jenkins, 2007).

Immersive narrative: Ryan explores the impact of virtual reality and interactive media on narrative forms, proposes the concept of multimodal narrative, and emphasizes the integrative role of multimedia in narrative (Marie-Laure Ryan, 2004).

6. Museum Narratives

Museum storytelling creates personal connections between visitors and content, benefiting exhibitions, public programs, and school outreach (Bedford L., 2001).

Narrative research provides novel insights into the nature of visitor/museum relationships, enhancing our understanding of museum experiences that build and strengthen relationships with visitors (Everett et al., 2009).

2.4.2 Narrative Elements in Museum Displays

The "three-layer distinction" of narratology from Mieke Bal (M. Bal, 2017), namely, the "narrative text, story and fabula," which is further interpreted by Tom Duncan (T. Duncan et al., 2018). In the exhibition context, "In the museum, the narrative text is the navigable exhibition experience consisting of sequences of spaces, images, written words, and objects, in combination with different media. The story is how the designer intends the visitor to experience the exhibition; in other words, how the multiple elements and media are presented and organized. The fabula is the chronological account of

events, not necessarily in the order in which the visitor experiences them." (Hailin Chen et al., 2024).

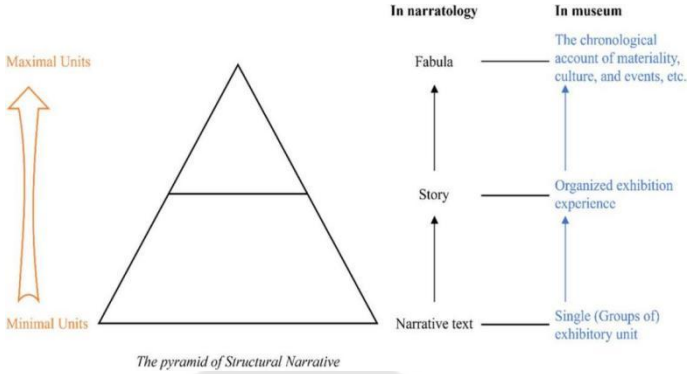

Figure 59 The combined structure in narratology and museum context

Source: Hailin Chen, Jonathan Hale, & Laura Hanks. (2024, May). Archive or Exhibition?: A Comparative Case Study of the Real and Virtual Pitt Rivers Museum. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S2212054823000504?dgcid=rss_sd_all#bib7

For objects' whole lives, their display in the PRM utilizes them as "narrative text," namely, the smallest parts in the narrative system. This means more "stories" and "fabula" are absent. Therefore, visitors cannot tell a reductive or imagined full version of a story from object-driven exhibitions because they need higher elements in the pyramid of narrative structure. Although presenting a full scope of every single object is optional for the PRM or the typological tenet, bringing back more narrative pieces of objects may help visitors enter a higher level of narrative exploration within the complex typological system (Hailin Chen et al., 2024).

Narrative elements in museum displays create compelling stories by skillfully combining elements such as plot, character, setting, theme, and narrative perspective to enhance audience engagement and understanding.

The plot can be further categorized into linear and non-linear narratives. Linear narratives are presented in chronological order or the order of events. History museums often use this approach, showing different periods of history from ancient to

modern times. The National Museum of History in Washington, D.C., presents American history through a timeline, revealing historical events and changes from colonial to modern times. Non-linear narratives allow visitors to explore an exhibit at their own pace and in order. They are commonly found in art and themed exhibitions that break the traditional linear narrative mold through interactive exhibits and multimedia presentations (Nam Wook Kim et al., 2020).

Characters can be divided into historical figures and fictional characters. Historical figures show the life and deeds of specific historical figures, making the exhibition content more attractive and authentic. Fictional characters are some museums that create fictional characters to guide the audience, such as the Capital Museum's digital person, Jinghui, who tells the exhibition's story through a digital person to enhance the fun and interactivity.

Setting can be further categorized into geographic and temporal contexts. Geographic setting builds stories by showing a particular place's history, culture, and environment. Yunnan Provincial Ethnic Museum tells stories about different ethnic groups in different places by dividing them into different regions. Temporal context is to lead the audience to travel through time and space by recreating scenes from a specific period.

Theme can be divided into central and decentralized themes. Each exhibition of a central theme centers on a core theme and deepens the audience's understanding of the theme through various exhibits and narrative elements. Decentralized themes revolve around multiple themes displayed through zoning or thematic display cabinets.

Narrative Perspective is categorized into first-person and third-person narratives. First-person narratives present events through the eyes of the individuals behind the exhibits and the witnesses. Third-person narratives usually tell the exhibits and stories through objective descriptions from the viewer's, curator's, or narrator's point of view.

The application of narrative elements in museum exhibitions enhances the coherence of the exhibition and the audience's sense of participation. Usually, the use of narrative elements is not isolated, and the exhibition design concept that synthesizes the use of narrative elements plays a crucial role in establishing a deep emotional connection with the audience and knowledge transfer. Through continuous exploration and innovation, museums can further enhance their educational and cultural dissemination effects and bring richer and more meaningful experiences to their audiences.

2.4.3 Narrative Elements in The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum

Taking the whole province as the perspective and the country of Yunnan as the geographical background, it reproduces how the mysterious "country of Yunnan" under Sima Qian's writing developed step by step from a small frontier tribe into a "sheikhdom" society with the nature of a former state and was eventually incorporated into the Western Han Empire, and the specific course of the "great unification" of the Western Han Empire.

The exhibition is divided into four parts: the beginning of the Bronze Age in Yunnan, the general situation of the Bronze Age in Yunnan, the leader of the Southwest Barbarians - the Dian State, and the Yizhou County in the Han Dynasty.

The exhibition adopts the third-person perspective by narrating vivid visualizations of historical events and intuitive displays of exquisite cultural relics to achieve the unification of the sense of history and the aesthetic effect and make the audience "return to the past." The historical sense and aesthetic effect are unified so that the audience "returns to ancient Yunnan" and re-recognizes the glory of Yunnan bronze culture.

2.5 Development and Application of Serious Games

2.5.1 Development of Serious Games

1. Theory development

The origins of serious games can be traced back to ancient times when games were used for military training. Examples include the board games Chaturanga from India and Wei Hei from China, both over four thousand years old. These early games were designed to improve military officers' strategic thinking and planning skills.

In the 1970s, Clark Abt introduced the term "serious game" and provided the initial conceptual definition in his book Serious Games (Phil Wilkinson, n).

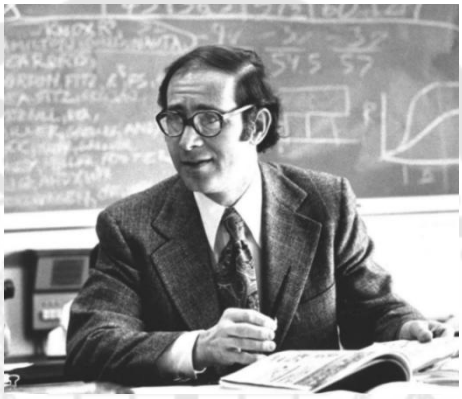

Figure 60 Clark C. Abt, Ph.D.

Source: Abtglobal. (n.d.). Clark C. Abt, Ph.D. Abtglobal. https://www.abtglobal.com/who-we-are/our-people/clark-c-abt-phd

Figure 61 Serious Games

Source: Amazon. (n.d.). Serious Games. Amazon. https://www.amazon.com/dp/0670634905/?_encoding=UTF8&pd_rd_w=HdSt5&content-id=amzn1.sym.f911c8db-3a2b-4b3e-952f-b80fdcee83f4&pf_rd_p=f911c8db-3a2b-4b3e-952f-b80fdcee83f4&pf_rd_r=141-6748941-8113041&pd_rd_wg=x4Mmn&pd_rd_r=92a8861c-e3d7-4c2f-8c67-1c8feb170b01&ref_=aufs_ap_sc_dsk

The modern concept of serious games began to take shape with the development of digital technology. Noah Falstein is widely recognized as the "Father of Serious Games," his career spans the intersection of neural gaming, VR, and entertainment. He served as the Chief Game Designer at Google and has extensive experience working with renowned developers such as LucasArts, 3DO, and DreamWorks Interactive (Theinspiracy, n).

Beginning his professional game development career in 1980, Falstein was among the first ten employees at LucasArts Entertainment, 3DO Company, and DreamWorks Interactive. He later ran his freelance design company, The Conspiracy, for 17 years. Falstein is renowned for co-designing arcade games like Sinistar and Indiana Jones and the Fate of Atlantis, as well as contributing to serious games such as ReMission and Neuroracer. His work has significantly impacted the field of serious

games, blending entertainment with educational and therapeutic applications (Wikipedia, n).

The U.S. Army's release of "America's Army" in 2002 marked a significant milestone in the history of serious games (Matthew Thomson, 2008). This game, designed for recruitment and training, was one of the first well-known examples of a serious game that successfully integrated entertainment with practical training objectives.

In the early 2000s, the Woodrow Wilson International Center for Scholars in Washington, D.C., launched the Serious Games Initiative (Wilsoncenter, n). This initiative aimed to explore the use of games to address public policy and management challenges, thereby formalizing the field of serious games and promoting its growth across various sectors, such as education, healthcare, and corporate training.

Kristian Kiili proposed evaluating an experiential gaming model based on research and analysis of flow theory and experiential learning theory combined with relevant game design theories. He emphasized the importance of clear goals, immediate feedback, and a balance between skills and challenges in designing educational game software (Kristian kiili, 2006).

Scholars such as Eelco Braad have also made significant contributions to the design of serious game models. By thoroughly analyzing educational theories, game design, game development, and models like GOP and Pom, they proposed the Game Achievement Model (GAP) (Eelco braad et al., 2016).

After a detailed analysis of the game process, Scholars Magdalena Bober, O. Dziabenko, and Matthew Barr outlined general steps for designing and developing game-based learning software. These steps include:

① Identifying Learning Objectives:

Clearly define what the learners are supposed to achieve through the game.

② Transforming Learning Objectives into Activities:

Convert learning goals into activities and tasks within a simulated world.

③ Detailed Description:

Provide specific details about the tasks and activities.

④ Integration of Learning Support:

Integrate appropriate learning supports into the game.

⑤ Embedding Learning Concepts into Game Objects:

Infuse the concepts to be learned into the game's objects and scenarios.

⑥ Merging Learning Activities with Game Activities:

Seamlessly integrate learning activities into the gameplay to ensure educational objectives are met through the gaming experience.

According to scholars McDaniel, Fiore, and Nicholson, "The goal of serious games is to create a virtual environment where learners encounter and solve problems, thereby acquiring skills or knowledge that can be applied to real-world situations." (R. McDaniel et al., 2010).

2. Application

Military:

The military has historically been a major user of serious games for training and simulation purposes. Games like "America's Army" have been used for recruitment, pre-training, and mission preparation.

Figure 62 Game America's Army

Source: Steamcommunity. (n.d.). America’s Army 3. Steamcommunity. https://steamcommunity.com/app/13140?l=tchinese

Education:

Serious games have become increasingly important in the global education and training market. They offer a way to make learning more interactive and engaging, catering to the digital native generation that expects interactive experiences from their educational media.

Figure 63 Pavlov: Brain'it On

Source: Glenna. (2021, September 30). Game as a service: the path of integrated research and development of the cognitive training game Pavlov is Busy. Zhuimeng. https://zhuimeng.qq.com/web201904/detail-news.html?newsid=15057841

Healthcare:

In the healthcare sector, serious games are used for training medical professionals, patient education, and even therapy. They provide safe, controlled environments for practicing skills and learning new procedures without the risks associated with real-life practice.

Some surgical operation simulation software uses virtual reality augmentation technology, such as AR/VR, to allow doctors to simulate surgical operations in a virtual environment to improve their surgical skills. Some of the more successful software in this category include Surgery Simulator and HeartWorks.

Figure 64 Virtual Environment Surgical Simulation

Source: Viwaviwa.(September 30). Gamification in action (III): Can medical research be fun? Knowing. https://zhuanlan.zhihu.com/p/581734903

Phylo: Another application developed by MIT, Phylo uses gamification to assist in aligning and analyzing gene sequences. Users can sort and align gene sequences in the game, aiding scientists in understanding the evolution and function of gene sequences.

Figure 65 Phylo

Source: Viwaviwa.(September 30). Gamification in action (III): Can medical research be fun? Knowing. https://zhuanlan.zhihu.com/p/581734903

Corporate Training:

Businesses use serious games to train employees in various skills, from customer service to complex technical tasks. These games can simulate real-world scenarios, allowing employees to practice and improve their skills in a risk-free environment.

Figure 66 Aviation training system"Come Fly With Me"

Source: Sina. (n.d.). Exquisite Chrome Xbox 360 Grip Announced. Sina. http://news.sina.com.cn/o/2007-02-13/095711232228s.shtml

Table 5 Milestones in the history of serious games

Year	Serious game	Application
1970	Serious Games book by C. Abt	Academic book
1972	Magnavox Odyssey	Education
1973	The Oregon Trail	Education
1980	BattleZone	Training
1981	The Bradley Trainer	Training
1982/1983	Pole Position/Atari VCS 2600 console	Training
1996	Marine Doom	Military
2002	America's Army	Military
2003	DARWARS	Military
2005	VBS1	Military
2006	BiLAT	Interpersonal communication
2009	VBS2/Game After Ambush	Military
2012	X-Plane 10	Training

2.5.2 Serious Games in Museum Displays

Museum display based on serious games is an emerging method that enhances the audience's learning experience and sense of participation by combining game design and educational content. The traditional museum virtual interactive display is only a virtual way to restore and reconstruct the real content; the interactive way is still the traditional display and introduction, on the original basis, plus the content of serious games will help to improve the effect of a virtual interactive display (Hanbing wang et al., 2024).

