



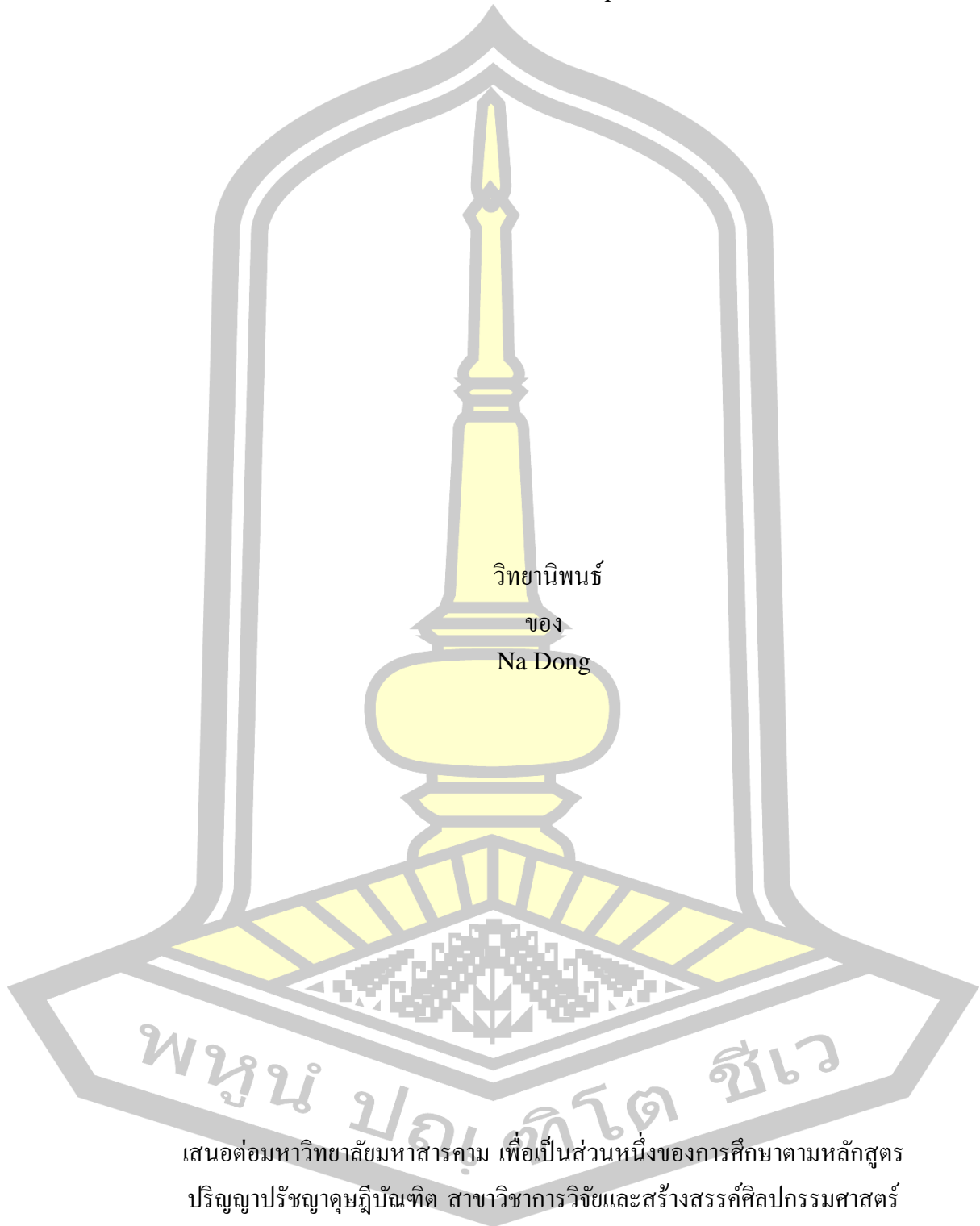
Development and application of digital interactive game for Nanjing Paper-Cutting in virtual cultural space

Na Dong

A Thesis Submitted in Partial Fulfillment of Requirements for
degree of Doctor of Philosophy in Fine and Applied Arts Research and Creation
March 2025

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virtual cultural space



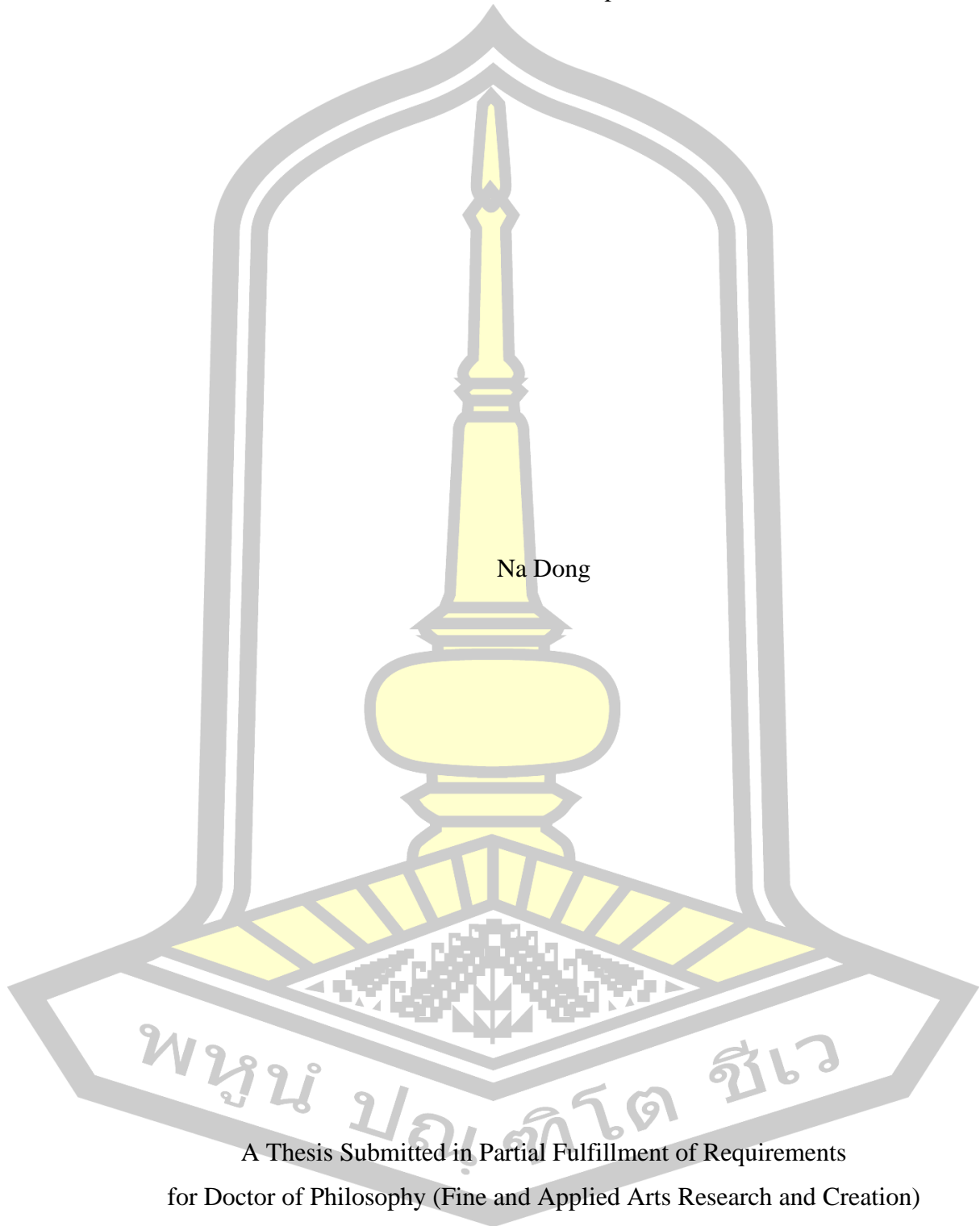
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เสนอต่อมหาวิทยาลัยมหาสารคาม เพื่อเป็นส่วนหนึ่งของการศึกษาตามหลักสูตร
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Development and application of digital interactive game for Nanjing Paper-Cutting in
virtual cultural space



Na Dong

A Thesis Submitted in Partial Fulfillment of Requirements
for Doctor of Philosophy (Fine and Applied Arts Research and Creation)

March 2025

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TITLE	Development and application of digital interactive game for Nanjing Paper-Cutting in virtual cultural space		
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ABSTRACT

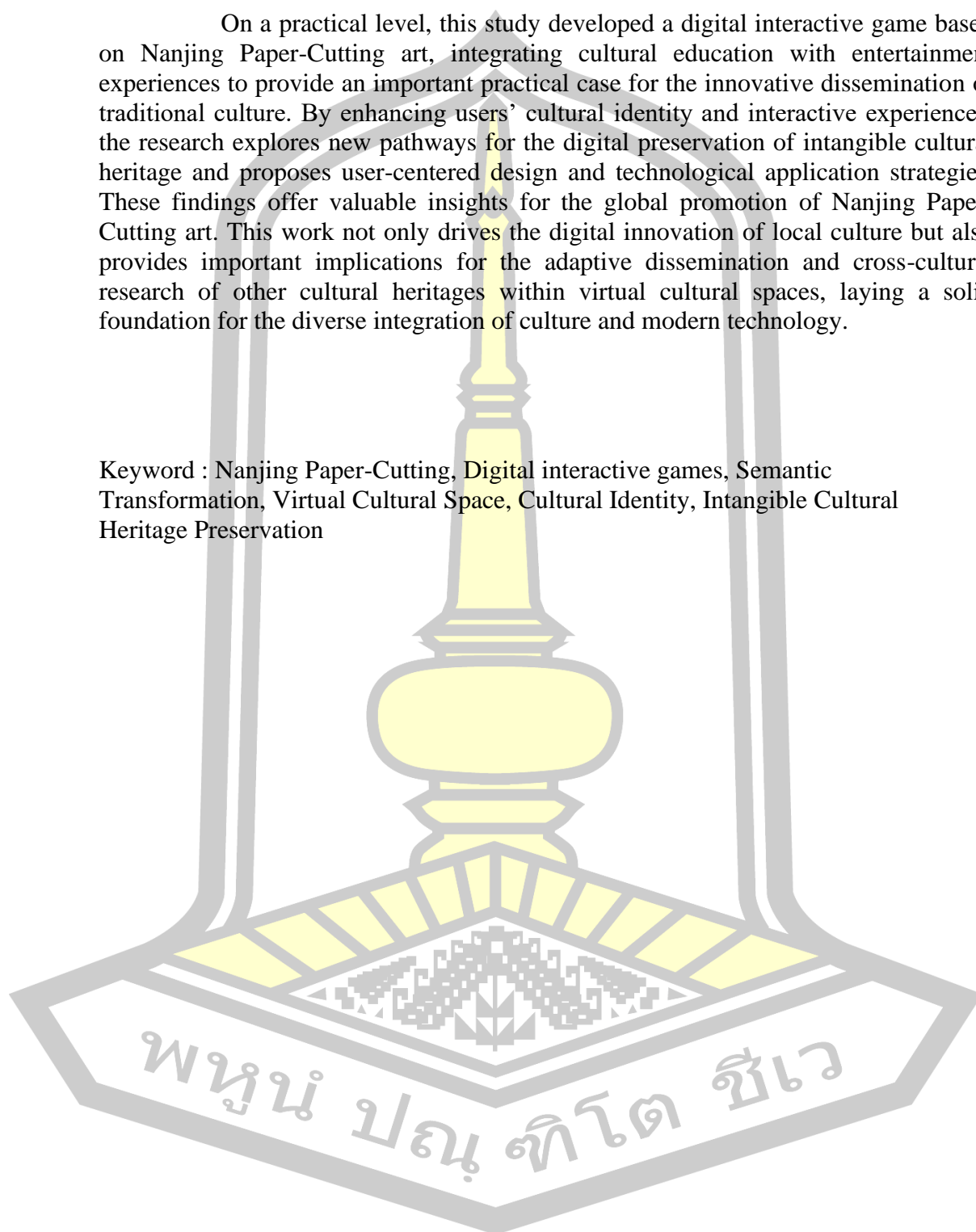
This study explores the development and application of digital interactive games based on Nanjing Paper-Cutting art within virtual cultural spaces, aiming to preserve and innovate the art form through digital technology while analyzing its cultural dissemination effects among younger audiences. The research integrates multiple dimensions, including theoretical analysis, user research, game design and functionality implementation, as well as quantitative and qualitative evaluations. The key findings are as follows: Digital technology has opened new expressive pathways for Nanjing Paper-Cutting art, transitioning it from static displays to dynamic forms and from one-way dissemination to interactive experiences, significantly enhancing its modern communication capacity. Game functionality design is user-centered, incorporating interactive paper-cutting modules that meet diverse user needs in learning, cultural cognition, and entertainment. The cultural connotations of Nanjing Paper-Cutting symbols have been innovatively transformed within digital games, endowing traditional symbols with new forms of expression and interactivity. Based on UTAUT2 model analysis, cultural identity, social influence, and performance expectancy are identified as key factors influencing user behavioral intentions, with cultural identity having a particularly significant impact on user engagement. Expert evaluations and user feedback indicate that the game excels in educational, cultural, and entertainment dimensions but still requires improvements in user experience and cultural interaction design.

The theoretical significance of this study lies in uncovering the semantic transformation mechanisms of traditional cultural symbols in a digital context, constructing a cultural communication model centered on virtual cultural spaces, and deepening the understanding of the role of cultural identity in digital games. This perspective not only enriches the research content of cultural identity theory but also expands the academic foundation for the digital preservation of intangible cultural heritage, offering new references for the theoretical framework of deep integration between culture and technology. Moreover, by exploring the representation of Nanjing Paper-Cutting art in virtual cultural spaces, the study advances the bidirectional interaction between cultural symbols and digital media, further refining

the research system in the field of cultural transmission.

On a practical level, this study developed a digital interactive game based on Nanjing Paper-Cutting art, integrating cultural education with entertainment experiences to provide an important practical case for the innovative dissemination of traditional culture. By enhancing users' cultural identity and interactive experiences, the research explores new pathways for the digital preservation of intangible cultural heritage and proposes user-centered design and technological application strategies. These findings offer valuable insights for the global promotion of Nanjing Paper-Cutting art. This work not only drives the digital innovation of local culture but also provides important implications for the adaptive dissemination and cross-cultural research of other cultural heritages within virtual cultural spaces, laying a solid foundation for the diverse integration of culture and modern technology.

Keyword : Nanjing Paper-Cutting, Digital interactive games, Semantic Transformation, Virtual Cultural Space, Cultural Identity, Intangible Cultural Heritage Preservation



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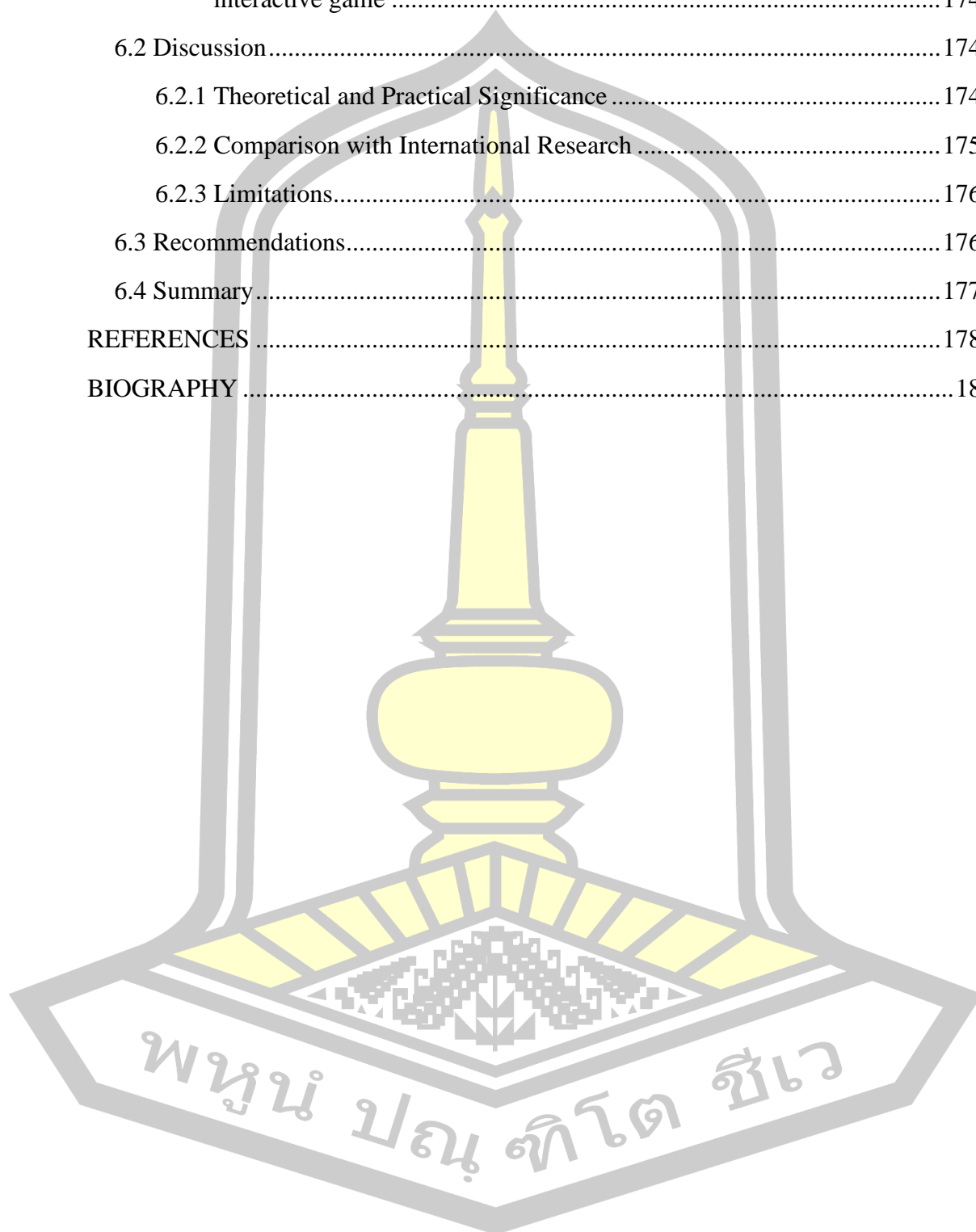
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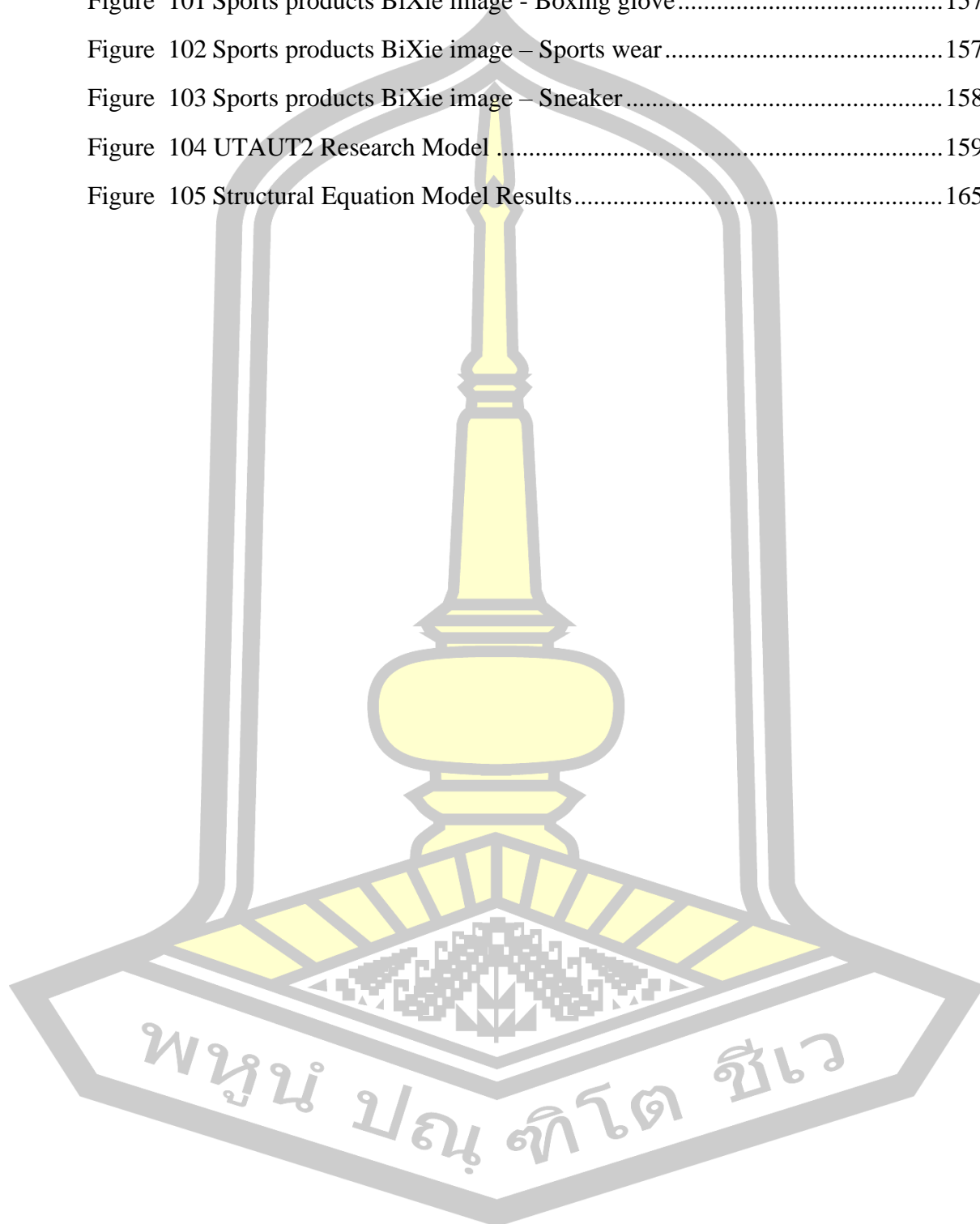
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Chapter I

Introduction

1.1 Background of Research

The origins of paper-cutting in China can be traced back to the Han Dynasty (206 B.C.-220 A.D.) or earlier(Lianhai, 2022). The earliest works of paper-cutting were probably monochromatic paper-cuttings used in rituals and religious ceremonies. By cutting paper in the shapes of plants and animals, people expressed their reverence for the gods and spirits, and these paper-cuttings were religious and ceremonial in nature. During the Six Dynasties period (220 A.D.-589 A.D.), the art of paper-cutting was gradually developed. People began to use paper-cuttings for celebration and decoration as part of banquets and festivals. Paper-cutting in this period was mainly based on simple shapes and patterns, while the technique was not yet fully developed. During the Tang and Song dynasties, the art of paper-cutting matured and began to be widely used in palaces and temples. Paper-cutting works became more refined and styles gradually diversified during this period. It was used for banquets, rituals and religious ceremonies, and also became a traditional handicraft for celebrating important festivals such as the Spring Festival. During the Yuan and Ming Dynasties (1271-1644), paper-cutting developed further, resulting in a variety of different genres and styles(*Nüshu: Chinese Women's Characters*, n.d.). Paper-cutting was no longer confined to palaces and temples, but became a widely spread folk craft. Paper-cutting works began to show more complex lines and patterns, and the technique reached new heights. During the Qing Dynasty (1644-1912), paper-cutting was widely used as a decorative art in temples and houses(Knapp, 2012). At this time, paper-cutting occupied an important position in Chinese society as a traditional handicraft.

China's various regions and ethnic groups have made unique contributions to the art of paper-cutting. Over centuries of development, Chinese Paper-Cutting has gradually evolved into two major schools: the northern and southern styles(KANG Wenwen, 2024). The northern school, represented by paper-cutting from Shanxi and Shaanxi provinces, is characterized by a bold and unrestrained style with strong regional features. In contrast, the southern school, epitomized by Nanjing Paper-Cutting is known for its delicate and elegant style, emphasizing smooth lines and intricate patterns.