According to the purpose of serious games can be categorized as follows:

① Educational

The main purpose is education; the game content design focuses on transferring knowledge and skills development, such as historical knowledge quizzes.

Ant Manor Quiz: Guess what the initial use of the ancient bronze "tripod" is? Was it a "cooking vessel" or a "sacrificial vessel"? The correct answer is cooking utensils.

Figure 67 Ant Manor Interface

Source: Fatty Baldy. (2023, November 18). Guess what the original purpose of the ancient bronze "tripod" was? Ant Manor Trivia. Sohu. http://healthnews.sohu.com/a/737421841_121404574

② Role Playing Games (RPG)

Viewers learn about history and culture by playing specific roles, completing tasks, or exploring virtual environments.

For instance, the game Horizon Forbidden West released a promotional video in early April showcasing a collaboration with the Rijksmuseum in Amsterdam. The game's developer, Guerrilla Games, worked with the museum to create a bunker within the game that preserves great artworks from the past.

Figure 68 Horizon Forbidden West

Source: Prebend. (2022, May 17). Museums in games or games in museums? Art and Culture IPs Unlock New Markets for Games. Youxichaguan. http://youxichaguan.com/news/29005.html

Earlier May 2022, popular for its beautiful production, rich plot, and gameplay, the European and American dress-up simulation game Time Princess (Time Princess) also announced a co-branded collaboration with the Louvre in France, featuring a new special story, music, and customized costumes.

Figure 69 Time Princess

Source: Prebend. (2022, May 17). Museums in games or games in museums? Art and Culture IPs Unlock New Markets for Games. Youxichaguan. http://youxichaguan.com/news/29005.html

③ Simulation

When specific historical events or cultural scenes are simulated, the audience can participate with an in-depth understanding of the relevant background knowledge.

Antique Restorer is a casual simulation game that simulates fixing artifacts in an extremely simplified version. Essentially, it's a puzzle game based on artifacts. It is still in development, but a free trial has been released on Steam (Zhu Siqi, 2023).

Figure 70 Antique Restorer Interface

Source: Touchdown.com. (2023, April 22). What to Play This Weekend: New Chinese Puzzle and Girl Raising Game, Classic "Fallout" Series "Plagiarizer." NetEase. https://www.163.com/dy/article/I2UGSMEN052681DU.html

In the demo, you can see the game in its current incarnation. There are now three levels in the game, each corresponding to an artifact to be restored, now broken vases. The game allows you to choose the difficulty, which largely depends on whether or not you show the original vase on screen.

After passing the level, the game provides basic information about these artifacts in reality. If you are a fan of artifacts, you will feel more accomplished after putting them together.

④ Puzzle-Solving Type

Advance the game by solving puzzles or completing tasks to learn about exhibits or historical events.

As early as 2012, the Metropolitan Museum of Art in the United States launched a museum detective game called "Murder at the Met Game." The game's fictional plot takes players back to a soirée in 1899, where amidst the clinking of glasses, the beautiful Madame Virginie Gautreau is murdered. The storyline unfolds as players need to use the museum's space and the artworks in the galleries to establish connections with the game's story, find meaningful clues, and catch the culprit (Meetgames Publishing Academy, 2020).

Figure 71 Murder at the Met Game

Source: Gamification of art may become a new trend of art communication in the future. (2020, July 21). CHINA COMMUNICATIONS INDUSTRY ASSOCIATION ELECTRONIC SPORTS BRANCH. http://chinaesa.org.cn/talk_show-1117.aspx

The Lost Atlas will go live on Saturday, May 18, 2024, at 13:30 at the Saddleback Museum (Ma On Shan Museum,2024). Solve the puzzle at the end by collecting clues in the museum.

Figure 72 The Lost Atlas game site

Source: Ma On Shan Museum. (2024, May 10). International Museum Day - The Lost Atlas Museum Live NPC Interactive Immersive Decryption Game. Saddleback Museum. https://mp.weixin.qq.com/s?__biz=MzIwNTM5MDAzOQ==&mid=2247533569&idx=1&sn=83642f8f7a780f56e924c91305f1a4ef&chksm=96d98d395c3de220afe76c7e904480451fda83796222

Figure 73 The Lost Atlas Game Interface

Source: *Ma On Shan Museum. (2024, May 10). International Museum Day - The Lost Atlas Museum Live NPC Interactive Immersive Decryption* Game. Saddleback Museum. https://mp.weixin.qq.com/s?__biz=MzIwNTM5MDAzOQ==&mid=2247533569&idx=1&sn=83642f8f7a780f56e924c91305f1a4ef&chksm=96d98d395c3de220afe76c7e904480451fda83796222

The target audience comprises adults or children with experience using digital products and professional researchers. Games can be played on PCs and mobile devices and enriched using virtual reality (VR) and augmented reality (AR), where virtual content is superimposed on the real world through devices or apps to enhance the audience's understanding and experience of the actual exhibits.

The application of serious games on museum displays is not just a novel approach but a beneficial one. It imparts knowledge in specific fields, such as history, culture, and science, while cultivating particular audience skills through the game process, such as problem-solving ability, teamwork, and more. It guides the audience's behavioral change through game content, such as cultural heritage awareness, heritage protection awareness, and social responsibility. It enhances the audience's entertainment experience through game design to improve the museum's attractiveness and participation.

2.5.3 Serious Games in Yunnan Provincial Museum

Yunnan Provincial Museum often organizes colorful activities, such as Children's Day on June 1, when children can touch fossils in the museum to explore the origin of life. International Museum Day is carefully planned for lecturers in schools and exhibition halls, public service explanations, the ancient Yunnan shadow puppetry public service treasure appreciation, and other activities. During the Qingming Festival, arrangements were made for Qingming custom explanation and kite painting production.

However, the Yunnan Provincial Museum has yet to utilize the concept of serious games in its exhibitions. There is an excellent opportunity, especially to combine The Bronze Age of Yunnan Exhibition hall with narrative-based serious games that will inspire unusual sparks.

In the future, I will collect and analyze data through qualitative and quantitative methods to verify the feasibility of using the narrativized serious games virtual interactive display in The Bronze Age of Yunnan Exhibition hall and analyze its advantages and disadvantages. Based on the analysis results, targeted designs will be developed, and the production of related functions and products will be explored to promote the realization of this innovative exhibition method.

CHAPTER 3
METHODOLOGY

3.1 Research Design

3.1.1 Reasons for the Exhibition Hall Selection

There are four main reasons for choosing The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum as the research object.

Yunnan is the intersection of the China-ASEAN Free Trade Area, the Greater Mekong Subregion, and the Pan-Pearl River Delta (PPRD) Economic Circle. It is also the frontier channel of China's opening up to the five major regions of South Asia, Southeast Asia, West Asia, Southern Europe, and Africa, which is facing the economically vibrant Southeast Asia and 18 countries in South Asia, covering a population of 2.12 billion and linking up with ten provinces and municipalities in the Pan-PRD. Pan-Pearl River Delta" 10 provinces, autonomous regions, and cities linked, the market is huge, and the development space is very broad (Yunnan Provincial People's Government, 2015). As the largest comprehensive museum in Yunnan Province, the Yunnan Provincial Museum has a unique location advantage for protecting and disseminating ancient Yunnan (Dian) culture.

Ancient Yunnan culture is one of the most vibrant in Chinese history. Its bronze culture is especially fascinating, with many remaining mysteries. Selecting the Yunnan Provincial Museum is crucial for preserving and promoting culture.

Due to bronze's unique material, it easily oxidizes when displayed for extended periods, which can damage cultural artifacts. Additionally, bronze items' varied sizes and shapes make it difficult to display them effectively using traditional methods. Therefore, there is an imminent need to digitize and virtualize bronze displays to showcase the details of the artifacts from all angles.

Normally, traditional online museums or virtual interactive displays digitally restore real exhibition halls, leaving the exhibition format unchanged. However, by blending narrative serious games with virtual interactive displays, we can enhance audience interaction with the exhibition, improve the display effect, foster cultural

dissemination, and increase awareness of cultural relics protection. Moreover, the Yunnan Provincial Museum needs this exhibit that integrates serious narrative games with virtual interaction.

3.1.2 Research Methods

Field research method: Conduct in-depth on-site research at the museum in Yunnan Province. Record the number of museum visitors as well as their behaviors. Analyze the reasons for this phenomenon and collect and collate data to understand the real situation of the museum in Yunnan Province.

Interview method: The in-depth interview method was used to interview the staff of the Yunnan Provincial Museum and practitioners in the virtual interactive display industry to collect relevant data and analyze the feasibility, advantages, and disadvantages of applying narrative serious games to The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum.

Questionnaire: A questionnaire was used to survey the audience of The Bronze Age of Yunnan Exhibition to collect relevant data and understand the audience's preference for the display method, which will enhance the user experience of the later application.

3.2 Research Sample

In-depth understanding of experts' perspectives on using serious games in the design of virtual interactive displays in museums. Design a semi-structured interview outline and select 3-5 museum staff and experts in related fields to conduct in-depth interviews to discuss the principles of narrativization design, application of serious games, and implementation of virtual interactive technology.

Table 6 List of Interviews with Yunnan Provincial Museum Staff

Participants in The Survey	Professional Background & Work Experience	Number of People
Exhibition Supervisor	Daily management of the exhibition halls	1-3

Table 7 List of Interviews with Virtual Interactive Display Practitioner

Participants in The Survey	Professional Background & Work Experience	Number of People
Virtual Interactive Display Designer	Design and production of different types of virtual interactive exhibition halls	1-3
Virtual Interactive Application Designer	Design and production of different types of virtual interactive applications	1-3
Academic experts (university professors)	Experts and professors in digital media, virtual interaction, 3D restoration, etc.	1-3
Expert in Bronze Culture	Specialists in history, culture, and archaeology	1-3

3.3 Data Analysis Methods

3.3.1 Qualitative Data Analysis

Content Analysis: Analyze the records of expert interviews and open-ended questionnaire responses to extract key information, understand the planning and design process of the exhibition hall of The Bronze Age of Yunnan Exhibition, clarify the narrative structure and design concepts, and gain an in-depth understanding of the characteristics of the application of narrativized design and serious games in virtual interactive displays.

Coding and Classification: Processing qualitative data including coding, classification, finding connections and commonalities, analyzing the feasibility and practical application of the narrativized serious games in the exhibition hall of The Bronze Age of Yunnan Exhibition in Yunnan Provincial Museum, and summarizing the improvement and trend analysis of future exhibitions.

3.3.2 Quantitative Data Analysis

Descriptive statistics: This method involves a descriptive statistical analysis of the questionnaire data. It is instrumental in providing a statistical understanding of the sample's basic characteristics and the distribution of the main variables, thereby contributing to the overall museum visitors' preferences for exhibition methods.

Regression analysis: to explore the degree of influence of narrativized design and serious games on user experience and learning effect and their mechanism of action through multiple regression analysis.

3.4 Reliability and Validity of the Study

This project aims to ensure the reliability and validity of the study from both subjective and objective aspects.

First of all, we have utilized various research methods and two research theories to ensure their reliability and validity and to enhance them for more valid research results on the subjective side.

The study's quality was enhanced through member checking and peer review. The data obtained will be shared with the participants to assess its reliability and to receive valuable feedback to enhance the study. The entire study process, from research design to data collection, analysis, and results, will be submitted to other peer researchers for constructive feedback.

3.5 Ethical Aspects of the Study

Ethical aspects are crucial when conducting research. Some ethical issues that need to be considered during the research process include:

1. Informed Consent

Inform participants of the research's purpose, methods, expected benefits, and potential risks. After being fully informed, participants should be allowed to decide whether to participate freely in the research. They must sign a consent form confirming that they understand the research and are willing to participate. Informed

consent should occur after they have had the chance to ask questions and receive clear answers.

2. Confidentiality and Privacy

All data collected during the study should be kept securely, and measures should be taken to protect the participants' privacy. Anonymization or coding techniques should used when necessary to protect personally identifiable information. It should also ensure that the data collected are used only for the study and not for any other purpose without the participants' consent.

3. Protection of Participants

During the study design phase, a detailed risk assessment is carried out to minimize any psychological, physical, or social risks to which participants may be exposed. Special attention is paid to protecting vulnerable groups, such as children, the elderly, and people with disabilities, to ensure that their participation is entirely voluntary and that they receive special protection and attention.

4. Fairness and Equity

Participants should be selected fairly and without any form of discrimination. They should be selected based on research needs, not race, gender, age, or other personal characteristics. All participants should be treated equally in the research process, and ensure that the publication and application of research results should not unfairly and negatively impact a particular group.

5. Transparency and Integrity

Ensure that the research process is transparent and that the research design, data collection, and analysis methods are open and allow for peer review and oversight. Ensure the authenticity and reliability of data and eliminate any form of data falsification, tampering, or improper handling.

6. Ethical Review

Prior to the commencement of the study, the study plan should be submitted to an independent ethics committee for review to ensure that the study design and methodology meet ethical standards. During the study, the ethics committee should

be regularly informed of the progress made and seek guidance and resolution of ethical issues.

7. Closure and Feedback

At the end of the study, the researcher should provide feedback to the participants on the study's results and thank them for their participation and contribution. After the study is completed, the researcher should continue to protect the privacy and data of the participants to ensure that their personal information is not disclosed or misused.

By comprehensively considering these ethical issues, it is possible to ensure the morality and legitimacy of the research process and results, protect the rights and interests of participants, and enhance the credibility and social responsibility of the research.

CHAPTER 4
RESULT

4.1 Analysis of Data Results

The study will yield a practical and theoretical foundation for revolutionizing museum exhibitions through virtual interactive exhibitions of narrativized serious games. It will provide actionable strategies for museums to enhance their social influence, educational value, and cultural appeal, specifically focusing on The Bronze Age of Yunnan Exhibition. These results will serve as a valuable contribution to the museum community and related fields, supporting the sustainable development and digital transformation of cultural heritage institutions.