On June 7, 2008, Nanjing Paper-Cutting was officially included in the second batch of National Intangible Cultural Heritage (ICH) by the State Council of the People's Republic of China. Additionally, during the fourth session of the UNESCO Intergovernmental Committee for the Safeguarding of ICH held from September 28 to October 2, 2009, China's application for the "Chinese Paper-Cutting" project was successfully inscribed on the Representative List of the ICH of Humanity(X. Zhang, 2023). As a vital component of "Chinese Paper-Cutting," Nanjing Paper-Cutting also gained international recognition.

Nanjing Paper-Cutting combines the boldness of northern paper-cutting and the delicacy of southern paper-cutting into one, unique charm, is an important part of Chinese Paper-Cutting art. As the capital of Jiangsu Province, the history of Nanjing can be traced back to the Xia Dynasty more than 3,000 years ago(Zhaoyan & East, 2021). In 495 B.C., legend has it that the King of Wu built the city of Yecheng here,

beginning the history of Nanjing's city walls. In 472 B.C., after King Goujian of Yue destroyed Wu, the city was built on the southwest side of today's Zhonghua Gate in Nanjing. Since then, Nanjing has been the capital of many dynasties, including Wu, Eastern Jin Dynasty, Southern Song Dynasty, Southern Tang Dynasty, and Ming Dynasty, etc. Therefore, Nanjing is known as the "Ancient Capital of the Six Dynasties"(Bai et al., 2024). During the Six Dynasties period, Nanjing's political, economic and cultural prosperity reached great heights, contributing greatly to important cultural, artistic and academic achievements in Chinese history. Nanjing is located in the lower reaches of the Yangtze River in eastern China, and its unique geographic location has led to the development of the art of Nanjing Paper-Cutting, which has been influenced by a variety of cultures and has formed a unique artistic style.

As a branch of Jiangnan Paper-cutting, Nanjing Paper-Cutting is deeply influenced by the culture of the Jiangnan water towns. Themes such as the region's water-town scenery, garden landscapes, and floral patterns frequently appear in Nanjing Paper-Cutting works. Artists skillfully incorporate these natural and cultural elements into their designs, creating pieces that not only reflect the delicate and elegant charm of Jiangnan but also highlight the distinctive cultural appeal of Nanjing.

Situated at the intersection of northern and southern cultures, Nanjing Paper-Cutting has developed by absorbing the intricate and refined qualities of Jiangnan culture while integrating the bold and robust characteristics of northern culture. This cultural fusion has given Nanjing Paper-Cutting a unique style described as "flowers within flowers, themes within themes, intricacy within boldness, and vitality within simplicity." The works feature detailed and delicate linework without losing the strength and rhythm of bolder strokes.

Nanjing's strategic geographical location as a hub of diverse cultures has provided abundant creative material and inspiration for Nanjing Paper-Cutting. This rich cultural interplay has endowed the art with a distinct style, making it a shining gem in the realm of traditional Chinese Paper-Cutting. Known for its exquisite craftsmanship, diverse themes, and profound cultural connotations, Nanjing Paper-Cutting enjoys a strong reputation both domestically and internationally.

Traditional types of Nanjing Paper-Cutting include Xi Hua (symbolizing joy and celebration), Dou Xiang Hua (Fragrance Contest Flower), Xiu Hua Paper-Cutting (Embroidery Flower Paper-Cutting), and Men Jian (Door Decorations). These pieces vividly demonstrate the unique artistic style of Nanjing Paper-Cutting enriching the heritage of Chinese folk art. Its creation process is particularly distinctive, as it requires no preliminary sketches. Artists cut directly, producing continuous and flowing lines in a single(CHU Jiaqian et al., 2021), uninterrupted motion akin to "one-stroke painting," showcasing extraordinary skill and artistry. Consequently, Nanjing Paper-Cutting occupies a significant position in Chinese Paper-Cutting art and represents an essential part of China's traditional culture and folk-art heritage.

The origin of Nanjing Paper-Cutting can be traced back to at least the early Ming Dynasty. According to *Bai Xia Suo Yan*, written by Gan Xi during the Daoguang period of the Qing Dynasty, paper-cutting was already being used in Nanjing for door decorations and lantern adornments at that time.

The history of Nanjing Paper-Cutting is closely tied to the development of local embroidery. In the past, many households in Nanjing kept a booklet of paper-cut patterns specifically for embroidery. As part of the Jiangnan paper-cutting tradition, Nanjing Paper-Cutting emphasizes smooth and intricate lines. However, it was not until the 1920s and 1930s that Nanjing Paper-Cutting truly became a distinct school. During that period, many folk artists worked in the vicinity of the Confucius Temple, creating shoe patterns and decorative designs for belly bands.

After 1912, artists such as Madam Wu, Ma Zhihong, and Zhang Jigen began practicing paper-cutting professionally in Nanjing, becoming pioneers of modern paper-cutting. Before 1949, folk paper-cutting artists were highly mobile, and distinct regional styles had not yet formed. After 1949, Madam Wu played a leading role in establishing a new artistic style for Nanjing Paper-Cutting.

In 1952, the Nanjing Cultural Bureau organized several paper-cutting artists, including Zhang Jigen, Wu Zhifang, and Wang Mingchang, to spend nearly five years excavating and collecting traditional folk paper-cutting practices in Nanjing. They revived types of Xi Hua that had been lost for years. Art experts such as Chen Zhifo, He Yanming, Wu Shan, and Zhang Daoyi provided guidance. Subsequently, dozens of representative works were selected from the hundreds of pieces restored and compiled into the book *Nanjing Paper-Cutting*, published in 1956 by Shanghai People's Fine Arts Publishing House. This publication established the distinctive festive style of Nanjing Paper-Cutting and enhanced its artistic value.

The development process of Nanjing Paper-Cutting is summarized in Table 1.



Table 1 The development of Nanjing Paper-Cutting

Time	Event	Characteristic
Han Dynasty (206 BC-AD 220) or earlier	The origin of Chinese Paper-Cutting	The use of thin sheet materials, through the hollow carving techniques made of crafts
During the Six Dynasties period (220–589 CE)	Chinese Paper-Cutting techniques began to develop	Primarily serving as a medium for celebration and decoration. The designs from this era were
During the Tang and Song dynasties (618–979 CE)	paper-cutting techniques reached maturity	The art form featured intricate Works and diversified styles, with applications extending to royal courts and temples
During the Yuan and Ming dynasties (1271–1644 CE)	paper-cutting underwent further development	Distinct schools and styles emerged, and the art form became widely popular among the general populace
During the Qing Dynasty (1644–1912 CE)	paper-cutting became widely used as a decorative art form	It was regarded as a traditional handicraft and held an important place in society, often seen in festivals, rituals, and daily life
In the 1920s and 1930s	Nanjing Paper-Cutting developed into a distinct school	Folk artists in the vicinity of the Confucius Temple in Nanjing began creating paper-cut works, contributing to the establishment of the local style
After 1949	a new style of Nanjing Paper-Cutting was established	Led by artists such as Madam Wu. The Cultural Bureau organized efforts to excavate and collect traditional paper-cutting works, preserving and revitalizing the art form.
In 1952	the artistic style of Nanjing Paper-Cutting further developed	With the involvement of artists such as Zhang Jigen and Wu Zhifang. Art experts from the fine arts community provided guidance, contributing to the refinement and promotion of the style
In 1956	the book Nanjing Paper-Cutting was published	Helped establish the distinctive "Xi Hua" style of Nanjing Paper-Cutting and enhanced the artistic value of the craft
On June 7, 2008	Nanjing Paper-Cutting was included in the national ICH list	Be approved by the State Council of the People's Republic of China
From September 28 to October 2, 2009,	"Chinese Paper-Cutting" was included in the "Representative	recognized as an important component of this tradition

With the rapid development of the times, the traditional Nanjing Paper-Cutting art in the form of expression is also advancing with the times, and constantly integrated into the modern aesthetic concepts and technical means, and strive to present a more colorful appearance.

Simplification of complexity is the starting point for the re-creation of the content of Nanjing Paper-Cutting. Although traditional paper-cutting graphics are also processed by taking natural images, most of them are realistic and delicate graphics with complicated structures and old forms. After the baptism of “less is more” in modern design, people are more accustomed to and inclined to simple and clear, full of sense of form and unique creative graphics. Therefore, the traditional paper-cutting graphics should not be used directly, need to be simplified, the second abstract. To simplify is to eliminate the complicated parts, retain and extract the typical characteristics of the part, on the basis of the simplified and refined image, simple and clear modeling, distinctive features, in line with the aesthetic standards of the times. Breaking up and reconstructing is the basic method of modern graphic creativity, and its graphic visual characteristics are novel and unique, and its core is deconstruction and reorganization. Deconstruction requires a more detailed observation of things, through a deep understanding of the outside and inside of things, breaking down the original shape and extracting the characteristic elements of things to form new visual symbols. This kind of modeling technique enriches the expression language of modern design, and will certainly enrich the expression form and artistic style of Nanjing Paper-Cutting.

Color is symbolic, it can convey people's emotions. Traditional paper-cutting colors are red, yellow, green, blue, etc. Red in Chinese aesthetic imagery is a symbol of good luck, goodwill and festivity(Pang, 2007), in the development process of Nanjing Paper-Cutting, often monochromatic “red” as the center of the performance of its theme colors. Dou Xiang is a kind of incense burned by Chinese folk in the past when they worshiped the moon during the Mid-Autumn Festival(*Crafting customer experience through cultural theming*, n.d.). The shape of the incense is like a pagoda, and the top of the incense is decorated with colorful carved paper in the shape of a “bucket” with four corners and six corners, hence the name “Dou Xiang”. In addition to the top, the incense of the upper and lower layers, also decorated with many colorful carved papers, commonly known as Dou Xiang Hua. It is a kind of colorful paper-cutting, each piece of Dou Xiang Hua is composed of many colors, bright and colorful, with strong contrast.

While traditional Nanjing Paper-Cutting mainly uses cheap and thin paper materials such as red paper and burlap, the Dou Xiang Hua paper-cutting uniquely uses a combination of waxed and crumpled paper, and this material combination is one of the important differences between it and other paper-cutting varieties. While other paper-cutting works usually use only a single type of paper, Dou Xiang Hua paper-cutting uses a combination of two different types of paper to accomplish its unique effect. However, with the rapid development of science and technology and the continuous innovation of paper-cutting tools and materials, the modern Nanjing Paper-Cutting art has made a bold breakthrough based on tradition. Nowadays, art creators try to use a variety of new materials and cutting and carving techniques, changing the carrier of traditional paper-cutting and getting rid of the limitations of traditional materials. For example, the reuse of discarded paper, various kinds of

colored cardboard, handmade paper, sandpaper, tin paper and other diversified papers are processed and applied in the creation of paper-cutting.

In recent years, the preservation of ICH has received more and more attention, and scholars and practitioners are actively exploring a variety of methods and techniques to ensure that these valuable cultural resources are passed on and carried forward. Combining digital technologies such as virtual reality and augmented reality with traditional preservation methods has been recognized as one of the effective means (Buragohain et al., 2024). These technologies not only help preserve traditional Chinese culture and art, but also enable their wider dissemination and display in modern society. At the same time, participatory development is also playing an increasingly important role in the safeguarding of ICH, especially in the context of the growing cooperation between governments, scholars and the public.

Digital technologies have come to play a crucial role in ICH safeguarding. A large number of studies have focused on the digital preservation of ICH archives (Buragohain et al., 2024), the application of high-performance computing in digital preservation, and how modern information technology can help preservation efforts. Meanwhile, the establishment of a comprehensive digital preservation platform and management mechanism has become a key direction to enhance the effectiveness of preservation (C. Li & Yu, 2024). In addition, the combination of ICH with industry is also proposed as a way to promote its preservation and development. For example, the creation of ICH brands can contribute to its transmission and innovation (Bhattacharya et al., 2021), and the practice of sustainable cultural innovation to ensure that ICH crafts can be passed on creatively (J. Guo & Ahn, 2023).

Many studies have also explored the use of digital technologies in the dissemination and safeguarding of indigenous knowledge and traditional practices. Studies have shown that indigenous voices can be effectively shared and safeguarded through digital means, especially web archiving and digital prototyping (Reid, CA & Bourget, Chelsea, 2020). The ICH of specific groups such as the Bedouins can be preserved more comprehensively through participatory methods (Kennedy, Susan, 2017). The study also proposes a theory of culturally significant presence, which emphasizes the presentation of indigenous intangible heritage and historical ecosystems through single-player computer games, further expanding preservation avenues. In addition, the application of semantic-oriented digital documentation framework and Linked Data model for ICH provides new ideas for digital preservation.

Digital tools and technologies play a vital role in the safeguarding and promotion of ICH, offering innovative solutions for preservation and facilitating global collaboration (Deacon & Smeets, 2018). These technologies, such as virtual reality, augmented reality, and high-performance computing, help expand ICH transmission beyond protection to global dissemination and education, enhancing its cultural influence.

However, there is a lack of thorough evaluation of the effectiveness of these technologies in practice. Most research focuses on their introduction and implementation, with insufficient empirical studies on their real-world impacts, challenges, and limitations. This hinders a comprehensive understanding of their utility and the potential for future optimization.

In China, digital interactive games are increasingly used for ICH preservation (Zhou et al., 2019), yet several challenges remain. First, there is limited discussion on game design theory, especially in terms of aligning design principles, interaction methods, and user experiences with ICH culture. Current research focuses mainly on game production, with less attention to creating engaging game mechanisms tailored to ICH's needs. Second, empirical research is lacking, with few studies on how these games affect public knowledge and attitudes toward ICH. Finally, limited interdisciplinary collaboration hampers innovation. The design and application of digital games involve various fields, but most studies remain within a single discipline, restricting the potential for innovation.

As an important representative of Chinese traditional art, Nanjing Paper-Cutting has a profound historical and cultural heritage and artistic value, but its development is facing some challenges and opportunities. On the one hand, despite the high artistic value of Nanjing Paper-Cutting, its popularity and influence have not yet reached the level it deserves. The main reason for this is the lack of effective publicity and promotion, which has led to many people knowing little about Nanjing Paper-Cutting or even not having heard of it. This makes Nanjing Paper-Cutting in the market recognition and acceptance is limited, it is difficult to get a wider dissemination and popularization. On the other hand, Nanjing Paper-Cutting inheritance of talents facing a shortage of difficulties. With the gradual aging of the older generation of paper-cutting artists, the interest and enthusiasm of the younger generation in the art of paper-cutting is generally low, leading to the risk of a break in the inheritance chain. This has limited the inheritance and development of Nanjing Paper-Cutting, making it difficult to maintain its unique artistic charm and skill continuity. In this regard, some studies have proposed the integration of the teaching method of Nanjing Paper-Cutting into the classrooms of secondary schools and colleges (T. Li, 2024), aiming to promote the inheritance and popularization of paper-cutting skills through educational means.

Traditional methods of promoting Nanjing Paper-Cutting can no longer meet the needs of modern society, making it essential to explore new ways to disseminate this art form. Digital media technology offers a promising solution, allowing for more organized and structured preservation and global promotion of ICH. While some studies have explored the potential of digital technology in the inheritance of Nanjing Paper-Cutting, empirical research is still limited. Therefore, finding effective ways to use digital technology for the protection, inheritance, and innovation of Nanjing Paper-Cutting remains an important challenge.

As a traditional craft, Nanjing Paper-Cutting faces both challenges and opportunities in the digital age. With the rapid advancement of technology and the growing popularity of virtual cultural spaces, traditional forms of art, like Nanjing Paper-Cutting, struggle to maintain appeal, particularly among younger generations who prefer digital entertainment, such as interactive games. This shift has reduced the influence of traditional art forms in virtual spaces, creating a dilemma for Nanjing Paper-Cutting in maintaining its vitality.

However, digital technology also presents unprecedented opportunities for innovation. By integrating with modern technology, Nanjing Paper-Cutting can create new, engaging digital artworks that attract young audiences. The development of digital interactive games based on Nanjing Paper-Cutting not only preserves and

promotes the art but also meets public entertainment needs, further expanding its reach in virtual spaces. Digital platforms also offer broader visibility, enabling global dissemination and cultural exchange.

To address the challenges facing Nanjing Paper-Cutting, it is crucial to leverage the advantages of digital technology, innovate traditional artistic expressions, and explore new pathways for development in virtual cultural spaces. Additionally, promoting the inheritance of Nanjing Paper-Cutting among the younger generation is essential for its sustainable development in the digital era.

Through the analysis of relevant studies at home and abroad and the development status of Nanjing Paper-Cutting, the following major problems and development opportunities can be summarized:

Nanjing Paper-Cutting faces the challenge of shortage of inherited talents.

As a treasure of Chinese culture, Nanjing Paper-Cutting skills are facing a shortage of inherited talents(Xiaohong, 2012). With the accelerated pace of modern life, young people's interest in and patience with traditional paper-cutting skills have gradually declined, while the older generation of artists have gradually withdrawn from the stage due to health problems, leading to a break in the inheritance chain of paper-cutting skills. In this context, the virtual cultural space provides new opportunities for the inheritance of Nanjing Paper-Cutting. Through the design and development of digital paper-cutting games, young people can be attracted to participate and their interest in traditional art can be stimulated. However, there is currently a lack of interactive games on the market specifically targeting Nanjing Paper-Cutting, and this potential has not yet been fully explored. Therefore, there is an urgent need to combine the design concept of virtual cultural space to develop educational and interesting digital interactive games, which can not only attract young people's interest, but also help them to deeply understand and learn this traditional art, and inject new vitality into the inheritance of Nanjing Paper-Cutting.

The popularity and influence of Nanjing Paper-Cutting has not met expectations.

Despite its deep historical and cultural heritage and artistic value, the popularity and influence of Nanjing Paper-Cutting in contemporary society are still low(Jia et al., 2019). This is mainly due to the lack of effective publicity and promotional tools, resulting in many people knowing little about Nanjing Paper-Cutting or even not having heard of it. In the era of digitalization, virtual cultural space has become an important platform for cultural promotion, but the presence of Nanjing Paper-Cutting in this field is relatively weak. At present, there is a lack of digital interactive games with the theme of Nanjing Paper-Cutting on the market, which cannot fully demonstrate its artistic charm and cultural connotation. Therefore, the development of Nanjing Paper-Cutting digital games, through this medium of wide audience and strong interactivity, can not only show the unique charm of paper-cutting, but also let more people understand and love this traditional art, so as to promote its dissemination and popularization, and become an important way of traditional cultural heritage.

Lack of innovation and sense of the times.

Although Nanjing Paper-Cutting is famous all over the world for its unique skills, in modern society, Nanjing Paper-Cutting still faces certain challenges in terms of innovation and sense of the times. With the continuous evolution of people's

aesthetic concepts and artistic needs, the traditional art of paper-cutting needs to actively incorporate modern aesthetic and creative elements on the basis of maintaining the traditional essence in order to attract the attention of more young people. However, at present, Nanjing Paper-Cutting has made fewer attempts to innovate, and although the traditional skills are exquisite, it lacks forms of expression and content that are compatible with modern society, resulting in its limited influence among young people. Through the form of digital interactive games, it is possible to combine Nanjing Paper-Cutting with modern technology to create a more attractive and contemporary form of expression. This will not only enhance the innovation and modernity of Nanjing Paper-Cutting, but also stimulate the interest of the younger generation in this traditional art and promote its innovative development.

Lack of dissemination of Nanjing Paper-Cutting in virtual spaces and inheritance.

Although China has fully entered the mobile Internet era, and digital learning and socialization habits have become deeply rooted in people's hearts, digital games and socialization resources for the art of paper-cutting are still scarce on the Internet. Especially in the field of digital interactive games, although players are interested in new and interesting games, there are only a few games around Nanjing Paper-Cutting, which directly limits the dissemination and popularization of Nanjing Paper-Cutting among young people. Therefore, how to fill this gap in the virtual cultural space, so that more people can understand and love Nanjing Paper-Cutting through digital interactive games has become an urgent problem.

Opportunities for safeguarding ICH in the digital era.

In contemporary China, the rapid development of science and technology has had a profound impact on the inheritance and development of ICH. The rise of digitization technology has made China's ICH no longer confined to traditional means of transmission(Y. Zhang, 2024), but expanded to a broader field. With the popularization of mobile technology and the diversification of people's entertainment needs, the gaming market continues to thrive, with digital platforms providing a more interactive and immersive cultural experience. Through digital interactive games, the public can not only appreciate the unique charm of Nanjing Paper-Cutting, but also gain a deeper understanding of its cultural connotation and historical value through interaction and entertainment.

This study aims to explore how to inherit Nanjing Paper-Cutting through digital interactive games in virtual cultural space. With the help of modern technology, we can promote the inheritance and innovation of Nanjing Paper-Cutting in contemporary society, and stimulate its attention and love among the young generation. This is not only the inheritance of the traditional art of Nanjing Paper-Cutting, but also a useful exploration of the integration of modern science and technology with traditional culture, aiming to provide new ideas and new methods for the sustainable development of the culture and art of Nanjing Paper-Cutting.

1.2 Purpose of Research / Objective

- 1.Research on the historical culture and artistic value of Nanjing Paper-Cutting
- 2.Research on paper-cutting art in virtual cultural space supported by digital technology.

3.Design and development of *Nanjing Paper-Cutting Show* digital interactive game

4.Applying and evaluating the *Nanjing Paper-Cutting Show* digital interactive game

1.3 Research question

- 1.What are the historical, cultural and artistic values of Nanjing Paper-Cutting?
- 2.What is the current situation of paper-cutting art in virtual cultural space under digital technology support?
- 3.How to design and develop *Nanjing Paper-Cutting Show* digital interactive game?
- 4.How to apply and evaluate the *Nanjing Paper-Cutting Show* digital interactive game?

1.4 Definition of Terms

1.4.1 Virtual Cultural Space

Virtual cultural space is not a real cultural space with specific forms and cultural resources in the traditional sense, but a “virtual space” for cultural exchange and other interactive activities with the help of technological means to transcend the specific location differences and time differences(Kuksa & Childs, 2014), so the virtual space has cultural attributes in the first place, and has social attributes as a result of the accession of the members of the virtual space and their interaction(Madouni, 2020), and therefore has social attributes. The operation of virtual space cannot be separated from the support of technology and so on, so it has economic attributes. However, unlike specific learning environments that require the association of more physical objects, cases for learning, and roles of teachers and students, virtual cultural spaces are considered to be “virtual bridges” that enable users to connect the virtual space, which sends stimulating information such as knowledge(Higgins, 2024), to the space in which they live, and the existence of this bridge is not due to the need for a practical bridge that connects the virtual space to the real space, but rather to the fact that the subject of the participant is the one who is connecting the virtual space to the real space. This bridge exists not because of the need to connect the virtual space with the real space, but because of the practical needs of the participant subject, and the interactive behavior of the participant subject cannot be ignored. The imaginary space simulated by computer image processing technology. The rapid development of Internet technology has given rise to intelligent hardware and software, and in this context, the speed of information transmission, reception and sharing has been accelerated ten million times. And the existence of virtual space cannot be separated from human activities, is the result of human activities, that is to say, virtual space cannot be separated from human culture(Sandelowski, 2008). The modern philosophy of virtual cultural space believes that the study of space should be combined with the social background, culture and details of people's lives at that time, and the concept of space should be integrated into various disciplines for research(Kühne & Edler, 2022). Virtual cultural space, as a product of digital media, breaks the limitations of physical space and realizes the instant dissemination and wide sharing of cultural information (Sun et al., 2022). It is an innovation and extension of the traditional physical cultural space, constructing a new cultural platform with openness, inclusiveness and interactivity. In the virtual cultural space, cultural elements, art forms and social behaviors are transformed into digital information, which can be

reconstructed and displayed through advanced technologies such as virtual reality and augmented reality(Liu, 2023). This transformation process not only gives the virtual cultural space a unique virtual character, but also realizes the transcendence of the traditional physical cultural space in terms of spatial and temporal concepts and morphological structure. Compared with the physical cultural space, the virtual cultural space has a wider coverage and stronger interactive ability. It eliminates geographical barriers and enables individuals with different cultural backgrounds to meet on the same virtual platform to communicate, share and create together. At the same time, the virtual cultural space also weakens the differences in status and hierarchy, provides everyone with equal opportunities to participate in cultural activities, and further promotes cultural pluralism and democratization.