4.1.1 Analysis of the Results of Interviews with Yunnan Province Museum Staff

This interview was conducted with a staff member of the Yunnan Provincial Museum, whose identity will be kept hidden because of his personal wishes. It is hereby declared that the views expressed by the staff are only personal views and do not represent the official opinion of Yunnan Provincial Museum. The interviewee gave the following answers to the questions listed in the annex.

The interviewees said that the planning of The Bronze Age of Yunnan Exhibition involved thorough research, collaboration with historians and archaeologists, and consultations with design experts. The narrative was structured chronologically, highlighting key themes such as daily life, warfare, and religion. The exhibition aimed to educate the public on Yunnan's Bronze Age culture, emphasize its contributions to ancient civilization, and foster cultural appreciation.

Multimedia elements like documentary videos, animations, audio guides, and interactive touchscreens were used to enhance storytelling, though no advanced virtual technologies like VR or AR were included. Visitors could engage digitally through online tours and large digital screens, which received positive feedback, especially for their educational value and immersive reconstructions. Feedback was gathered via surveys, comment cards, kiosks, interviews, and social media, guiding annual updates to the exhibition.

Looking forward, the staff highlighted the potential of AI-guided tours, haptic feedback, and 3D projection mapping to improve engagement and accessibility. They also expressed strong interest in incorporating narrative-driven serious games, suggesting such gamified learning tools, developed in collaboration with historians and game designers, could significantly enhance the visitor experience.

4.1.2 Analysis of the Results of Interviews with Virtual Interactive Display Practitioner

This time, we conducted online interviews with practitioners of virtual interactive displays. There are five interviewees in total: two university professors three designers and production experts of virtual interactive displays. Four of them are male, and one is female. The youngest is 28 years old, and the oldest is 53. Their engagement in related work varies from 1 year to 30 years.

They are Zhang Jingping, professor and master's degree supervisor, working in Shanghai Theatre Academy, mainly engaged in the interactive design and creation of new media art for performing arts, focusing on interactive visual art, artificial intelligence art, expanded reality, virtual production, etc. He currently serves as director of the teaching and research department of the digital media art program and deputy director of the Key Laboratory of the Ministry of Culture of the Digital Performing Arts Integration and Innovation.

Cheng Yining, Chief Game Graphic Designer, Technical Director of Unity Animation. He has 15 years of experience in character animation and has worked in He has 15 years of experience in character animation and has worked in Pearl Studio, 37Ent, IDMT, and other well-known animation companies. With expertise in character animation and character rigging, he has participated in the production of such works as Kung Fu Panda 3, Kung Fu Panda 3 Promo Special, Dragons: Riders of Berk (TV), title animations for Zheng He 1405 (feature film), and League of Legends. (TV), title animations for Zheng He 1405 (feature film), and League of Legends (game). After joining Unity, he has focused on the research and development of film and TV animation and has participated in the production of Windup, a short film of Unity Animation. He has participated in the production of Windup, a short film of Unity Animation.

He Ming, CEO of Guangdong Hagrid Network Technology Co., Ltd, has twelve years of experience in 3d games and CG animation projects. He has participated in the game CG League of Legends, Asura, Honor of Kings, CrossFire, Demon Seals, animation How to Train Your Dragon, Monkey King: Hero Is Back, Legend of Ravaging Dynasties, AOTU, and game Tomb Raider, The End of Ming Dynasty: The Feather of the Abyssal Void, Black Myth: Wukong, and many other excellent projects.

Yin Rui, Kunming Metallurgy College, teacher of Art and Design College, teaches interface design, interaction design and other courses.

Zeng Chen, freelancer, interaction design producer, UI interface designer.

Interviewees emphasized different priorities in virtual interactive presentation design. Zhang Jingping focused on innovative content expression and interactive experiences. Cheng Yining highlighted subtle interaction to drive immersive storytelling. He Ming stressed a people-oriented approach, while Yin Rui prioritized experience, functionality, and usability. Zeng Chen emphasized balancing education and entertainment, cultural content integration, and emotional resonance.

Zhang advocated role-play with NPC guidance and subplots to boost engagement. Cheng stressed logical story structure rooted in local culture. He Ming suggested starting with familiar visuals to bridge the gap between virtual and real, emphasizing cultural attributes. Yin proposed branching plots and interconnected sessions, while Zeng recommended multi-narrative structures and emotional audience-character interaction.The immersive opera "Daiyu Burying Flowers" directed by Zhang Jingping integrates reality and fiction in opera. "A Romance of Gulangyu and Qin Island" produced by Cheng Yining explores local history and music in the form of chapters. He Ming “The Feather of the Abyssal Void”, based on ancient Shu civilization using Unreal Engine and 3D scanning.

Zhang: Interactive narrative with limited complexity. Cheng: Incorporating myths to spark curiosity and story evolution. He: Virtual roaming, HD artifact display, cultural storytelling, interactive games. Yin: Simplified interactions focusing on linked artifacts. Zeng: Interactive maps, AR scenes, and focus on craftsmanship and history.

Zhang favored MR/AR for superimposing digital content on artifacts. Cheng highlighted VR for immersion and explored AI-assisted 3D modeling and NeRF. He cited VR/AR, Unreal Engine, and scanning as foundational. Yin noted VR's high requirements and suggested WebGL for narrative efficiency. Zeng emphasized mature technologies that enhance visual and interactive impact. Zhang mentioned hardware limitations. Cheng preferred a case-by-case approach. Yin encountered coding and implementation issues. Zeng tackled compatibility and optimization for low-end devices.Devices included Meta Quest 3, Pico 4 Ultra, Holokit X, PCs, mobile phones, and AR/VR headsets depending on context. Suggestions included audio guides, behavioral data tracking, rewards, and social media promotion. Cheng noted the importance of meaningful interactions to maintain interest. Yin stressed simplifying interactions and providing feedback.

Key strategies included spatial and temporal immersion (Zhang), realistic storytelling with comfort-focused interaction design (Cheng), high-quality graphics, and interactive details (He, Yin, Zeng). Haptics and real-time lighting also improved realism.Mostly gathered via QR code surveys, questionnaires, interviews, and heatmaps to analyze interaction hotspots and inform improvements.

Common methods involved suspense, breadcrumb navigation, mini-games, branching storylines, collectible pieces, and environmental storytelling. Narration and dialog were seen as immersive tools.These were valued for enhancing personalization, exploration, and reflection, though some noted high cost and limited audience revisits as barriers.

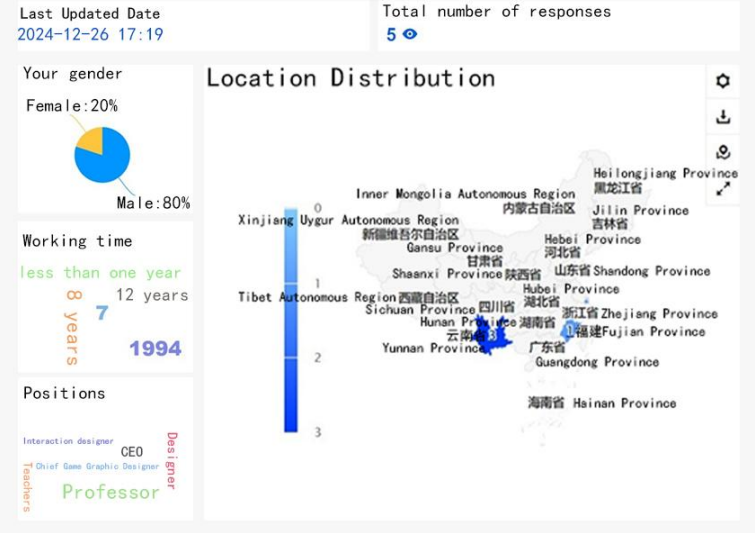

Figure 74 Virtual interactive display of data charts analyzing the results of practitioner interviews

Source: Image by the researcher

The interviewees provided diverse insights on the design and implementation of virtual interactive exhibitions, with a particular focus on how to enhance audience engagement and experience. Key themes included integrating immersive technologies like AR, VR, and MR, with a balance between education and entertainment. Several emphasized the importance of building coherent and compelling narratives through interactive elements, such as character roles, branching storylines, and immersive scenes that encourage exploration. Technology suggestions ranged from AI-guided experiences to 3D modeling and haptic feedback for heightened immersion.

Regarding The Yunnan Bronze Age Exhibition, respondents supported incorporating narrative serious games and virtual interactive elements. They suggested creating engaging stories, using historical evidence to ensure cultural accuracy, and incorporating gamification to deepen understanding of Yunnan's Bronze Age. The overall consensus was that a well-designed virtual experience can provide both

educational and emotional resonance, fostering greater interaction and reflection on the exhibition's cultural content. Future trends point toward AI-driven personalized experiences and mixed-reality environments that blend history with interactive storytelling, potentially transforming museum engagement and education.

4.1.3 Analysis of the Results of the Questionnaire for the Visitors of Yunnan Provincial Museum

This survey was conducted to investigate the feasibility of integrating a virtual interactive exhibition of narrative serious games into The Bronze Age of Yunnan Exhibition At Yunnan Provincial Museum. There were a total of 65 participants in this questionnaire. Among the respondents, the majority were in the 18-25 age range 66.15%, with a smaller proportion from older age groups. In terms of gender, 52.31% were male and 47.69% were female. The participants' educational backgrounds varied, with most having attended college at 64.62% or having a high school education at 13.85%.

Regarding previous experience with virtual interactive exhibitions, 46.15% had attended such exhibitions before, while 53.85% had not. Participants learned about The Bronze Age of Yunnan Exhibition At Yunnan Provincial Museum mainly through the museum's website 53.85% and social media 50.77%, with 46.15% discovering it through recommendations from friends.

When asked about their overall satisfaction with the exhibition, 46.15% of participants were satisfied, and 29.23% were very satisfied. Furthermore, 87.69% of respondents expressed interest in combining virtual interactive displays with the physical exhibition, with 38.46% being highly enthusiastic about the idea.

Regarding the narrative appeal of past virtual interactive exhibitions, 47.69% found the stories somewhat engaging, while 29.23% found them very compelling. As for the interactive experience, 70.77% rated it positively, with 41.54% describing it as "very good" and 29.23% as "excellent."

When asked whether integrating virtual interactive displays would enhance their understanding of the Bronze Age culture, 41.54% of respondents felt it would significantly improve their understanding, and 33.85% believed it would help to some

extent. Overall, the feedback indicates a strong interest in combining narrative serious games with the museum's exhibition to enhance engagement and educational impact.

Figure 75 Yunnan Museum Visitor Questionnaire Survey Result Analysis Data

Source: Image by the researcher

Visitors' favorite part of the exhibition hall was the section of bronze artifacts on display in the exhibition hall, the main exhibits were mentioned such as Bronze Table with Tiger and Oxen Motif, and the multimedia playback equipment added to the exhibition hall was also of great interest. The Southwest Barbarians: Kingdom of Dian and exhibits focusing on the Yunnan Bronze Age's historical context were well-received.

Suggested improvements to the exhibition halls included increased interactivity, with many visitors suggesting that the exhibits be enhanced with virtual reality (VR) or augmented reality (AR) elements to provide a more immersive experience. Educational content could also be added, with some interviewees suggesting that the exhibition would benefit from a more in-depth exploration of the historical context of Yunnan's bronze culture and a clearer telling of the story throughout the exhibits. Furthermore, realistic interactions could be included, and it was also suggested that the realism of the 3D models and interactive touchscreens be improved. Finally, cultural relevance could be strengthened, and it was suggested that more local cultural

elements be incorporated into the design of the exhibits, especially emphasizing the uniqueness of Yunnan culture.

In some virtual interactive exhibitions, some visitors experienced technical problems, such as slow or unresponsive feedback from interactive displays. These issues centered around virtual interactions and AR functionality, which did not always live up to expectations.

Visitors also raised demands for new features in future exhibitions. For example, respondents expressed interest in adding interactive elements, such as 3D scanning and modeling, to explore the details of artifacts. The use of AR technology to reconstruct scenes of ancient life, allowing visitors to experience daily life in the Bronze Age. Role-playing elements allow visitors to take on the role of artisans, warriors or leaders and make decisions that affect the storyline of the exhibition. Some respondents would like to see more educational games embedded in the exhibition to teach the significance of bronze artifacts and ancient cultures. Others suggested that the virtual interactions should support multiple languages and expand international participation.

Many respondents expressed strong interest in the exhibit and rated it positively (typically between 8 and 10 out of 10). They would recommend it to friends and family, especially if more innovative interactive elements were added.

There was a consensus that further innovation could make the exhibit even more engaging and effective in conveying the culture and history of the Yunnan Bronze Age.

In conclusion, The Bronze Age of Yunnan Exhibition at Yunnan Provincial Museum received generally positive feedback. Suggestions focused on increasing interactivity, enhancing the storytelling elements, and leveraging more advanced technologies like VR, AR, and 3D modeling to provide a deeper and more engaging visitor experience. The improvements suggested reflect a desire to integrate more cutting-edge digital interactions and educational content, ensuring that the exhibition appeals to a broader audience and enhances the understanding of Yunnan's ancient cultural heritage.

4.2 Results of the Field Survey of The Bronze Age of Yunnan Exhibition

The exhibition is divided into the beginning of the Bronze Age in Yunnan, Yunnan Bronze Age Overview, the leading southwest barbarians - Dian State, Yizhou County in the Han Dynasty, four parts, through the vivid visualization of historical events, as well as exquisite cultural relics visual display, to achieve the unity of the sense of history and the aesthetic effect, so that the audience return to the ancient Dian State, re-understand the glory of Yunnan bronze culture, feel the ancient culture of Yunnan is related to the mainland, the continuity of the process of the unity of Chinese cultural diversity.