In the 1980s, due to the booming development of information technology, all kinds of new media sprang up and were applied to people's production and life(Schiller, 2024), making people's life more convenient, which led to the emergence of countless virtual cultural spaces with their own characteristics, applied to various disciplines, and promoted the dissemination of culture as well as cultural reproduction, so scholars believe that the network era has linked a new style of space with the window of information technology, namely virtual cultural space(Psarros et al., 2022). Therefore, scholars believe that the network era has linked a new style of space with information technology as a window, i.e. virtual cultural space(Dong et al., 2022).

In this study, virtual cultural space is defined as a new type of cultural space carrier based on digital media, capable of breaking through the limitations of physical space and realizing real-time interaction and sharing of information. This space not only inherits some of the attributes of physical cultural space, such as cultural expression, art display and social interaction, but also greatly expands its spatial and temporal boundaries through digital technology, realizing the rapid dissemination and extensive sharing of cultural information. In the design and development of Nanjing Paper-Cutting digital interactive game, virtual cultural space plays a pivotal role as an important carrier. It makes Nanjing Paper-Cutting, a cultural element with profound historical background and unique artistic charm, to be disseminated and displayed in a wider range. At the same time, through the form of games, the virtual cultural space has also injected new vitality into the inheritance and development of the culture of Nanjing Paper-Cutting, so that more people can personally feel the charm of this culture.

1.4.2 Digital interactive games

Digital interactive gaming refers to interactive entertainment activities conducted through electronic devices, such as computers, cell phones, and tablets(Aydemir, 2022). It utilizes technologies such as digital technology, computer graphic to virtually construct game worlds and content, presenting an interactive gaming experience. These games can include various types, such as video games, mobile games, online games, etc., and support single or multi-player participation, covering different forms such as real-time battles, role-playing, and strategy.

This study introduces a Nanjing Paper-Cutting digital interactive game, a single-player experience accessible on mobile phones, tablets, and computers. The game combines entertainment with educational and social functions, aiming to preserve and promote the cultural essence of Nanjing Paper-Cutting within a virtual cultural space.

The core concept of the game involves integrating Nanjing Paper-Cutting's cultural elements with digital technology and interactive design to create an engaging and educational product. By utilizing digital technology, the game vividly presents virtual scenes, characters, and paper-cutting motifs, providing an immersive cultural experience. High interactivity allows players to actively participate, influencing the game's process and outcomes through real-time interactions with the virtual environment and characters. This interactive design not only enhances the game's entertainment value but also deepens players' understanding and appreciation of the cultural significance and artistic beauty of Nanjing Paper-Cutting.

The game serves as both a showcase of Nanjing Paper-Cutting culture and a tool for its inheritance and development. Paper-cutting elements are seamlessly integrated into game scenes, characters, and props, conveying the art's cultural spirit and aesthetic appeal in a fun and accessible way. Additionally, the game's interactive and social features encourage active participation, particularly among younger audiences. This fosters broader interest and engagement in preserving and innovating the Nanjing Paper-Cutting tradition, advancing its modernization and relevance in today's world.

Beyond entertainment, the game carries significant cultural and social value. It provides an innovative platform for promoting the heritage of Nanjing Paper-Cutting, merging traditional art with modern technology. By doing so, it creates a contemporary and appealing medium for cultural communication, ensuring the ongoing vitality and appeal of Nanjing Paper-Cutting in the digital age. This approach not only supports the art's preservation and dissemination but also facilitates its evolution and integration into modern culture.

1.4.3 HTML5 Technology

HTML5 technology, as a great leap in Web development standards in the past decade, not only greatly enriches the expressiveness and interactivity of web pages, but also provides a strong technical support for the design and development of digital interactive games. HTML5 technology plays an indispensable role in the development and design of the Nanjing Paper-Cutting digital interactive game in the virtual cultural space.

First of all, the semantic characteristics of HTML5 technology make the webpage structure and content of Nanjing Paper-Cutting digital interactive game clearer and more meaningful. With the support of rich tags and microdata, the game webpage can more accurately describe the game content, characters, scenes and other elements, which not only improves the user experience, but also facilitates the search engine optimization. Secondly, the local storage feature of HTML5 enables the Nanjing Paper-Cutting digital interactive game to run smoothly without Internet connection. By applying the caching and local storage functions, the game can load and save user data quickly, which greatly improves the responsiveness and stability of the game. In addition, the multimedia features of HTML5 enable the Nanjing Paper-Cutting digital interactive game to fully demonstrate the artistic charm of Nanjing Paper-Cutting. By supporting audio, video and other multimedia elements, the game is able to present the delicate textures and dynamic effects of paper-cutting art, bringing players an immersive gaming experience. HTML5's graphic and special effects features also bring rich visual performance to the Nanjing Paper-Cutting digital interactive game. Based on the support of SVG, Canvas, WebGL and other

technologies, the game is able to present realistic paper-cutting patterns and smooth animation effects, which further enhances the attractiveness and playability of the game. The cross-platform nature of HTML5 technology enables the Nanjing Paper-Cutting digital interactive game to run seamlessly on different devices and browsers. This not only broadens the audience of the game, but also makes it more attractive and playable. This not only broadens the scope of the game's audience, but also facilitates the game's promotion and dissemination.

HTML5 technology played a significant role in the design and development of the Nanjing Paper-Cutting digital interactive game. With a series of excellent features and powerful functions, it provides a solid technical cornerstone and unlimited creative space for the game. Through the application of HTML5 technology, Nanjing Paper-Cutting culture can be displayed in an unprecedented form, which not only enriches the content and expression of the game, but also promotes the inheritance and development of this traditional culture. The application of HTML5 technology not only highlights its technological advancement, but also makes the game more attractive. The use of HTML5 technology not only highlights its technological advancement, but also injects new vitality into the dissemination and promotion of the culture of Nanjing Paper-Cutting.

1.4.4 Interaction design

Interaction design plays a crucial role in the design and development of the Nanjing Paper-Cutting digital interactive game in the virtual cultural space. Interaction design aims to realize smooth, natural and meaningful communication between users and the game system through well-conceived interface layout, operation mode and feedback mechanism. Interaction design focuses on the overall layout and arrangement of the game interface. Through reasonable layout design, it ensures that users can intuitively understand the game's status, objectives and operation methods. At the same time, the interface is decorated with Nanjing Paper-Cutting elements to create a strong cultural atmosphere and enhance the attractiveness of the game. The interaction design focuses on the optimization of the game operation. Taking into account the operating habits and skill levels of different users, we designed an easy-to-understand and easy-to-follow operation method so that users can easily control the game process. In addition, innovative interaction methods, such as gesture recognition and voice control, are introduced to enhance the interactivity and fun of the game. Interaction design focuses on the information exchange and feedback between the user and the game system. The interaction design in this study aims to realize smooth communication between users and the Nanjing Paper-Cutting digital interactive game through the well-conceived interface layout, operation mode and feedback mechanism, so as to enhance the playability, fun and immersion of the game, thus promoting the inheritance and development of the Nanjing Paper-Cutting culture. The game will enhance the playability, fun and immersion of the game, thus promoting the inheritance and development of the Nanjing Paper-Cutting culture.

1.5 Scope of Research

1.5.1 Research area

Nanjing Paper-Cutting, as one of the important schools of Chinese Paper-Cutting art, originated and spread in Nanjing and its surrounding areas. It is a unique folk paper-cutting technique that not only inherits traditional paper-cutting forms, but

also cleverly incorporates local characteristics and cultural elements. The creative content of Nanjing Paper-Cutting often reflects the history, culture, and natural landscapes of the Nanjing region, such as the beautiful scenery of the Qinhuai River, the grandeur of the Ming Imperial Palace, and the prosperity of the Confucius Temple. As such, it has become a symbol of Nanjing's cultural identity and a symbolic artistic expression.

The influence of Nanjing Paper-Cutting is not only limited to Nanjing, it has also been widely spread and developed in many cities inside and outside of Jiangsu Province, such as Wuxi, Taizhou, Danyang, Ezhou, Huaibei, and Maanshan. Therefore, the scope of the fieldwork in this study is not limited to Nanjing city, but covers Nanjing and its surrounding areas to explore the inheritance and innovation of this art form in a wider region.

In addition, with the development of the digital era, the dissemination of Nanjing Paper-Cutting has gradually entered the virtual space. Virtual cultural spaces such as online platforms and social media communities for the production and dissemination of Nanjing Paper-Cutting culture have become a new way of spreading the art form. These platforms not only provide a wider audience for Nanjing Paper-Cutting, but also provide a new interactive and exhibition space for its artistic creation and inheritance.

1.5.2 Time

Contemporary China refers to the period of modernization and development from the founding of the People's Republic of China in 1949 to the present, particularly after the reform and opening-up in 1978. Politically, China has undergone significant transformations, transitioning from socialist construction and the Cultural Revolution to a market-oriented economy, reshaping its political and economic systems.

Economically, post-1978 reforms propelled China into rapid industrialization and urbanization. By attracting foreign investment, fostering technological innovation, and boosting both exports and domestic consumption, China has become the world's second-largest economy and a key player in the global market.

Culturally and socially, China has seen profound changes, merging traditional and modern influences amid rapid technological advancements. The rise of digital technology has reshaped lifestyles, while globally, China's influence in economics, politics, and innovation has grown, underscoring its role in an increasingly interconnected world.

1.6 Research Methodology

1.6.1 Population and Sample

1. Young game users
2. Nanjing Paper-Cutting inheritors
3. Software development experts
4. Educational game design experts

1.6.2 Instrumentation

This study adopts a mix of qualitative and quantitative research.

Qualitative research mainly includes research on the target user groups of the game, expert evaluation, and research on the cultural symbols of Nanjing Paper-Cutting elements.

Quantitative research mainly involves surveys and data analysis of game players.

1.6.3 Data Collection

This study research to comprehensively analyze and evaluate the design and application effects of the Nanjing Paper-Cutting digital interactive game.

(1) Qualitative research

The main purpose of the qualitative research is to gain a deeper understanding of the needs and preferences of the game's target user groups, as well as experts' evaluations of Nanjing Paper-Cutting digital interactive game. Specifically, this study collected data in the following two ways:

Target user group: Nanjing Paper-Cutting enthusiasts in the Nanjing Paper-Cutting inheritor community in the virtual cultural space.

Expert evaluation: Invite Nanjing Paper-Cutting inheritors, experts in game design, education and other fields to evaluate the Nanjing Paper-Cutting digital interactive game. The evaluation is conducted through a questionnaire survey to collect experts' evaluation of the game's artistic, educational, interactive and cultural communication effects. Based on their professional knowledge and experience, the experts conducted an in-depth analysis of the game's design, gameplay mechanism, and cultural communication accuracy, providing guidance for the improvement and optimization of the game.

Research on the cultural elements and symbols of Nanjing Paper-Cutting elements: Through a variety of methods, such as interviews, document analysis and on-site observation, the qualitative research will be able to collect in-depth data on the cultural symbols of Nanjing Paper-Cutting. These data will help reveal the cultural value, artistic characteristics, and the inheritance and innovation of Nanjing Paper-Cutting in contemporary society, and provide a basis for further analyzing the cultural connotation of Nanjing Paper-Cutting elements.

(2) Quantitative Research

The purpose of quantitative research is to obtain objective data support about the effects of the game through surveys and data analysis of a large number of game players. This study conducts data collection in the following ways:

After collecting the player survey data, this study will use SPSS and AMOS statistical analysis tools for data processing. First, SPSS is used to analyze the data with descriptive statistics to understand the distribution of variables such as players' basic information, game experience, and satisfaction. Next, structural equation modeling (SEM) was performed using AMOS software to analyze players' behavioral intentions and attitudes toward the game based on the Unified Theory of Acceptance and Use of Technology 2. (UTAUT2). The UTAUT2 model includes key factors such as performance expectations, effort expectations, and social influences, which help to reveal how these factors affect players' game engagement and cultural perceptions.

1.6.4 Data Analysis

The data analysis of this study adopts a combination of qualitative and quantitative analysis to comprehensively interpret the connotation of the Nanjing Paper-Cutting cultural symbols and the user feedback and cultural dissemination effects of the Nanjing Paper-Cutting digital interactive game.

1. Qualitative data analysis

The content analysis method is used to organize and code the paper-cut art works, and extract the core features of Nanjing Paper-Cutting cultural symbols. Through thematic induction, the symbolic meanings of Nanjing Paper-Cutting cultural elements are summarized, and their potential for application in digital expression is analyzed. Combined with the observation records, we explore the expression forms and user acceptance modes of Nanjing Paper-Cutting in cultural communication to provide theoretical support for the design of digital interactive games.