Ancient Yunnan, recognizes the glory and splendor of Yunnan bronze culture, feels the ancient culture of Yunnan is closely related to the mainland, the continuity of the process of Chinese cultural pluralism, vigorously promotes the spirit of patriotism, enhances national cohesion, to maintain national stability and unity, nationalities living in harmony, and the construction of Yunnan's major national cultural province to make ancient examples of this The typical exemplary effect.

On this basis, the exhibition hall also actively combines innovative science and technology and modern exhibition methods. During the field investigation of the exhibition hall, many vivid and interesting interactive devices were found, and the following is the introduction of some interactive devices that attracted me.

4.2.1 Museum Guides

Guided tours in the pavilions are available in a variety of ways, and you can choose the most traditional way of hiring a docent, while there is also a free volunteer docent service available at set times. Alternatively, you can rent an audio guide device, and you can also scan the QR code underneath the artifacts through a mobile app and listen to the explanation on your cell phone. The most innovative way is to rent AR glasses for guided tours.

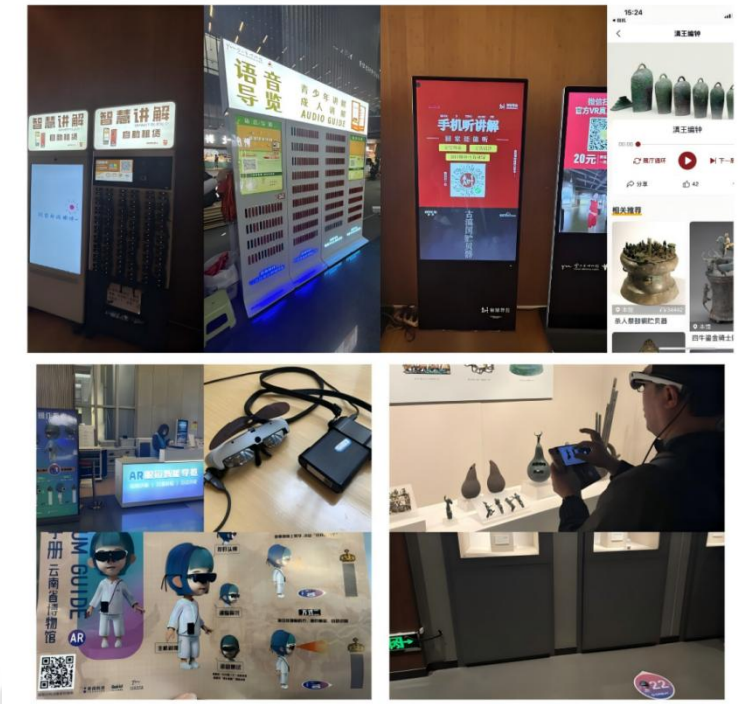

Figure 76 Different ways of guiding museums

Source: Image by the researcher

Traditional docent services provide you with a personalized, in-depth guided tour of the exhibit, explaining the history, context and significance of the artifacts. The advantage of this approach is that it provides a personalized experience, and the guide can tailor the tour to your interests and questions. And docents often have extensive knowledge of the exhibits and can provide insights that may not be available otherwise. You can engage in conversation, ask questions, and get immediate answers. But there are limitations to the traditional way of hiring a docent, such as limited availability, guided tours are only offered at certain times and may need to be booked in advance. And guided tours are fixed in time, so if you want to explore certain areas in more depth or stay longer in front of specific exhibits, the tour may be limited. There are also limitations on group size, which may reduce the personal experience if the group is large.

Volunteer Docent Service This is a free docent service, usually provided by volunteers at set times. It offers a more informal and casual approach to visiting the museum than professional docents. The main advantage of his service is that it is free, which is an affordable option. Offering the service at a fixed time is convenient for visitors who do not want to pay for a guide. It also enhances community involvement, and volunteer guides may offer unique perspectives, and their enthusiasm may make the tour more engaging. However, there are drawbacks to this type of guided tour, mainly in the form of limited professional knowledge, volunteer docents may not have the same level of knowledge and experience as professional guides. And the quality of the explanation is not stable, the quality of the guided tour may vary depending on the knowledge and experience of the volunteers. Finally, time and groups are limited. Since the tour time is fixed, you may need to adjust your schedule to match the tour time.

An audio guide device provides a recorded narration or explanation of an exhibit, often selecting a specific tour based on your interests or the object of your visit. Its advantage is that it can set its own pace, so you can visit the exhibits at your own pace, skipping or revisiting the exhibits at will. It is also more flexible and convenient, providing explanations at your convenience, and you can visit the whole exhibition with the guide equipment. And it's more cost-effective for museums, usually more affordable than hiring a docent. On the other hand there are drawbacks to this approach, such as a lack of personalization and the interactivity and flexibility of a live guide. The explanations may be generalized and not tailored to individual interests. There may be technical issues, potential problems with the equipment such as audio malfunction or battery life.

Explanatory function of scanning QR codes with mobile devices, where visitors use a mobile application to scan QR codes next to exhibits and access multimedia content such as audio, video and detailed explanations. His advantage is that it is highly interactive and the multimedia content (images, videos and interactive features) in the app provides a richer understanding of the artifacts. And it's convenient, you can access all the information you need just by using your smartphone.

Customizability is also enhanced and you can choose what to explore according to your interests. At the same time there are drawbacks to this approach, he requires the use of a smartphone, which not everyone has or wants to use during the tour. And potential connectivity issues, if the wifi or cell service is poor, may prevent you from accessing the content. Some people may be distracted by constantly looking at their phones instead of being fully immersed in the exhibit.

Augmented reality (AR) glasses for guided tours superimpose digital information or three-dimensional images on physical exhibits, providing a highly interactive and innovative way to experience the tour. With the advantage of providing an immersive experience, AR technology can provide an immersive and interactive experience that blends the digital and physical worlds. It can make a visit more exciting, especially for younger visitors or those interested in cutting-edge technology. Can be information-rich, providing visual aids such as 3D reconstructions, detailed data overlays, and additional context that traditional methods cannot provide. However there are drawbacks to this approach when viewers encounter technical issues such as equipment failure, battery life or unfamiliarity with the technology that may affect the experience. Furthermore, the cost of use is generally high, and renting AR glasses is often more expensive than other methods. Wearing comfort needs to be improved. Some visitors may find wearing AR glasses uncomfortable or cumbersome, especially for long periods of time. The availability of AR glasses is limited. Not all museums or exhibits offer AR images, and only a small percentage of exhibits in the pavilion offer AR interaction, and there may be a shortage of units during peak times.

Each method of guided tour offers a unique experience, so the choice largely depends on personal preferences, the type of experience you seek, and your budget.

4.2.2 Cultural and Creative Products

① Traditional Cultural and Creative Products

The common cultural and creative products of museums can be categorized functionally into souvenirs, education, art, and daily necessities.

Souvenirs such as key chains, postcards, refrigerator stickers, etc. These products are usually purchased by visitors after their visit. They help museums gain financial support through sales, while enhancing the cultural experience of visitors and extending the educational and cultural dissemination functions of museums. Educational products include puzzles, picture books, DIY crafts, etc. Educational products are usually designed for students or families, aiming to improve the cultural literacy and historical understanding of children or visitors through interactive experiences. These products help museums achieve their educational goals and enhance public participation and learning interest. Artistic products include, for example, paintings, handicrafts, sculptures, etc. Artistic cultural and creative products usually have high artistic and collection values, they help to enhance the cultural status of museums, and they also provide art lovers with a more direct cultural experience and artistic enjoyment. Products in the category of daily necessities mainly include T-shirts, scarves, hats, handbags, etc., which are usually printed with the museum's logo, exhibit patterns or thematic elements. Living goods-type cultural and creative products can infiltrate the museum's cultural concepts into daily life, so that visitors' cultural experience continues into their living space. Through these products, museums can continuously expand their influence and realize brand communication.

Figure 77 Part of Traditional Cultural and Creative Products

Source: Image by the researcher

② Cultural and Creative Products Combined with New Technology

Museums are launching interactive VR/AR cultural and creative products, leading visitors to learn more about the historical stories behind the exhibits. Digital cultural and creative products not only enhance the sense of modernization of the museum, but also enhance the interactive experience of the audience, especially in today's increasingly advanced technology, digital products have become an important means of attracting young visitors.

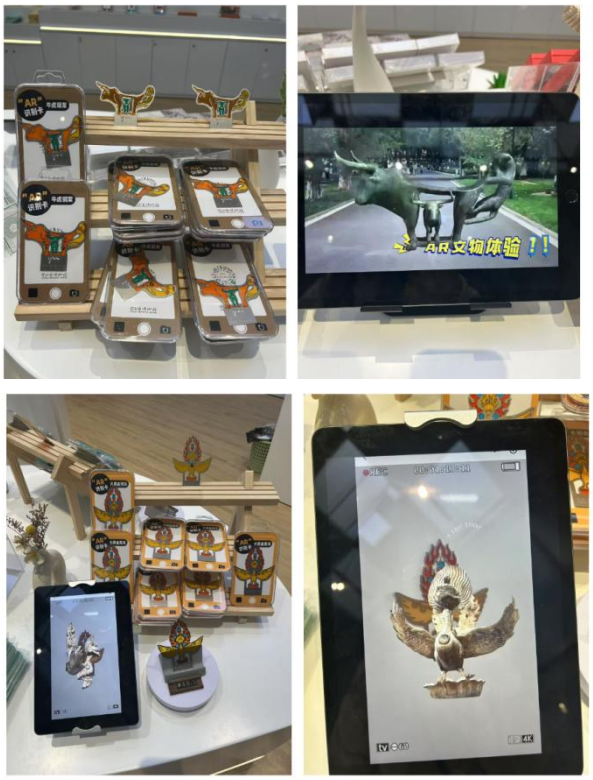

Figure 78 AR Bookmark

Source: Image by the researcher

Traditional bookmarks come to life and leap off the page with the help of VR technology. This is a AR-recognized bookmark, which, in addition to being used as a bookmark, will pop up a 3D display of cultural relics and an introduction to the relics after scanning the picture using a cell phone.

Figure 79 AR Playing Card

Source: Image by the researcher

This is an AR playing card, each playing card is printed with a different picture of the cultural relics on display in the Yunnan Provincial Museum, and after scanning the picture using a cell phone, the 3D model of the relics as well as an introduction will appear on the cell phone. While playing cards for entertainment, you can also learn about cultural relics.

By refining and re-creating the cultural relics and historical and cultural elements in the collection, cultural and creative products present the cultural content of the museum in a daily usable form, which helps to extend the museum culture into the public life. Cultural and creative products make abstract historical and cultural knowledge easier to understand and accept by visualizing and making it interesting. Through creative products, visitors can take away part of the exhibition and continue the visiting experience. The sale of cultural and creative products has become an important source of income for museums. By combining exhibitions with the market and launching co-branded limited editions or specialty products, they can attract more potential consumers and increase revenue. The revenue generated from cultural and creative products can be used to support the museum's exhibition development, collection conservation and research programs, thus realizing a virtuous cycle. The combination of cultural and creative products of museums with local cultural and tourism resources can promote the development of cultural and tourism integration.

Museum cultural and creative products play a positive role in cultural dissemination, educational functions, audience interaction, economic benefits, brand building and cultural innovation. By designing cultural and creative products with cultural connotation and market attraction, museums can not only achieve economic self-sufficiency, but also promote modernized expression and international dissemination of cultural heritage, and ultimately strike a balance between culture and market.

4.3 A Case of Virtual Interactive Exhibition Design Based on Serious Games for Yunnan Bronze Age Exhibition

4.3.1 Objectives and Core Design Ideas

Enhance the understanding of Yunnan bronze culture, through the game experience, players can deeply understand the characteristics, casting process, social function and historical value of Yunnan bronze culture. On the basis of cultural understanding, enhance interactivity and immersion, and utilize technologies such as VR, AR, and digital twins to give players more intuitive access to bronzes. Delivering historical knowledge in the process of entertainment makes the exhibition more attractive, especially to young people and student groups.

Combining Role-Playing (RPG), Puzzle-Solving, and Quest-Based to create an immersive and interactive experience. For example, the player takes on the role of an artisan, emissary, or archaeologist from the ancient Dian State, and explores in the virtual world the production and use of bronzes, as well as the history and culture they carry. A time-travel setting is used to allow players to return to the era of the Dian kings, experience the glorious period of bronze culture, and complete historical quests.

4.3.2 APP use process

① Launch and login interface

Visitor Mode: You can enter the exhibition directly, but some interactive functions are limited.

Register/Login Mode: Experience all the game and interactive functions.

User Data Binding: Used to record game progress, answer questions and exhibit collection.

② Exhibition area selection and immersive navigation

Virtual Pavilion Construction:

Virtual reconstruction of the actual Yunnan Museum Bronze Age exhibition area, divided into four exhibition halls

The beginning of Yunnan Bronze Age,

Overview of Yunnan Bronze Age,

Dian State, the leader of the Southwest Barbarians,

Yizhou County in Han Dynasty

Navigation system:

360° panoramic roaming

Real-time positioning of the mini-map

Click on the logo at the entrance of the exhibition hall to enter

③ Serious Game Interactive Module

This is the core design part of this APP, embedding the game mechanism into art and cultural communication.

Object Recognition Challenge (ORC)

Users click on the cultural relics to enter the “AR + text + voice” triple introduction interface.

Game Format: Users need to judge the use, age or tribal affiliation of the artifacts according to the clues.

Scoring system: Each correct answer will add points to unlock a new gallery or get “Bronze Coin Reward”

Bronze Puzzle

The game combines the images of real artifacts with archaeological documents to convey the message that the artifacts have been restored.

The game incorporates real archaeological documents to convey knowledge of the structure and craftsmanship of the artifact.

Historical Role-playing

The user chooses a role (e.g., sorcerer, warrior, noble girl) and enters a virtual drama of the Bronze Age.

The system triggers plot tasks (e.g. rituals, war mobilization, wedding preparation, etc.), which require the user to explore the exhibits for clues.

Game dialogues embed cultural knowledge, such as the use of bronze drums, religious worship, tribal totems, etc.

④ Knowledge feedback and achievement system

Question and answer statistics: the system records the correct rate and time of each question and challenge.

Artifacts Collection Book: Completing challenges can obtain digital artifacts cards and generate an exclusive collection book.

Knowledge map: presenting the key points of culture mastered by users, structured display (e.g. “military bronzes”, “daily objects”, “bronze smelting technology”).

Achievement system: such as “Bronze Craftsman”, “Cultural Relics Scholar”, “Guardian of National Culture” and other honorary titles.

⑤ Sharing and Extended Learning

Social Sharing: Users can share the cultural relics collection book or the screenshot of the score to the social platform.

Extended resource links:

Video lectures (expert interviews)

PDF illustrations download

Yunnan Bronze Culture Database Access Portal

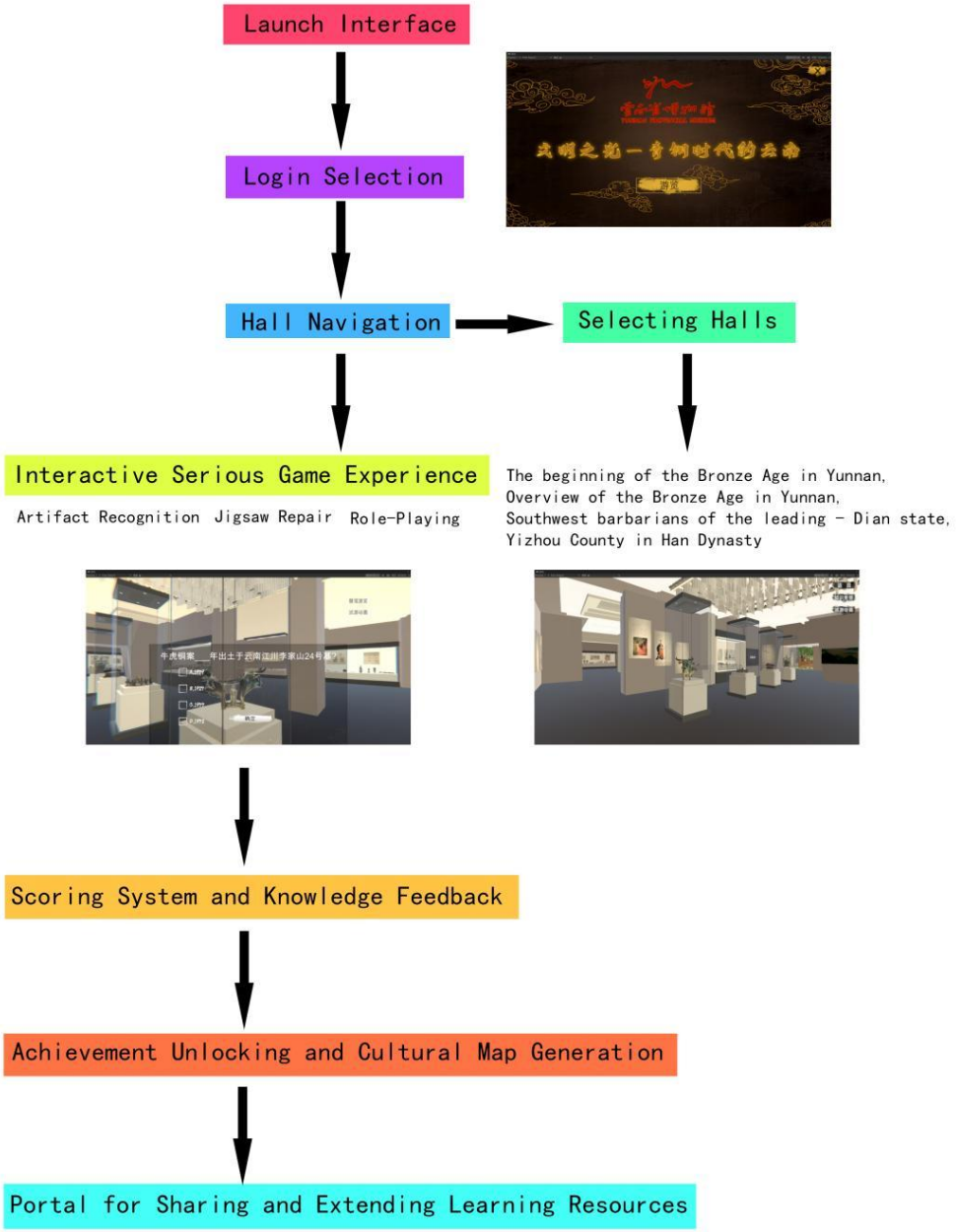

Figure *80* APP use process

Source: Image by the researcher

4.3.3 Serious Game Mechanics

Combining historical documents, archaeological discoveries, and academic results, players will complete the following interactive tasks to visualize the charm of the bronze culture of ancient Yunnan.

① Bronze Smelting Workshop - Recreating the Dian Casting Craft

The background of the quest is that King Dian ordered the craftsmen to create a new batch of bronze ceremonial vessels for the rituals and oath-taking ceremonies. Players need to follow the ancient Dian smelting and casting process, from the selection of raw materials to the completion of casting, to complete the challenge step by step.

In terms of interactive experience, players collect raw materials through virtual interaction. Players need to select appropriate metals such as copper, tin and lead and calculate the ratio to ensure the quality of the bronzes. And choose the right casting method to make it, such as lost wax casting, using wax molds to shape, burn the molds, and pour in the molten metal. Fan casting method challenge, try to use the fan casting method to make bronze tripod or bronze short sword, adjust the temperature to avoid casting failure. Pattern engraving using a somatosensory interactive device, copy the unique patterns of ancient Yunnan to engrave on a bronze vessel and understand its symbolism.

In terms of cultural understanding, most of the Yunnan bronzes were made by the lost-wax method and the Fan casting method, etc., and their styles are different from those of the Central Plains and Southwest China. Through the differentiation of casting methods and understanding the difference between the bronze culture of Dian and other regions, players will learn how to cast bronzes and understand their significance in the game.

② Bronze Weapons for King Dian's Legion - Simulating Battles and Strategic Decisions

The background of the quest is set in King Dian's desire to expand his power to the outside world, and players are required to assist in the formation of a legion, build bronze weapons, and formulate tactics.

In terms of interactive experience, combining virtual interaction to realize the building of weapons, selecting bronze swords, gorgets and halberds, testing their strength and understanding the combat style of different weapons. Conduct army training, learn Dian's army tactics and infantry formations through simulated battles, and make decisions on the battlefield. With the defense of Dianchi as the goal, players need to guard the tribes around Dianchi and engage in battle with foreign enemies, using bronze weapons to develop strategies.

The bronze weapons of Dian were clearly influenced by the Central Plains, such as the excavated bronze swords, which are similar to the bronze swords of Wu-Yue. According to the historical background and history books, the army of Dian State was good at riding and shooting, and players can experience this feature in the game.

③ Yunnan Sacrificial Ceremony - The Symbolic Function of Bronze Vessels

The background arrangement of the task is that the player needs to prepare for an important heavenly ceremony, which requires the player to choose suitable sacrificial bronze ritual vessels to pray for favorable winds and rain, and the prosperity of the country.

Use virtual interactive equipment for the placement of sacrificial bronze, learn how to place the ox and tiger bronze case, bronze drums and other artifacts, and understand their sacred significance. Reproduce the rituals and perform the rituals according to King Dian's instructions, including the burning of incense, playing of music, and chanting of congratulatory speeches. Performing divination and solving riddles during the sacrificial rituals, using bronze divination instruments, interpreting the trigrams, and deciding the country's next move.

The nobles of the Dian State used bronze drums and bronze cases of bulls and tigers in their rituals, reflecting their ancestor worship and concept of theocracy. In

the game, players can use somatosensory devices to manipulate these artifacts and experience their cultural functions.

④ King Dian's Pledge of Allegiance: Bronze Diplomatic Mission

The background of the mission is set as King Dian wishes to conclude a pact with the forces of the Central Plains, the Hundred-Yue, and the Southwest Barbarians, and the player, as an emissary, is required to carry a bronze ceremonial gift on his mission.

Players use the virtual interactive device to select bronze gifts, picking the right bronze as a diplomatic gift, such as bronze jewelry, bronze buckle ornaments and so on. Choose the appropriate negotiation strategy, through the interaction with NPCs, players need to skillfully negotiate and facilitate the covenant. Facilitate cross-cultural exchanges, learn the etiquette of the Middle Kingdom, and compare the similarities and differences in bronze culture between the Dian Kingdom and the Han Dynasty.

The king of Dian was once titled “King of Dian” by the Han Dynasty, indicating his close relationship with the Han Dynasty. There were many ethnic groups around Dianchi, and bronzes played a role as “ceremonial currency” in the exchange.

⑤ Modern Archaeology of Bronzes - Digital Twin Recovery Challenge

The background of the task is based on a modern archaeology team that found bronze fragments near the Dianchi field, and players need to piece together and recover them and interpret their use. Depending on the number of restored bronzes, bronze souvenirs can be exchanged at the store.

Using the use of 3D scanning to digitize artifacts, use virtual interactive devices to restore bronze artifact fragments and reveal historical information. Choose the right archaeological tools for patina restoration to clean up bronze patina and discover hidden inscriptions or decorations. Trace the history back to the past, combine historical documents and archaeological findings to speculate on the attribution of the bronze vessel and its use, and unravel the mysteries of the Dian State ruins.

A large number of bronzes have been unearthed in Yunnan, and archaeological restoration is an important part of modern research. The game combines

digital twin technology to let players feel the charm of archaeology. At the same time with the museum souvenir sales associated with the game at the same time, visitors have a higher incentive to buy first off souvenirs, improve the museum's economic income.

4.3.4 Technical Realization

① Hardware support

VR interactive devices (HTC Vive, Oculus Quest): to enhance the sense of immersion.

AR glasses/mobile AR (Hololens, smartphones): allow visitors to freely explore the artifacts in the exhibition hall.

Somatosensory devices (Leap Motion/Kinect): simulate bronze operations, such as smelting and engraving.

② Software technology

Unity/Unreal Engine: to realize high-quality 3D rendering and interactive design. The following demonstrates a Bronze Age of Yunnan APP for the Yunnan Provincial Museum using Unity engine based on a serious game virtual interactive display created by the researcher and her research team.

Below is a partial display of the interface:

Figure 81 The Bronze Age of Yunnan APP Initial Interface

Source: Image by the researcher

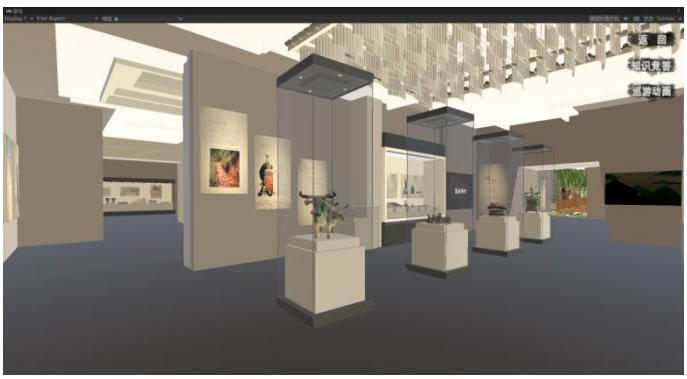

Figure 82 Scene Reproduction Inside the Exhibition Hall

Source: Image by the researcher

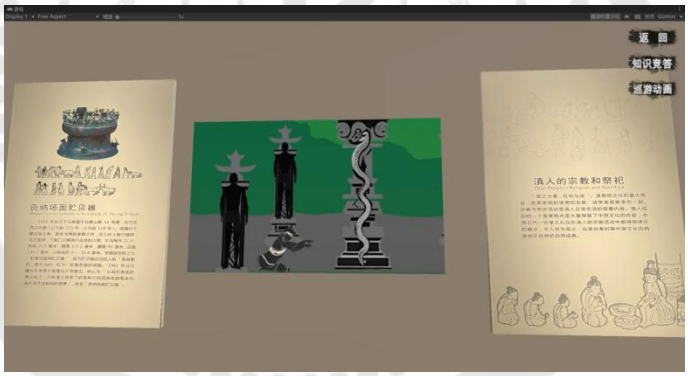

Figure 83 Narrative animated short film playback

Source: Image by the researcher

Figure 84 Body Artifacts Interactive Introduction Interface

Source: Image by the researcher

Figure 85 Serious game based question and answer interface

Source: Image by the researcher

Below is a demonstration of some of the control code：

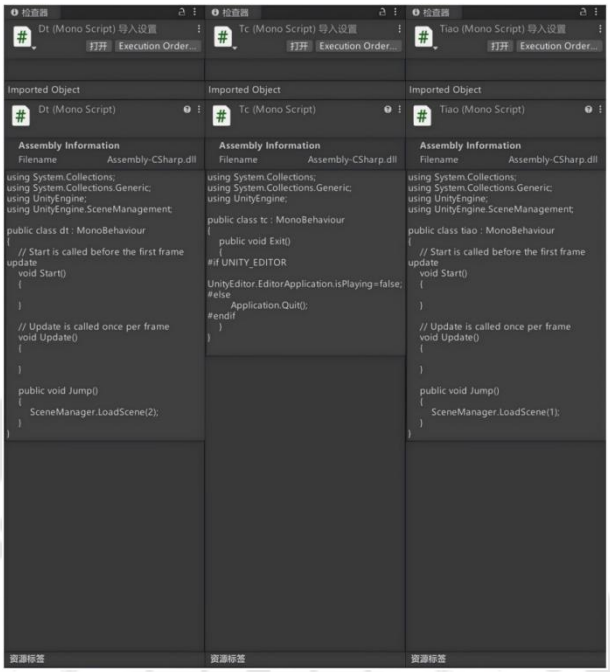

Figure 86 The three codes are the code to control the answer jump, the code to exit the interface, and the code to jump the page

Source: Image by the researcher

AI-driven NPCs: NPCs can quiz players on historical knowledge to improve educational interactivity. Different AI systems are trained to learn historical documents, archaeological findings, and academic literature for relevant questions to realize that the virtual NPC answers are as consistent with historical facts as possible.