2. Quantitative Data Analysis

Use SPSS to organize and count the data from the players' questionnaires, conduct descriptive statistical analysis, and analyze the basic characteristics of the players (e.g., age, gender, and cultural background), the game experience, satisfaction, and changes in the perception of Nanjing Paper-Cutting culture. Utilize statistical indicators to understand the overall data characteristics.

Structural equation modeling was conducted using AMOS, with the core constructs of the UTAUT2 model as variables, to analyze how these factors affect players' gaming behaviors and attitudes. Path analysis can reveal the performance of the game in terms of educational, entertainment and cultural communication effects, providing data support for further optimizing the game design.

Through the integrated analysis of qualitative and quantitative data, this study will deeply reveal the way Nanjing Paper-Cutting cultural symbols are expressed in the virtual cultural space and their influence. Thematic induction and pattern recognition of qualitative data provide support for the design of cultural symbols in the game content, while the statistical results and model validation of quantitative analysis provide scientific basis for the design optimization and promotion strategy of the game. This hybrid analysis method will provide a comprehensive and deep insight into the development and application of the Nanjing Paper-Cutting Digital interactive game.

1.6.5 Research presentation

1. Nanjing Paper-Cutting digital interactive game
2. Dissertation
3. International journal papers

1.7 Literature Review

1.7.1 Research Status of Nanjing Paper-Cutting

From the Google Scholar website, searching for the keywords “Nanjing paper cut” OR Nanjing Paper-Cutting, there are few related studies, one of which is Nanjing Paper-Cutting art review. “Nanjing Paper-Cutting” art synthesis, based on the current domestic academic works on paper-cutting, this paper summarized the research situation and fruits of Nanjing Paper-Cutting from the perspectives of the researchers. Nanjing Paper-Cutting from the perspectives of status quo, theme and craft, artistic characteristics, cultural connotations and inheritance and innovation (CHU Jiaqian et al., 2021), so as to explore the research situation of Nanjing Paper-Cutting. innovation, so as to explore the research approaches for the diversified development and protection of Nanjing Paper-Cutting (Gu, 2023). There are few articles discussing the development and inheritance of paper-cutting art from the perspective of cultural integration (Pan, 2021), and two articles exploring the digital image restoration and database construction of paper-cutting (Z. Zhu, 2023).

A search for the keyword Nanjing Paper-Cutting on CNKI (China National Knowledge Infrastructure) returned 72 results, including 47 academic journal papers. These papers mainly focus on three aspects of Nanjing Paper-Cutting: the historical and cultural value and artistic expression of Nanjing Paper-Cutting; innovative design of Nanjing Paper-Cutting in the context of "ICH"; and discussions on integrating Nanjing Paper-Cutting into educational teaching.

There is one doctoral dissertation, which primarily proposes optimizing public policies for the protection and inheritance of "ICH" based on survey research. It suggests implementing category-based protection, strengthening intellectual property protection, promoting integration between cultural tourism and education, and enhancing social recognition to foster cultural awareness.

Additionally, seven master's theses focus mostly on cultural and artistic perspectives, or product design, as a means to preserve the ICH of Nanjing Paper-Cutting.

In summary, some scholars have recognized the challenges faced by Nanjing Paper-Cutting in contemporary development. While acknowledging its cultural and artistic value, they have attempted to use technological means, especially digital methods, to protect and inherit Nanjing Paper-Cutting. However, these efforts remain relatively singular and lack empirical research.

1.7.2 Virtual Cultural Space

In traditional philosophy, space is regarded as a container of objective existence, limited and relative, occupying a certain position(Heelan, 2023). After the middle of the 19th century, psychology proved that various forms of space are the result of interaction between human beings and their surroundings, and space is regarded as a static and eternal physical space, which is regarded as an object of objective knowledge; anthropology proved that there is a very different spatial consciousness. In the late 20th century, space attracted the attention of philosophers to the emergence of the space turn, space should be associated with the society, culture and life, etc., people's grasp of space has been created, such as living space, real space, social space, cyberspace and so on. Cyberspace is the earliest virtual space, which describes the state of human consciousness combined with cyberspace(Abu-Taieh et al., 2020).

According to Lefebvre, "space is a social product"(Qi et al., 2021), and space is dynamic, its structure and attributes will be reorganized and reconstructed with the progress of society and the development of human history(Y. Zhang et al., 2022). In the 21st century, the theory of spatial production proposed by Lefebvre has gradually attracted the attention of scholars and has been applied to a number of disciplines. Human beings are able to exert interventions on space, and space can also influence and limit the ways in which human beings operate(Deudney, 2020). People thus consider space as a dynamic activity space with social nature, and no longer consider space as a static and objective physical space. Lefebvre argued that space is a product of dynamic activity of a social nature, and that space can be reconfigured or reorganized in response to the development of the times and changes in culture and lifestyles.

In 1991 Benedikt proposed the concept of "virtual space", a computer-supported, linked and generated multidimensional global network, or "virtual" reality(Champion, 2021). Communication scholar focuses on the impact of technological development on cultural communication and social life, arguing that

technological development has enabled all of humanity to connect in an electronic space(Joosse et al., 2020). Custer believes that cyberspace is fluid and immobile, directly affecting the social process and social order, space is the expression of society, society itself(Lindholm & Wood, 2024), he believes that cyberspace is a new spatial logic generated in the era of the Internet, this new spatial logic is not a replication of the real space, but a new spatial form, is a form of social expression, is the human being into the era of the network of the generation of the brand new cyberspace, and the flow of information and social life in the cyberspace. And the flow of information in cyberspace and the cyberspace social order will have a certain impact on the social order and social interaction in real space. Howard Leingold defines “virtual community” as a balanced public sphere composed of like-minded people created in the network with virtual identity(X. (Leah) Li et al., 2024), which is the spiritual home of netizens. Holly Bust has developed how to build an online learning community with offline and online exchanges(Boyd, 2024). Davis et al. have studied the influence of group dynamics on learners in the virtual learning community formed during the learning process in cyberspace(Abidin et al., 2021). To summarize, it can be seen that foreign scholars either take the virtual learning community constituted by the participants in cyberspace as the research object, or take the cultural attributes of virtual cultural space as the research object, and carry out the research on virtual cultural space from different angles.

The virtual cultural space provides a broad platform for the research of Nanjing Paper-Cutting digital interactive game. By means of digital technology, realistic scenes and interactive experiences of Nanjing Paper-Cutting can be constructed, enabling players to feel the charm of paper-cutting art. At the same time, the virtual cultural space also provides rich data resources and analysis tools, which help researchers to deeply analyze the user behavior, market demand and dissemination effect of the Nanjing Paper-Cutting digital interactive game.

1.7.3 The Use of Digital Technology in the Protection and Inheritance of Paper-cutting

In recent years, with the rapid development of digital technology, the protection and inheritance of Chinese Paper-Cutting has gradually changed to the digital direction. Various local scholars in China have also carried out research on this, for example, the digital protection and promotion of Yangzhou paper-cutting is realized by designing a multi-platform interactive game. The game uses virtual human-computer interaction to replace real paper-cutting with virtual paper-cutting, aiming to innovate communication channels and promote the art of Yangzhou paper-cutting(Xiong, 2017). Junxi Chen summarizes the characteristics and development status of Shanxi paper-cutting, and discusses the necessity and ways of its digital preservation(J. Chen & Lyu, 2015). Similarly, Some local paper-cuttings were also studied for digital preservation and artistic dissemination through HTML5-based multi-platform interactive games(Y. Guo et al., 2020). Digitization technology can not only effectively preserve the original appearance of paper-cutting art, but also enhance the user's cultural experience and interactive feeling through virtual reality, augmented reality and other emerging technological means . This not only enriches the expression of the art of paper-cutting, but also opens up new markets and application areas for digitized products of paper-cutting. Through digital displays and

interactive experiences, Chinese Paper-Cutting inheritors, enthusiasts and researchers are able to convey the essence of paper-cutting to the general public, especially the Chinese youth, in a novel way, realizing the inheritance and development of cultural heritage.

Although a large number of studies have focused on the application of digital technology in cultural heritage preservation and transmission. However, the current research mainly focuses on technical realization and application effects, for example, scholar Lulu Zhao explores how to use digital technology to enhance the viewing experience and interactivity of paper-cutting art (Zhao & Kim, 2024). Research on user acceptance and behavioral intention is still lacking. In particular, empirical studies on the behavioral intention of youth groups towards such digital products are still insufficient. This leads to a lack of systematic and scientific theoretical support in understanding user acceptance of cultural heritage-type digital products. This limits the application and promotion of the products to a certain extent, and hinders the further realization of their potential cultural value.

1.8 Concept, Theory and Conceptual framework

1.8.1 Theoretical foundation

The core theories used in this study include semiotics theory, cultural identity theory, gamification theory, interactivity theory, theory, user experience theory, and unified theory of technology acceptance and use. Together, these theories provide a solid theoretical foundation for the design of the game, helping to increase user engagement and identity while respecting cultural connotations.

1.Semiotics Theory

Semiotic theory is the study of symbols and their meanings, with the foundations laid by Swiss linguist Ferdinand de Saussure and American philosopher Charles Peirce. According to semiotics, culture is a system of symbols that convey cultural information by expressing specific meanings (Tektigul et al., 2023). A symbol consists of two parts, the signifier, which is the form of the symbol (Rasmussen, 2012), and the signified, which is the meaning it represents. In cultural communication, semiotic analysis helps to explore the symbolic meaning of cultural elements and help the audience understand the cultural connotation through symbols. The traditional symbol system and cultural semantics of Nanjing Paper-Cutting are analyzed through semiotic theory.

In digital games or interactive experiences, semiotics theory guides designers to select and use symbols, and integrate cultural values and stories into symbolic elements. For example, *Nanjing Paper-Cutting Show* can utilize the classic patterns of Nanjing Paper-Cutting, such as dragons, phoenixes, flowers and birds, as symbols to convey the characteristics of regional culture and historical accumulation. These patterns are not only decorative visual symbols, but also cultural carriers that express traditional concepts such as good life and good luck. Through semiotic analysis, the game enables users to recognize these symbols in interaction, and then understand the deep cultural connotation of Nanjing Paper-Cutting art.

2.Cultural identity theory

Cultural identity theory originates from sociology and cultural studies, and explores the process of formation of an individual's sense of belonging to a specific culture and identity. Stuart Hall and other cultural studies scholars believe that

cultural identity is the process by which an individual gradually internalizes and identifies with a particular culture through contact with its symbols, values and lifestyle (Kim, 1996). The theory of cultural identity holds that identity cannot be established without people's perception of and empathy for cultural symbols and practices, especially in the era of globalization, where the collision of different cultures reinforces people's need to identify with their own culture.

Researchers in the field of digital products have contributed important results to the literature on digital class formation through ethnographic studies of China's emerging game culture. Cultural researchers focus on the concept of cultural identity to explain the ways in which an individual or group establishes a position in society, interacts with others, and perceives the world. Cultural identity is defined as an individual's sense of belonging to and identification with a particular cultural unit (Grimson, 2010). It covers not only identification with cultural traditions, values and behavioral patterns, but also the feeling of being part of a cultural group and social identity. In the digital preservation of cultural heritage, especially in the field of education, cultural identity is an important factor in determining user acceptance and willingness to use digital tools and resources. In analyzing the role of digital technology in the preservation and dissemination of the art of paper-cutting, digital technology has been able to break through geographic constraints, enabling this traditional art form to be accepted and understood by a wider audience, and providing our country with the means to express and deepen its cultural identity and recognition.

In digital game design, the theory of cultural identity helps to understand how to stimulate the emotional resonance of users through cultural elements, so that they can form a sense of cultural identity in their experience. *Nanjing Paper-Cutting Show* can make users come into contact with and understand this cultural art in the game through the local patterns, colors and story background of Nanjing Paper-Cutting, and gradually build up their identity and interest in Nanjing Paper-Cutting. In addition, the context and interaction in the game can enhance the users' sense of participation and make them feel a sense of cultural belonging and pride in their interaction with the art of paper-cutting. Cultural identity theory here emphasizes the importance of not only displaying cultural elements, but also designing contexts and experiences that allow users to emotionally identify with them and form positive attitudes and psychological belonging to traditional culture. However, the current literature on user acceptance of digital games based on cultural heritage lacks a detailed exploration of how cultural identity affects acceptance mechanisms. Incorporating cultural identity into the UTAUT2 model to study paper-cutting digital games can provide valuable theoretical insights for research in this area.