Figure 87 The above are the training questioning process of Quark, Beanbag, and Deepseek AI respectively

Source: Image by the researcher

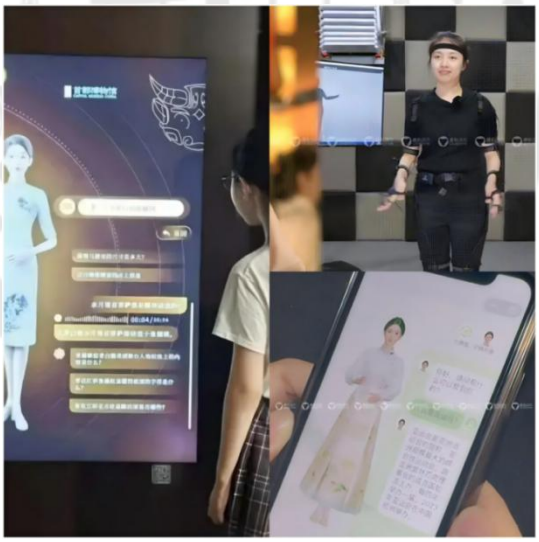

Figure 88 Digital Human Demo

Source: Guangzhou virtual power. (2024, September 20). Virtual Digital Person Landing Program for Exhibition Halls: Exploring Full-Scene Intelligent Tours. Sohu. https://it.sohu.com/a/810279428_120912206

Digital Twin: Create accurate 3D models of bronzes for players' immersive research. The researcher used digital photographic equipment to enter the pavilion and capture digital images of the artifacts on display. After high-precision acquisition from multiple angles, the collected images were digitally restored in three dimensions using the digital twin AI 3D restoration technology. This series of restoration can not only show the real appearance of the exhibition hall and the artifacts, but also enable the audience to observe the artifacts from a close distance and multiple perspectives, and at the same time provide the possibility of the production of derivative products in the future.

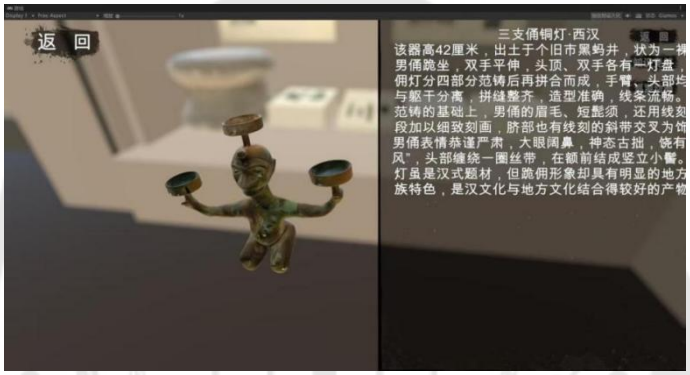

Figure *89 Digital Twin AI 3D Reduction Technology Generated Digital 3D Models*

Source: Image by the researcher

Figure 90 Digital 3D Modeling Derivatives, Bronze Series Blind Boxes

Source: Image by the researcher

4.3.5 Narrative Design

A story-driven plus historical restoration approach is used to build an immersive narrative line. Players enter the golden age of Yunnan's bronze civilization and go through a series of missions to uncover the secrets of cultural exchanges between Yunnan and the Central Plains.

Combined with the museum exhibits, the bronzes in the game correspond one-to-one with real artifacts, and players can collect pieces of bronzes in the game to put them together and find them physically in the exhibition hall.

4.3.6 Experience Mode

① Pavilion mode: In the "Light of Civilization" exhibition hall of Yunnan Provincial Museum, AR glasses augmented reality or touch screen are used for interactive experience.

② VR immersion mode: the museum ad hoc VR exhibition area, the audience can wear equipment to enter the world of ancient Yunnan.

③ Mobile APP/online mode: allowing users to experience the museum remotely, increasing the influence of the museum.

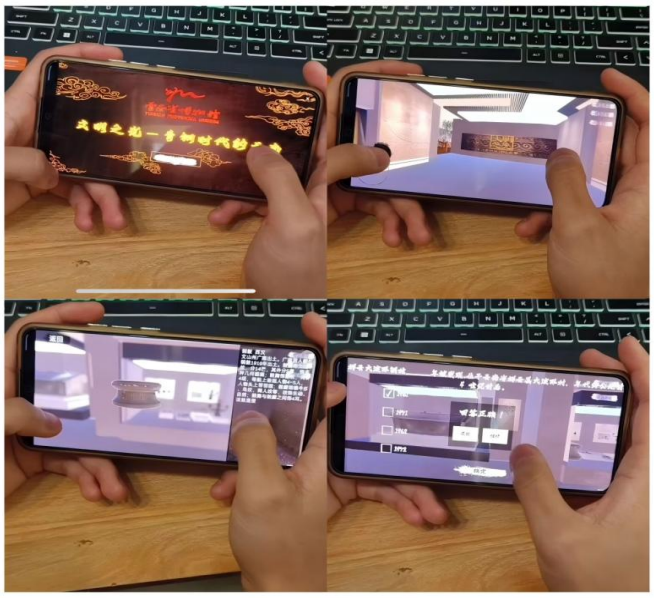

Figure 91 The Bronze Age of Yunnan APP Operation Demonstration

Source: Image by the researcher

4.3.7 APP Trial Results

For the results of the APP experience, the feedback was summarized by selecting from five categories of people, who were Yunnan Provincial Museum staff, university professors, virtual interactive display designers, virtual interactive application designers, university students.

① Yunnan Provincial Museum Staff Perspectives

Experience perspective: As a frontline cultural communicator and exhibition planner, concerned about the performance of APP in terms of cultural accuracy, educational extensibility and auxiliary display functions.

Content of use: In-depth experience of the virtual pavilion and Q&A module. Focus on the introduction of cultural relics, narrative clues and logic of historical events.

Feedback points: Advantage: The information of cultural relics is accurate and basically conforms to archaeological historical facts. Can be used in the “second classroom” of the museum to enhance audience interaction.

Problems: Some of the words used are more academic and not popular enough. Selection of exhibits does not cover some of the key collections, such as the Golden Seal of the King of Yunnan.

Comprehensive evaluation: The APP has a significant role in enhancing the extended learning after the museum visit, and has a realistic basis for pilot use in guided tours and youth education activities.

Ways to support cultural understanding: Emphasize the accurate expression of information and historical facts of cultural relics in the APP, which enhances the reliability of knowledge. It can be used as a “second classroom” extended learning tool to help visitors continue to understand the cultural connotation after the exhibition. Narrative design guides the audience to systematically grasp the development of the bronze culture through the logical connection of historical events.

② University Professor's Perspective (Direction of Digital Media Art and Design)

Experience Perspective: Under the perspective of academic specialization, the APP is concerned about the rationality of interaction and the feasibility of artistic and cultural communication.

Use of content: Tested with the module “Artifact Recognition Challenge”. It is used to support classroom teaching, as a virtual interactive design case study, and observe students' feedback.

Feedback points:

Strengths: Interactive learning design is effective in increasing student engagement. The “Artifact Recognition Challenge” helps students build structured cultural awareness.

Problems: Some interactions are not fast enough, and the logical sequence of the app needs to be optimized. It is recommended to actively maintain the background system to provide faster interactions.

Comprehensive Evaluation: The APP is suitable for use as an auxiliary teaching tool for history general education courses, but it needs to be expanded in academic depth to support higher-level art and cultural communication needs.

Ways to support cultural understanding: The “Heritage Quiz Challenge” inspires active learning and helps build systematic cultural awareness. The use of the app as a teaching aid helps to combine classroom content with real heritage experiences to deepen understanding. The contextual design of the serious game establishes a pathway to correlate knowledge points with cultural memory.

③ Virtual Interactive Display Designer Perspective (Immersive Exhibition Specialist)

Experience perspective: Focus on the APP's display performance in terms of spatial construction, interaction logic, and user navigation design.

Use content: Test the virtual exhibition hall three-dimensional roaming and user-oriented design. Analyze scene switching, narrative rhythm and coherence of immersive experience.

Feedback points:

Advantage: The layout of the exhibition hall is reasonable, and the theme of the exhibition area is clearly divided. The virtual space is highly consistent with the exhibition style of the real museum.

Problems: The scene transition animation is slightly stiff, and the sense of immersion needs to be strengthened. The positioning of some interactive contacts is not sensitive enough, affecting the smoothness of user experience.

Overall Evaluation: The overall design logic is good, with the prototype of “online exhibition hall”, which is suitable for forming a “dual exhibition system” with offline exhibition.

Ways to support cultural understanding: Realistically reproducing the spatial style of museums and the rhythm of exhibition helps to enhance the immersive cultural experience. The virtual roaming scene builds a sense of space and emotional connection between the audience and the artifacts, making the artifacts approachable and interactive.

④ The perspective of virtual interactive application designers (human-computer interaction and interface design)

Experience perspective: Starting from user interface (UI) and user experience (UX), assess the maturity of APP operation flow, interaction logic and technical architecture.

Usage Content: Test multi-device adaptability (tablet/mobile phone). Simulate APP response under different network conditions.

Feedback points:

Strengths: High integration of interface design with visual elements of Yunnan culture. Serious game design guides nature and improves user stickiness.

Problems: Data loading is a little slow, slightly lagging when the 3D model is large. Guiding hints are not clear enough, novice users may feel confused.

Overall Evaluation: High degree of completion in terms of technical implementation, it is recommended to optimize the model compression and loading logic, and improve the lightweight interaction performance.

Ways to support cultural understanding: The APP interface integrates visual elements of Yunnan's local culture, so that users can subconsciously accept cultural influences during operation. The serious game mechanism builds the user's cognitive path and knowledge composition through task guidance and interactive feedback.

⑤ Museum visitors' perspective (end-users, both learning and entertainment needs)

Experience perspective:Concerned about the fun, knowledge acquisition experience and social sharing function of APP.

Use of content:

Participate in all serious game modules (identification, puzzle, play). Share personal achievements and digital artifact cards.

Feedback on key points:

Strengths: Strong gameplay, “learning while playing” format is popular. The collection of digital artifacts stimulates interest in learning.

Problems: If there is no task guidance, it is easy to get “lost” in the pavilion. The interactive effect of the question and answer game is not good.

Comprehensive evaluation: It provides college students with a combination of cultural knowledge and interesting interactive experience, which is an excellent attempt in digital education of museums and provides an innovative solution for the dissemination of culture and art.

Ways to support cultural understanding: Engage in the game's tasks in a “play-and-learn” manner to easily grasp the complexities of the Bronze Age. The collection system of digital artifact cards stimulates interest and creates long-term memory and learning motivation. Task-based exploration and virtual role-playing allow users to immerse themselves in ancient cultural practices.

Table 8 List of APP Trial Results

User type	Core Concerns	Positive feedback	Main issues	Suggested directions for optimization
Museum Staff	Content accuracy and educational function	Can be used for extended education	The wording is highly academic and the selection of collections is slightly limited	Enhance popularized descriptions and expand exhibit variety
University Professor	Depth of knowledge and instructional support	Knowledge maps facilitate structured understanding	Some interactions are not fast enough	APP logic sequence to be optimized
Display Designer	Space and Narrative Experience	Clearly structured showroom with a strong sense of immersion	Slightly stiff animations and interactions	Optimize transitions and multi-dimensional interactions
Application Designer	Operation and Interaction Flow	Good visual integration and clear game logic	Average loading performance, slightly underboosted	Model optimization to improve navigation experience for newcomers
Museum visitors	Fun and Engagement	Engaging digital collections and innovative learning formats	Poor interactivity in answering questions and lack of clarity in the navigation system	Establishing game difficulty levels and enhancing task guidance

Overall APP usage enhance audience participation so that the bronze display changes from static to dynamic and explorable. To transform the bronze artifact display from a traditionally static format into a dynamic and engaging experience, virtual interaction can be used to create immersive and explorable virtual environments. These environments allow audiences to interact directly with virtual representations of artifacts —rotating, assembling, or even using them within simulated historical contexts.

Allow the audience to learn actively in the game and form a deep cultural memory, deepening the dissemination of art and culture. Serious games serve as powerful tools for cultural storytelling, allowing players to actively engage with the history, function, and symbolism of bronze artifacts. Through quests, problem-solving scenarios, and role-playing elements, audiences can experience historical narratives firsthand—such as participating in ancient rituals, managing a bronze workshop, or decoding inscriptions. These interactive experiences facilitate deeper cognitive and emotional connections with cultural content, helping players internalize historical knowledge and form lasting cultural memories. As a result, learning becomes both meaningful and memorable, reinforcing cultural identity and appreciation.

Innovate museum education mode, promote the application of serious games in cultural heritage education and provide model cases for future exhibitions. By embedding educational content within the mechanics of play, serious games introduce a transformative approach to museum education. This innovation breaks away from passive information delivery and fosters an active, learner-centered model. Museums can use serious games as modular, scalable tools adaptable to various age groups, learning objectives, and exhibition themes. These games can serve as model cases for future development in digital heritage education, combining academic research, cultural preservation, and modern technology. The success of such approaches not only elevates the educational function of museums but also broadens their role as interactive cultural platforms that bridge the gap between past and present.

CHAPTER 5
CONCLUSIONS AND DISCUSSION

5.1 Summary of the Study

This research has examined the intersection of serious games theory and virtual museum exhibitions through an applied case study of The Bronze Age of Yunnan Exhibition at the Yunnan Provincial Museum. The overarching aim was to explore how serious game design principles can enhance the visitor experience, promote deeper cultural understanding, and support the digital transformation of traditional museum exhibits.

The study was situated within an interdisciplinary framework combining museology, digital heritage studies, human-computer interaction (HCI), and game design. It responded to the increasing demand for more immersive, interactive, and educational museum experiences—particularly within virtual environments necessitated by shifting audience behaviors and technological advancements.

The research followed a multi-phase methodology that included theoretical research, design and development of a virtual prototype, and empirical evaluation through user testing. A prototype virtual exhibition was developed using Unity3D and other digital tools, structured around key features of serious games such as rule-based systems, interactivity, challenges, feedback, and narrative engagement. The exhibition content was curated based on authentic archaeological data and museological practices, including 3D scans and reconstructions of bronze artifacts, environmental modeling, and interpretive storytelling.

User studies involved museum visitors, students, and cultural professionals who engaged with the virtual prototype and provided feedback via surveys and interviews. Findings indicate that serious game elements significantly enhanced visitor engagement, motivation, and educational outcomes. Users reported increased interest in the Bronze Age culture of Yunnan and expressed a preference for interactive digital formats over traditional static displays.

Moreover, the study addressed practical considerations of integrating serious games into museum strategies, such as technological infrastructure, curatorial concerns, audience inclusivity, and content authenticity. It was observed that serious games can serve as a bridge between entertainment and education, transforming passive observation into active cultural participation.

In conclusion, this research has demonstrated that serious games offer a valuable and innovative approach for virtual museum exhibitions. The case study validates the conceptual and practical feasibility of this approach, presenting a model that can inform future initiatives aimed at digital engagement in heritage contexts. The project contributes original insights into the evolving role of digital interactivity in museums and underscores the transformative potential of game-based learning in cultural heritage preservation and dissemination.

5.1.1 Review whether the research objectives were achieved

Object 1: This objective was successfully achieved through both theoretical exploration and practical implementation. The study conducted a detailed review of narrative structures in serious games and their applicability to virtual exhibitions. Drawing on narratology and game studies, the research demonstrated how integrated storytelling—emphasizing plot progression, character interaction (e.g., role-based avatars or historical figures), and immersive environmental design—can significantly elevate user immersion and interpretive engagement. The virtual prototype applied these findings by embedding users in the world of Bronze Age Yunnan, inviting them to unravel stories through gameplay missions, contextual discovery, and interactive dialogues. Feedback from user testing affirmed that participants found the narrative elements both compelling and educational, confirming the effectiveness of narrative-driven serious games in cultural storytelling.

Object 2: This objective was addressed through an in-depth case study approach focusing on The Bronze Age of Yunnan Exhibition. The research translated traditional exhibition content—such as bronze artifacts, burial practices, and religious rituals—into an interactive narrative framework guided by serious games methodology.

Story arcs were constructed around authentic cultural themes, including identity, social hierarchy, technology, and belief systems. Using Unity3D, the digital environment simulated real museum contexts with added interactive layers. Evaluation of the prototype with museum visitors demonstrated that the serious game perspective enabled users to experience the historical narrative actively rather than passively. This experiential approach not only heightened emotional resonance but also facilitated deeper cognitive engagement with the cultural content.

Object 3: This objective was met through the successful development of a fully functional prototype application, integrating principles of both serious games and virtual exhibitions. The design process adhered to user-centered design (UCD) and design-based research (DBR) methodologies, ensuring iterative refinement based on stakeholder input and empirical findings. The prototype served as a demonstrative tool to validate the theoretical assumptions posited in the study—particularly the role of narrative, interactivity, and feedback mechanisms in enhancing user experience. Additionally, expert interviews and comparative analyses with other digital heritage initiatives suggested the model's scalability and adaptability to other cultural institutions. This establishes the project's broader applicability beyond the Yunnan Provincial Museum, supporting the potential for serious games to be employed as strategic tools in museum innovation.

5.2 Discussion

5.2.1 Combine the literature concerns and analyze the similarities and differences between the findings and existing studies

① Alignment with Literature

This study contributes to and extends the growing body of interdisciplinary research at the nexus of serious games, museum virtual interaction, and digital cultural heritage protection. Through a comparative analysis with extant literature, several key convergences and divergences emerge, illuminating both the alignment and unique contributions of the present work.

A dominant theme in the literature on serious games and virtual exhibitions is the potential for digital interactivity to enhance user engagement and immersion. Scholars such as Alfanda, A. M. (2025) assert that interactive digital technologies can shift museum experiences from passive observation to active exploration. The findings of this study corroborate these claims: participants consistently reported heightened interest and motivation when interacting with the virtual exhibition, especially when narrative and gamified elements were present.

Existing research (Gee, J.P., 2007)(Mayer, R. E., 2014)(Vasiliki., 2020) has demonstrated that game-based learning environments can improve knowledge retention, especially in complex, abstract, or historical domains. Similarly, this study found that participants exhibited increased understanding and retention of Bronze Age cultural knowledge after engaging with the virtual exhibition. The integration of interpretive storytelling, interactive challenges, and feedback loops mirrors the cognitive scaffolding mechanisms highlighted in prior pedagogical frameworks.

There is an ongoing concern in the literature regarding the balance between engagement and authenticity in digital heritage representations (Belhi, A. et al., 2020). This study aligns with best practices by grounding its content in authentic archaeological data and professional museological standards. The use of 3D scans of actual artifacts and adherence to cultural interpretive norms demonstrates a commitment to representing cultural heritage with fidelity—an issue echoed in both theoretical and applied museum studies.

② Divergences and Novel Contributions

Most existing literature centers on Western or global museum contexts. For example British Museum VR initiatives, Smithsonian digital projects. In contrast, this study is situated within the specific cultural and historical landscape of Southwest China. It introduces a regionally nuanced application of serious games to interpret Bronze Age Yunnanese heritage, thus diversifying the geographical and cultural scope of existing scholarship. Focusing on a provincial museum in China, this study provides insights into how digital innovation can be integrated with local history and culture.

While prior studies often focus on either user experience design (UXD), educational outcomes, or heritage interpretation in isolation, this research uniquely integrates multiple methodological strands: user testing, game design, curatorial practice, and empirical evaluation. This holistic approach provides a model for interdisciplinary collaboration in digital heritage projects—an area frequently cited as underdeveloped.

Although audience studies in museum contexts are well-established, this research contributes new perspectives by including a diverse participant pool composed of local museum visitors, students, and cultural professionals. It responds to Falk and Dierking's (2016) call for more nuanced understandings of visitor motivations and behaviors in digital environments. The comparative responses from distinct user groups enrich current understandings of how serious games resonate across varied demographics.

A persistent tension in the literature lies in reconciling entertainment and educational objectives in serious games (Slussareff, M. et al., 2016). This study demonstrates that the two aims are not mutually exclusive but can be meaningfully integrated through design. The exhibition prototype achieved both high levels of engagement and significant learning outcomes, suggesting that cultural heritage games can occupy a hybrid space that benefits both curatorial goals and public interest.

③ Critical Reflections and Limitations in the Literature and Conclusion

While this study reaffirms many established theories, it also exposes gaps in the literature. For instance, there is limited discussion on infrastructural challenges within smaller or regional museums when adopting high-tech digital solutions—a practical issue encountered in this project. Additionally, few studies deeply interrogate the ethical implications of gamifying sacred or contested heritage, a topic that merits further exploration especially in cross-cultural contexts.

By comparing this study's findings with those of prior works, it becomes evident that while serious games have been widely recognized as transformative tools for education and engagement in cultural heritage, their implementation within region-

specific, underrepresented contexts like Yunnan introduces new dimensions to this discourse. The Bronze Age of Yunnan Exhibition case study not only supports but also expands the field's understanding of how serious game-based virtual exhibitions can serve as inclusive, educational, and culturally respectful platforms for heritage dissemination.

5.2.2 Discuss the theoretical and practical implications of the study

The theoretical implications relate to the contribution the study makes to academic literature, theories, and models. These implications typically address how the research: extends existing theories, fills a gap in the literature, introduces new conceptual models or constructs, reconciles conflicting findings, opens avenues for future research.

Practical implications translate the research outcomes into actionable insights for stakeholders such as policymakers, educators, industry leaders, or community organizations. These implications might include: policy recommendations, organizational strategies, professional practice enhancement, technological innovations or design improvements, community or social impact.

5.2.3 Explore the potential and challenges of virtual interactive displays and serious game narrative elements in cultural heritage education

In recent years, the convergence of interactive technologies and serious game mechanics has reshaped the landscape of cultural heritage education. Museums, cultural institutions, and digital humanists increasingly deploy virtual displays and narrative-driven serious games to cultivate more immersive, participatory, and cognitively engaging educational experiences. However, while the affordances are vast, several challenges must be addressed to ensure their pedagogical efficacy, cultural sensitivity, and technological sustainability.

① Potentials

Enhanced Engagement and Motivation: Interactive displays and narrative elements inherent in serious games tap into intrinsic motivational drivers—curiosity, challenge, and exploration (Malone, t.w., & Lepper, m.r., 1987). Unlike static exhibitions,

these mediums invite learners to interact dynamically with content. They promote experiential learning through multisensory inputs, spatial navigation, decision-making, and real-time feedback, all of which have been shown to improve learner attention and retention (Gee, J.P., 2007)(Mayer, R. E., 2014).

Deepened Cultural Understanding through Narrative: Narratives are a powerful cognitive tool for structuring historical and cultural knowledge. In serious games, storylines serve as scaffolds for learning, enabling users to emotionally and intellectually relate to complex cultural themes (Henry Jenkins, 2004). By assuming roles (archaeologists, ancient artisans, local narrators), users internalize historical perspectives and interpret artifacts not merely as static objects but as vessels of cultural identity and memory.

Accessibility and Democratization of Heritage: Virtual platforms enable remote access to cultural materials that may be geographically or physically inaccessible. For marginalized communities and global audiences, this democratizes heritage education and facilitates cross-cultural understanding. Interactive features such as multilingual narration, sign-language avatars, and adjustable difficulty levels further enhance inclusivity (Stella Sylaiou et al., 2009).

② Challenges

Technological Barriers and Resource Constraints: Developing high-quality interactive and narrative-rich virtual experiences demands considerable resources—technical expertise, funding, hardware, and software infrastructure. Smaller institutions, particularly in underfunded regions, may struggle with implementation or long-term maintenance (Roger M. Addison, 2013). Furthermore, digital divide issues persist, limiting access in communities with inadequate connectivity or digital literacy.

Balancing Accuracy with Engagement: There is an inherent tension between historical accuracy and game design. While narrative embellishments may enhance engagement, they risk distorting facts or oversimplifying complex histories. Curators and designers must negotiate how much creative license is appropriate without undermining authenticity or scholarly rigor (Herrmann, S. M. et al., 2022).

Cultural Sensitivity and Ethical Storytelling: Serious games often fictionalize or dramatize real cultural practices. When applied without deep cultural consultation, this can lead to misrepresentation, appropriation, or offense—especially in contexts involving sacred, contested, or indigenous heritage (Smith, L., 2006). Ethical narrative design demands participatory approaches, including community co-creation and indigenous knowledge integration.

Cognitive Overload and Learning Efficacy: Highly interactive and content-rich environments may overwhelm users, particularly novice learners. Poor interface design or excessive gamification can detract from learning by overloading users cognitively or trivializing content (John sweller, 2022)(Tost LP et al., 2009). Thus, user-centered design principles must guide interaction and information pacing.

Evaluation and Impact Assessment: There is limited consensus on how to measure the educational effectiveness of serious game narratives in cultural contexts. Traditional assessment tools may not capture the nuanced impacts of experiential learning, such as empathy development, intercultural competence, or historical perspective-taking. Mixed-method evaluations combining qualitative and quantitative data remain underutilized but crucial (Falk, J.H. et al., 2013).

Virtual interactive displays and serious game narratives represent a promising frontier in cultural heritage education, capable of transforming passive engagement into active cultural participation. They enable learners to explore history through action, emotion, and context. However, their implementation must be critically informed by considerations of authenticity, inclusivity, ethics, and sustainability. Future research and practice should prioritize co-creative methods, robust evaluative frameworks, and interdisciplinary collaboration to fully realize the transformative potential of these digital modalities.

5.3 Limitations of the study

While this study contributes valuable insights into A Serious Games Perspective for Virtual Interactive Exhibition : A Case Study of The Bronze Age of Yunnan Exhibition At Yunnan Provincial Museum , it is essential to acknowledge several methodological

limitations that may affect the interpretation and generalizability of the findings. These limitations stem primarily from the constraints in research design, data collection procedures, and analytical frameworks employed.

5.3.1 Discuss the limitations of the research methodology

Firstly, the chosen methodological approach mixed-methods design, case study analysis, experimental simulation while suitable for exploring the core research questions, inherently restricts the breadth of inference. For example, qualitative interviews provide rich, contextual insights but lack the scalability and replicability of large-scale quantitative surveys. Conversely, controlled experiments may omit the complex real-world variables that influence naturalistic behavior.

Secondly, the operationalization of key variables may have introduced limitations in construct validity. Variables such as insert key variables, “user trust,” “efficiency,” “collaboration level” were measured using predefined indicators, which, despite validation, may not fully capture the conceptual nuances. Moreover, the study relied on self-reported data, which may be subject to social desirability bias or participant misperception.

Finally, the temporal scope of the research was limited, preventing the investigation of long-term trends or longitudinal effects. A cross-sectional design, while efficient, may overlook the evolving dynamics of virtual interaction technology.

5.3.2 Insufficient samples, limited experimental conditions

Another significant limitation pertains to the adequacy and diversity of the sample as well as the bounded nature of the experimental conditions.