3. Gamification Theory

It mainly refers to the application of game design elements and mechanisms to non-game scenarios to enhance user engagement (Lampropoulos et al., 2019), motivation and behavioral performance. These design elements usually include points, rewards, competition, levels, achievements, etc. The aim is to enhance user experience and behavior change through the fun and interactivity of the game. The core idea of gamification theory is to stimulate users' interest and motivation to achieve goals and improve efficiency by incorporating gamification elements into education, work, and health.

In the field of digital games and cultural heritage, gamification theory provides important guidance for user experience design. Gamification mechanisms not only allow users to gain a sense of achievement through participation, but also help them gradually gain a deeper understanding of the content through gradually escalating challenges (Tan & Lim, 2017). For example, *Nanjing Paper-Cutting Show* can make use of the gamification incentive system to allow players to receive point rewards or virtual medals when completing paper-cutting tasks, which pushes players to continuously challenge higher difficulty paper-cutting tasks, and can motivate players to deepen their interest in and understanding of Nanjing Paper-Cutting culture in the course of gradual exploration.

4. Interactivity Theory

Interactivity Theory is a discipline that studies the interaction between users and the media, emphasizing the user's initiative and participation in the media experience. Interactivity Theory believes that the user's behavior and choices play a crucial role in the experience process (Mollen & Wilson, 2010), and that the design and content of the media will change as a result of the user's participation. Interaction is not limited to simple clicks or swipes on the operating interface, but also includes the user's emotional, cognitive, and decision-making involvement, forming a dynamic user experience.

In digital games or interactive experiences, interactivity theory provides a framework for designers to create systems that respond to user behavior and input. Through interactivity, users are not only able to influence the course and outcome of the game, but also establish connections with cultural elements in the process. For example, the interactive design in *Nanjing Paper-Cutting Show* allows players to explore and unlock the cultural story behind the game by selecting different Nanjing Paper-Cutting symbols or patterns. Each user choice may trigger a different display of cultural symbols or story content, thus enabling the player to gain a deeper understanding of the multi-dimensional cultural context of Nanjing Paper-Cutting art. Through the interactive design, the game not only provides users with an entertainment experience, but also realizes the purpose of cultural dissemination and education, and enhances users' understanding and recognition of Nanjing Paper-Cutting art.

5. User Experience Theory

User Experience theory is a discipline that studies the overall experience and emotional response perceived by users in the process of using products or services (Lee et al., 2018). Its core idea originates from psychology, design and human-computer interaction disciplines, emphasizing that the design of products, interfaces and systems should focus on the feelings and needs of users in order to enhance their overall satisfaction and efficiency of use. User experience theory holds that users are not only completing tasks when interacting with technology, but also experiencing a series of emotional and cognitive responses, and that the user's experience is multidimensional, including emotional, cognitive, behavioral, and social factors.

In digital games or interactive experiences, user experience theory guides designers to optimize interface design, interaction flow, functional layout and other elements from the user's perspective to ensure that the product meets the user's needs and provides a pleasurable experience. For example, the game *Nanjing Paper-Cutting*

Show can enhance the user experience through simple and intuitive interface design, easy-to-operate interactive methods, and interesting game mechanisms. At the same time, combined with the unique cultural background of Nanjing Paper-Cutting art, the game design can let users better experience and understand the cultural heritage of this traditional art form through interactivity and immersion. Through the analysis of user experience theory, the designer is able to create an interactive experience with depth and meaning in the game, so that the user not only feels the beauty of the art visually, but also obtains satisfaction on the emotional and cognitive levels.

6.Unified Theory of Acceptance and Use of Technology

The unified theory of acceptance and use of technology (UTAUT) is a theory used to explain users' behavior in accepting and using new technologies(Williams et al., 2015). Originally proposed by Venkatesh et al. in 2003, the theory was developed by integrating several technology acceptance models (e.g., TAM, TPB, IDT, etc.) and has been widely used to study the acceptance and use of information technology and digital tools in different scenarios.

With the rapid development of information technology, users' acceptance of technology has gradually become the focus of researchers' attention. Fred Davis proposed the Technology Acceptance Model (TAM) in 1989, and the core variables include perceived usefulness and perceived ease of use, which directly affect users' behavioral intention and actual behavior. In 2003, Venkatesh et al. proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) model, which integrates multiple models, including core constructs such as performance expectations, effort expectations, social influence and facilitating conditions, and moderating variables such as gender and age. The UTAUT2 model further expands on UTAUT by specifically targeting the acceptance and use of information technology in the consumer context(Macedo, 2017), adding hedonic motivation, price-value, and habituation variables. By introducing new variables, the ability of the UTAUT2 model to explain differences in consumer behavioral intentions is significantly improved.

The UTAUT2 model expands the original framework to better understand user acceptance and technology usage behavior. It has been widely applied in culture and education, analyzing adoption of tools like Google Classroom and mobile learning resources. Factors such as performance expectancy, facilitating conditions, habit, personal innovativeness, security, and trust significantly influence user intentions and behavior.

However, research on audience acceptance of digital game platforms, particularly in cultural heritage contexts, remains limited. Understanding user intentions is key to determining whether digital games can effectively support cultural preservation, education, and inheritance. While UTAUT2 has been used in studies of digital entertainment, its application to cultural heritage products, such as paper-cutting digital games, is minimal.

To promote the preservation and development of paper-cutting, deeper research on digital preservation technologies and user behavior using UTAUT2 is needed. This approach can identify key factors influencing user acceptance, supporting digital cultural heritage preservation and revitalization. Gamification elements, particularly effective in engaging youth, further enhance the appeal of cultural digital products.

1.8.2 Research Framework Diagram

The research framework is shown in Fig.1.

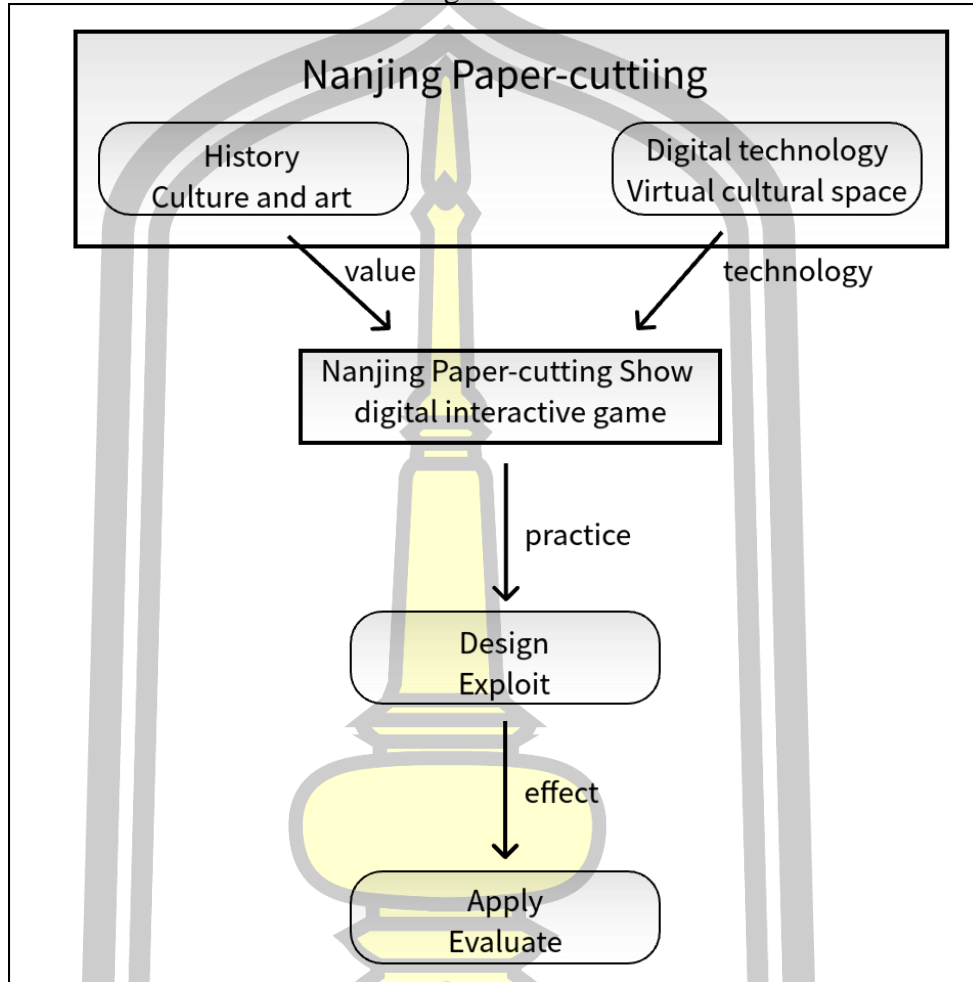


Figure 1 Research framework Source: Author. Feb. 20th, 2024

The diagram above illustrates the framework of this study, which aims to explore the historical, cultural, and artistic value of Nanjing Paper-Cutting and use digital technology to create a virtual cultural space. The core of the framework is to develop a digital interactive game that showcases the artistic charm of Nanjing Paper-Cutting. Through game design and development, the goal is to ensure the inheritance of its cultural value. After the game is completed, an application effect evaluation will be conducted to promote and preserve this valuable ICH, breathing new life into it in modern society.

Chapter II

The Historical, Cultural, and Artistic Value of Nanjing Paper-Cutting

2.1 Introduction

2.1.1 Research Background

Within the grand narrative of Chinese traditional culture, Nanjing Paper-Cutting, as a long-standing folk art, carries centuries of historical accumulation and cultural memory. As an art form that uses paper as a medium and scissors to create intricate cut-out designs, Nanjing Paper-Cutting holds an important position within China's ICH and worldwide. Its unique artistic style and profound cultural significance make it a prominent example of Chinese folk art. However, the fragility and impermanence of paper-cutting art, combined with the neglect of folk art in official historical records, pose significant challenges to understanding its developmental history. Fortunately, through traces left in prehistoric art, literature, and archaeological findings, we can glimpse the origins and development of Nanjing Paper-Cutting and its intrinsic connection to other ancient Chinese art forms, such as rock paintings, pottery, and bronze artifacts. These discoveries provide valuable perspectives and foundations for our study.

2.1.2 Research Purpose and Significance

The purpose of this research is to explore the historical origins, artistic characteristics, cultural value, and modern-day applications and impact of Nanjing Paper-Cutting, aiming to provide a comprehensive understanding of the current state and future of this ICH. By examining the development history of Nanjing Paper-Cutting, we can reveal the formation process of its artistic style and the interaction with other local crafts in Nanjing. These rich cultural connotations can serve as inspiration for game design, ensuring that the game respects and preserves traditional culture while showcasing the unique charm of Nanjing Paper-Cutting. This study provides a solid knowledge base and creative foundation for developing a digital interactive paper-cutting game, which not only helps create a high-quality cultural game but also achieves goals such as cultural education within an entertainment context.

The core objectives of this chapter are as follows:

- 1) Origins and Evolution:** Exploring the historical roots, development process, and modern transformation of Chinese Paper-Cutting, with a focus on Nanjing Paper-Cutting's unique background.
- 2) Artistic Characteristics:** Investigating the artistic forms, styles, themes, and production techniques that define Nanjing Paper-Cutting.
- 3) Cultural Significance:** Revealing the deeper cultural meanings and heritage value embodied in Nanjing Paper-Cutting.
- 4) Modern Applications:** Examining the contemporary use of Nanjing Paper-Cutting, particularly its integration and advancement within virtual cultural spaces.

2.1.3 Chapter Structure

This section will outline the structure of the chapter, guiding the reader through the following key areas: the historical background of Nanjing Paper-Cutting, its artistic characteristics, its cultural value, and its modern applications in both physical and virtual environments. Through this exploration, we aim to provide a thorough understanding of the significance of Nanjing Paper-Cutting as a cultural heritage and its potential for future development in the digital age, as shown in the figure2.