The questionnaire sample size 65 while sufficient for exploratory analysis, may not provide enough statistical power to generalize findings across broader populations. In particular, demographic homogeneity participants predominantly from Colleges in Yunnan Province restricts external validity. This limitation is particularly pertinent in studies addressing sociotechnical systems, where user diversity in terms of age, experience, cultural background, etc. may significantly affect outcomes.

Additionally, the APP design, though controlled for internal validity, was constrained by logistical and ethical factors. For instance, the simulation environment

did not fully replicate real-world operational pressures, time constraints, or interpersonal dynamics. Certain variables such as stress levels, collaborative, or real-time feedback mechanisms were held constant or excluded, potentially oversimplifying complex scenarios.

The environmental and contextual limitations of the study suggest that further research using longitudinal field studies, larger and more heterogeneous samples, is warranted to substantiate and extend the current findings.

5.3.3 Possible bias interference

Bias is an inherent risk in empirical research and can infiltrate various stages of the research process, from design and data collection to analysis and interpretation.

One potential source of bias in this study arises from selection bias, particularly if participants self-selected into the study or were recruited through networks with shared characteristics. This may have skewed the data toward specific perspectives or experiences, undermining the neutrality of the sample.

Observer bias is another concern, especially in the qualitative components of the research. The researchers' expectations, interpretations, or prior knowledge might have inadvertently influenced the thematic analysis of qualitative data, despite efforts to standardize interpretation through interviewee reliability measures and reflexive practices.

Furthermore, instrumentation bias may have emerged if the tools and questionnaires used were not sufficiently calibrated or culturally adapted, particularly if translated versions were used without proper cross-cultural validation.

Finally, confirmation bias might have affected the interpretation of ambiguous findings, with a tendency to highlight data that supports the hypothesis while discounting contradictory evidence.

To mitigate these risks, multiple strategies were employed, including triangulation of data sources, anonymization of responses, and peer debriefing

sessions. Nevertheless, the possibility of residual bias cannot be entirely excluded and should be accounted for when interpreting the conclusions of the study.

5.4 Suggestions for future research

The present study provides an initial exploration into the integration of narrative serious games within virtual interactive exhibitions, with a specific case study focusing on The Bronze Age of Yunnan Exhibition at the Yunnan Provincial Museum. While the findings demonstrate promising potential for enhancing user engagement, educational depth, and cultural immersion, several limitations have also surfaced. Accordingly, this section outlines prospective directions for future research aimed at extending, refining, and deepening the academic and practical understanding of this emerging interdisciplinary field.

5.4.1 Based on the limitations, it is suggested that the future direction of exploration can be continued in this field

Future research should begin by systematically addressing the limitations observed in this study. Firstly, this research adopted combining qualitative and quantitative case study methodology based primarily on user observation and thematic analysis. While this approach yielded valuable insights, it lacked large-scale quantitative validation. Thus, future research can adopt a methodological design that expands the research scope, integrating quantitative user experience assessments, such as usability testing, eye-tracking, or psychophysiological measures (e.g., EEG, GSR), to enrich empirical rigor and generalizability.

Secondly, the demographic scope of user participants in this study was relatively narrow, often skewed toward young, technologically adept individuals. Broader sampling across age groups, educational backgrounds, and cultural contexts would allow future research to better capture how different audiences engage with virtual exhibitions enhanced by serious games.

Lastly, technical limitations such as the fidelity of 3D rendering, network latency, and the absence of adaptive feedback mechanisms posed constraints on the realism and personalization of the experience. Future projects may explore emerging

technologies, including AI-driven personalization, cloud-based rendering, and 5G-supported interactions, to elevate both immersion and accessibility.

5.4.2 For further research on virtual interactive display, narrative design serious games

One of the most promising directions for future exploration lies in the advancement of narrative design frameworks tailored specifically to the museum and heritage context. While this study experimented with embedded storytelling elements, future research could delve into the development of culturally resonant narrative architectures that blend linear, branching, and emergent storytelling paradigms. Integrating these with serious game mechanics can further promote active knowledge construction, emotional resonance, and long-term retention.

Another critical area is the co-creation of content. Future studies might examine how participatory design approaches, involving museum curators, historians, game developers, and visitors themselves, can result in more authentic and meaningful serious games. This includes researching methodologies for collaborative storytelling and dynamic content updating, allowing virtual exhibitions to evolve over time and reflect ongoing scholarly discoveries.

Moreover, future research should investigate cross-platform adaptability. As virtual exhibitions become increasingly accessible through VR headsets, AR mobile apps, web browsers, and immersive installations, the transmedia design of serious games becomes essential. Studies exploring how narratives and interactions are maintained or transformed across different digital platforms will provide valuable guidelines for scalable and inclusive design.

Finally, the longitudinal impact of serious games in virtual exhibitions remains largely unexplored. Future research should track user engagement, learning outcomes, and behavioral changes over extended periods. This would enable a deeper understanding of how such interventions influence cultural education, identity formation, and digital heritage preservation in the long term.

5.5 Practical significance and application suggestions

The findings of this study underscore the transformative potential of integrating serious game principles into virtual interactive exhibitions, particularly within the context of regional cultural heritage. Based on the empirical insights gathered from The Bronze Age of Yunnan Exhibition at the Yunnan Provincial Museum, several key areas emerge where this research contributes practical value. These areas span the domains of museum exhibition design, heritage education, and digital technology implementation.

5.5.1 Implications for Museum Exhibition Design

Virtual exhibitions enriched with serious game elements offer museums a powerful strategy to revitalize their curatorial approach. Traditional static displays can be augmented or even reimagined as interactive, exploratory environments that invite visitors to actively engage with the artifacts, narratives, and historical contexts. This study demonstrates how serious games facilitate deep visitor immersion by transforming passive observation into goal-oriented interaction, thereby enhancing both cognitive and emotional connections to the subject matter.

From a design perspective, museums are encouraged to Adopt modular narrative structures, allowing visitors to navigate historical events or cultural developments in non-linear, personalized paths. Incorporate gamified tasks such as artifact restoration, decision-making scenarios, or time-travel missions, which serve both educational and entertainment functions. Utilize adaptive interaction models that respond to user input, creating dynamic experiences that cater to individual preferences and learning styles.

Furthermore, the use of serious games can help attract younger audiences, particularly those accustomed to digital interactivity, thereby expanding the demographic reach and educational impact of museums.

5.5.2 Advancing Cultural Heritage Education

The integration of serious games into virtual exhibitions also holds substantial educational potential, particularly in the field of informal cultural learning. Unlike conventional didactic methods, serious games allow learners to construct historical knowledge through simulation, experimentation, and storytelling. This aligns

with constructivist learning theories, where knowledge emerges through interaction and contextual engagement.

Based on this research, the following applications are proposed: Develop curriculum-linked virtual exhibition modules that can be used in schools to complement classroom instruction on regional history, archaeology, and anthropology. Establish interactive educational platforms that allow students to assume roles (e.g., ancient metallurgist, tribal leader, or archaeologist) within game-based scenarios derived from historical contexts. Foster interdisciplinary collaboration among educators, museum professionals, and game designers to co-create serious games aligned with pedagogical goals.

Such initiatives not only promote multimodal literacy visual, spatial, narrative but also stimulate cultural identity formation by allowing users to explore the intangible values embedded in artifacts and rituals.

5.5.3 Recommendations for Digital Exhibitions Technology

The implementation of virtual interactive exhibitions calls for a strategic and innovative application of digital technologies. This study reveals that technology should not merely digitize artifacts but recontextualize them through immersive storytelling and interaction.

Accordingly, museums and cultural institutions should consider: Utilizing real-time 3D rendering engines such as Unity or Unreal Engine to construct responsive, high-fidelity environments that support complex interactions and real-world physics. Integrating extended reality (XR) technologies, including Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), to enable multisensory experiences that bridge physical and digital domains. Applying cloud-based architecture and edge computing to enhance accessibility and performance, particularly for geographically remote users or institutions with limited on-site infrastructure. Embracing AI-driven content personalization, allowing systems to adapt game difficulty, narrative depth, or language settings based on user profiles.

Finally, open standards and interoperability should be emphasized to ensure that virtual exhibitions can be easily updated, shared, and reused across different museums and educational contexts, supporting long-term sustainability.

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APPENDIX

1. Interviews and Questionnaire

1.1 The Interview Questions for the Yunnan Provincial Museum Staff

1. Can you introduce the planning process for the "The Light of Civilization — The Bronze Age of Yunnan" exhibition?

2. What are the main objectives and core messages of the exhibition?

3. What is the exhibition's most distinctive and attractive part?

4. How is the narrative structure of the exhibition designed? Is there a specific narrative way?

5. How does the exhibition convey Bronze Age history and culture through storytelling?

6. What multimedia elements (e.g., video, audio, animation, etc.) were used in the narrative design to enhance the visitor experience?

7. Is there an virtual interactive design for the "The Light of Civilization — The Bronze Age of Yunnan" exhibition hall? If so, how is it realized? What are the specific interactive methods?

8. If there are virtual interactive designs, what technologies (e.g., VR, AR, etc.) are used in these interactive designs? What are the effects?

9. What activities can the audience participate in during the interactive experience? What is their feedback?

10. how did the audience react to the exhibition? What were their favorite parts?

11. How did you collect and analyze the audience's feedback?

12. Has the exhibition been adjusted or improved based on audience feedback?

13. What room for improvement do you see in the narrative design and audience experience of future virtual interactive exhibitions?

14. What new technologies or interactive methods will you introduce in future exhibitions?

15. Is our museum's combination of serious narrative-based games and virtual interactive displays feasible?

16. Do you have any comments and suggestions on using narrative-based serious games combined with virtual interactive displays in the exhibition 'The Light of Civilization — The Bronze Age of Yunnan'?

1.2 The Interview Questions for Virtual Interactive Display Practitioner

1. What is your core philosophy when designing a virtual interactive presentation?

2. How do you build a coherent and engaging story in a virtual environment?

3. Can you share a specific case study of a virtual display project you have been designing and its success?

4. If you were asked to design a virtual interactive exhibition for the "The Light of Civilization — The Bronze Age of Yunnan"exhibition, how would you plan it?

5. What key technologies (e.g., VR, AR, 3D modeling, etc.) were used in the virtual interactive exhibition? Why did you choose these technologies?

6. What are the challenges encountered in the process of technical realization? How were they solved?

7. What hardware devices must audiences use to experience the virtual interactive exhibition?

8. How do virtual displays encourage active participation and interaction?

9. How do you enhance the immersion and realism of the audience in the virtual exhibition?

10. How do you collect and analyze audience feedback? How does this feedback help to improve the presentation? Can you share some data or statistics on audience interaction and participation?

11. What narrative techniques enhanced storytelling in the virtual interactive exhibition?

12. Were multiple endings or branching plots designed into the virtual exhibit? If so, what is their purpose?

13. Are there characters designed in the virtual exhibit? What role do these characters play in the narrative?

14. What are the future trends in virtual interactive displays? What emerging technologies are likely to impact the future of virtual presentations significantly?

15. Can narrative serious games combined with virtual interactive displays be used in the “The Light of Civilization—The Bronze Age of Yunnan” exhibition?

16. Do you have any comments or suggestions on using narrative-based serious games and virtual interactive displays in the “The Light of Civilization — The Bronze Age of Yunnan” exhibition?

1.3 The Questionnaire for Museum Visitors

A structured questionnaire is designed and distributed through online and offline channels, and 200-500 valid questionnaires are expected to be collected. SPSS and other statistical software will analyze the questionnaire data, and descriptive statistics and regression analysis will be used to explore the relationship between different variables.

Part I: Basic Information

1. Age:

- How old are you?

2. Gender:

- Male

- Female

- Others

3. Educational background:

- High school and below

- Specialized/college

- Bachelor's Degree

- Master's Degree

- Doctorate and above

4. Have you ever visited a virtual interactive exhibition before?

- Yes

- No

Part II: Exhibition Experience

1. How did you learn about the “The Light of Civilization — The Bronze Age of Yunnan” exhibition?

- Museum website

- Social media

- Recommended by friends

- Museum publicity

- Other (please specify)

2. How satisfied are you with the exhibition as a whole?

- Very dissatisfied

- Unsatisfactory

- Average

- Satisfactory

- Very satisfactory

3. Are you looking forward to integrating the virtual interactive display with the showroom?

- Not expected

- Average

- Expected

- Very Expected

4. Did you find the storyline of the virtual interactive exhibits you participated in in the past attractive?

- Very unattractive

- Not attractive

- Average

- Attractive

- Very attractive

5. How was your interactive experience in the virtual interactive display?

- Very bad

- Bad

- Average

- Good

- Very good

6. If the virtual interactive display is used in the “The Light of Civilization — The Bronze Age of Yunnan” exhibition, will it enhance your understanding of the bronze culture?

- Not at all

- No

- Average.

- There is a little benefit

- Helps a lot

Part III: Specific Feedback

7. Which part of the “The Light of Civilization — The Bronze Age of Yunnan” exhibition did you like best?

- [Open-ended answer]

8. What can be improved in the “The Light of Civilization — The Bronze Age of Yunnan” exhibition?

- [Open-ended answer]

9. Did you encounter technical problems while experiencing the virtual interactive display? If so, please describe.

- [Open-ended answer]

10. What new elements or features would you like to see in the future "The Light of Civilization — The Bronze Age of Yunnan" Narrativized Serious Games Virtual Interactive Presentation?

- [Open-ended answer]

Part IV: Overall Evaluation

11. Would you recommend this exhibition to friends or family?

- Definitely no

- No

- Maybe

- Yes

- Definitely Yes

12. Please give an overall rating of the exhibition (on a scale of 1-10):

- [Scale of 1-10]

Part V: Additional Information (optional)

13. Please leave your contact information so that we can further understand your feedback (if required):

- Name:

- Email:

- Phone number:

Thank you for your participation!

Your feedback is very important to us and will help us improve and enhance the future "The Light of Civilization—The Bronze Age of Yunnan" narrative serious game virtual interactive presentation experience.

VITA