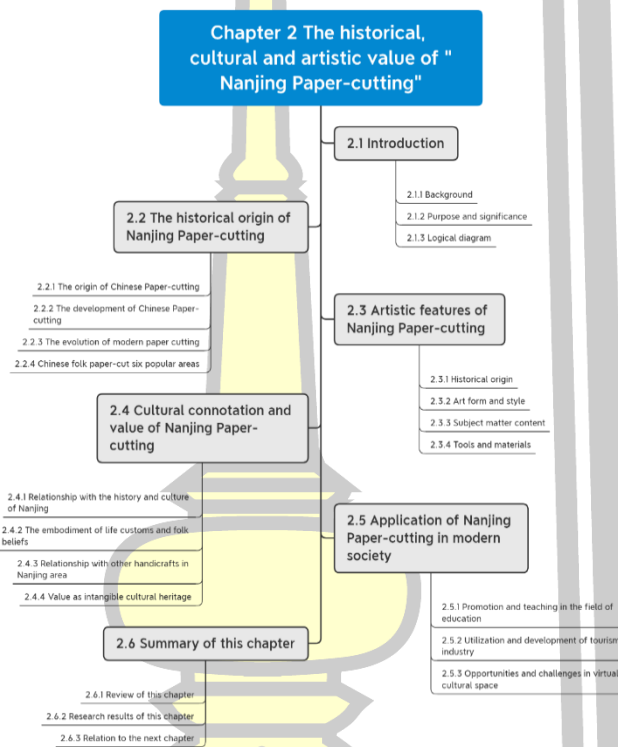


Figure 2 Chapter 2 Logical Structure Diagram

Source: Author. July 17th, 2024

2.2 The Historical Origins of Nanjing Paper-Cutting

2.2.1 The Origin of Chinese Paper-Cutting

The question of "When did Chinese Paper-Cutting originate?" is a difficult one to answer. Many moving stories about the origins of paper-cutting have been passed down through history, with the earliest record tracing back to a story about King Cheng of the Zhou Dynasty and his younger brother (Hang, & Guo, 2006), Shu Yu. It is said that while playing together, King Zhou Cheng casually cut a piece of paulownia leaf into the shape of a jade artifact known as a "Gui" and jokingly told Shu Yu, "I hereby grant you a fief as a prince." Later, it turned out that King Cheng did indeed grant Shu Yu the territory of the Tang Kingdom (modern-day Yicheng, Shanxi), making him a prince. This story not only shows the early form of paper-cutting skills but also reflects the ancient wisdom of utilizing natural materials in creative ways.

Additionally, a folk song from Shaanxi further supports the idea that thin materials like paulownia leaves could be used to make artistic creations: "The Han consort plays with her child by the window, skillfully cutting a paulownia leaf to mirror the window frame." This lyric serves as vivid evidence of the possibility of using thin materials like leaves for cutting, supporting the idea of the origins of paper-cutting art.

During the Jin Dynasty, Li Shaoweng, a sorcerer from Qi, created a paper likeness of Li Furen, Emperor Wu of Han's beloved concubine, to comfort the grieving emperor. This story highlights paper-cutting's role in emotional expression and is considered an origin of shadow puppetry and Jiaodong's paper-cutting art.

Mr. Bao Jiahua, in his article *On the Origins of Paper-Cutting*, argues that the true study of paper-cutting origins should begin with the invention of scissors and paper. It is only when scissors and paper are combined that paper-cutting as an art form emerges. Understanding when scissors and paper were invented, and when they were combined, reveals the history and origins of Chinese Paper-Cutting. Scissors were invented in the Spring and Autumn Period and the Warring States Period, whereas paper was invented during the Han Dynasty. This view has been supported by archaeological findings. Art historian Wang Bomin, in *A History of Chinese Folk Paper-Cutting*, dates the origin of paper-cutting to the Eastern Han Dynasty, nearly two thousand years ago (Needham & Tsuen-Hsuin, 1985).

As early as prehistoric times, humans discovered and began using images as symbolic representations, leading to the creation of hollow-carved art on various materials. Stone tools, one of the earliest human inventions, were used after the discovery of fire, marking the beginning of human civilization. Although early stone tools were crude, they symbolize the emergence of human culture. The rough surfaces of these tools leave traces of the early stages of human aesthetic consciousness. Over time, with the gradual use of tools, humans entered a new cultural development period in the Neolithic Era.

Humans gained rich experience through the use of stone tools, beads, and shells, inventing techniques such as perforating stone tools (Colwell, 2023). This invention, which involved creating holes in flat materials, was a remarkable leap forward, allowing for dimensional transformation. In terms of craftsmanship, the ability to perforate stone tools connected individual pieces into an overall structure. This practical work prompted humans to create three-dimensional images from two-dimensional materials, marking the first step towards carving and influencing the development of other crafts. In the Neolithic period, significant cultural advancements were made, such as the "*Double Bird Facing the Sun*" motif found on an ivory carving unearthed at the Hemudu site. The bird's eyes and sun motifs were created using conical drill holes, with six small circular holes on either side, demonstrating symmetry, as shown in the picture:



Figure 3 Double Bird Facing the Sun

Source: <http://www.ncha.gov.cn/> [Accessed on July 17th, 2024]

Rock art is an ancient form of self-expression by humans during religious and productive activities (Hoppál, 2013). It uniquely reflects the "childhood" of humanity through its distinctive style. Although rock art may seem unrelated to folk paper-cutting, it represents a native art form of Chinese culture, sharing a corresponding aesthetic sense with folk paper-cutting.

Chinese rock art features two main stylistic characteristics: figurative art and symbolic art (Taçon et al., 2010). Figurative art, also known as realistic art, is the reproduction of natural images, while symbolic art involves mental imagery or abstract representations created in the human mind. In Chinese rock art, these two styles are combined—figurative elements are used as the foundation to shape symbolic imagery. This organic fusion of the two styles results in unique, flat representations that distinguish Chinese rock art.

There are three main characteristics of rock art that later became prominent in folk paper-cutting:

Early rock artists had no understanding of perspective and thought in two-dimensional terms, much like children. Therefore, rock art is always flat, with no sense of depth. When depicting large or complex scenes, the artist arranges characters or landscapes in layers of two-dimensional space, without overlapping or any notion of foreground and background. To create flat images easily, rock artists would capture the essence of objects and simplify them. The technique of carving and painting was often used to highlight the key features of the objects, sometimes exaggerating them. When combining different elements, the artists did not follow proportional relationships but instead emphasized significant symbols by enlarging them arbitrarily.

Symbolism, which arises from the interconnected thinking of primitive people, is the foundation of primitive art and shamanistic beliefs. In the Neolithic period, rock art became a form of symbolic expression, conveying meaning through both imagery and abstract symbols. Some symbols in rock art were directly linked to ritualistic or mystical beliefs (Polley et al., 2015), such as the abstract motifs representing religious practices or totemic symbols.

An example is the *Goat Image* from the Keshiketeng Rock Art Group, which, with its distinct symbols and motifs, forms part of the larger tradition of Chinese rock art. Dating back to the Neolithic period, these rock carvings span over 6,000 years,

from the Bronze Age to the Northern and Southern Dynasties. The subjects depicted include totem worship, shamanism, fertility cults, rituals, dance, hunting, and pastoral activities. The imagery in these works is invaluable for understanding the cultural, religious, and social practices of ancient northern Chinese communities.



Figure 4 Keshketen Baicha River rock painting goat map
Source: <http://5b0988e595225.cdn.sohucs.com/> [Accessed on July 17th, 2024]

Pottery, as a form of decorative art, was used by early humans during religious and productive activities (Saraswati, 1978). It reflects their ability to harness the power of fire. The painted designs on pottery provide a direct connection to the painting practices of ancient times. The carvings and patterns on pottery, with their focus on hollowed-out designs, represent the beginnings of later paper-cutting art.

For example, black pottery excavated from the Hemudu cultural site in Yuyao, Zhejiang, features an image of a pig, which is carved with simple floral and leaf patterns. Notably, these patterns resemble those found in modern paper-cutting art. The jagged and crescent-shaped patterns are among the most commonly used decorative motifs in Chinese folk paper-cutting. While it cannot be definitively stated that the jagged patterns in paper-cutting directly inherit from those on painted pottery, it is clear that the artistic tradition of the culture carries a sense of ethnic identity and continuity.



Figure 5A pig bowl unearthed at Hemudu cultural site
Source: <https://m.thepaper.cn/> [Accessed on July 17th, 2024]

Early humans demonstrated an awareness of patterns and hollowed spaces in painted pottery, as seen in a Neolithic Dawenkou pottery piece from Shandong. This piece features swirling lines and hollowed-out circular designs reminiscent of paper-cutting, suggesting that "hollowed-out imagery" originated in the Neolithic era.

Bronze ware from the Shang and Zhou dynasties reflects the creative brilliance of ancient Chinese laborers, blending realism and abstraction (Hollihan-Elliott, 2014). Iconic examples include animal-shaped vessels like the Shang dynasty's elephant-shaped "xiang zun" and the Zhou dynasty's ram-shaped "dyang zun". These designs, rich in symbolism, influenced paper-cutting art.

Bronze patterns, such as the "taotie", "kui dragon", and "kui phoenix", combined figurative, abstract, and symbolic elements that became foundational for paper-cutting motifs. Hollow carving techniques, seen in artifacts across various regions, also impacted paper-cutting.

The Shang dynasty's "Sun God Bird" gold ornament, unearthed in Chengdu, is a remarkable example of intricate openwork design. Featuring jagged rays and interconnected flying birds in a circular composition, it conveys rhythmic motion and strong symbolic meaning. As one of the earliest known examples of the golden flower motif, this piece can be seen as an early precursor to paper-cutting art. Its delicate craftsmanship and openwork patterns highlight the origins of this unique artistic tradition.



Figure 6 The "Sun God Bird" gold ornament

Source: <https://zh.wikipedia.org/> [Accessed on July 17th, 2024]

Openwork carving involves creating intricate hollow patterns and shares similarities with later folk paper-cutting art (Xiaoqi et al., 2018). An example of this evolution is the late Shang dynasty jade carving "Jade Phoenix", featuring open spaces beneath the chest, back, and tail. It includes a round button at the waist for wearing and finely carved feather-like wing patterns with graceful, fluid lines.

This delicate craftsmanship highlights the use of negative space and intricate designs that closely resemble traditional paper-cutting. The openwork technique demonstrates the early development of patterns that influenced the evolution of paper-cutting, showing a continuity of artistic practices across mediums and eras.



Figure 7 Jade carving jade phoenix in Shang Dynasty

Source: <https://www.sohu.com/> [Accessed on July 17th, 2024]

Chinese Paper-Cutting art has been deeply influenced by various ancient art forms, gradually developing its own unique style. Stone tools and stone carvings provided paper-cutting with simple shapes and a foundation of two-dimensional composition, while also strengthening its symbolic expression. Pottery offered decorative patterns and openwork techniques, such as zigzag patterns and crescent shapes, making paper-cutting more ornamental. Bronze vessels enhanced the exaggerated expressiveness and symbolic meaning of paper-cutting, enriching the cultural connotations of the designs. Jade carvings introduced exquisite openwork effects and delicate line aesthetics, making paper-cutting art more refined and elegant, as shown in the table below:

Table 2 Ancient Art Forms' Influence on Chinese Paper-Cutting

Art Form	Influence	Specific Characteristics of Influence
Stone Tools	Simplification of Shapes	Stone tool carvings inspired paper-cutting's clear and simple forms
Stone Carvings	Flatness and Symbolism	Stone carvings influenced paper-cutting's flat style and symbolic elements
Pottery	Patterns and Piercing Techniques	Pottery patterns and hollow designs inspired paper-cutting motifs and technique
Bronze Ware	Exaggerated Forms and Symbolic Meaning	Bronze ware's shapes and symbols enhanced paper-cutting's expression and symbolism
Jade Carvings	Fine Lines and Ornamental Aesthetics	Jade carving's intricate lines and hollowing techniques shaped paper-cutting's detail and elegance.

Source: Author. July 18th, 2024

These ancient art forms, with their influence on shape, decoration, symbolism, and technique, have allowed paper-cutting to evolve into a folk art that both inherits tradition and possesses a unique aesthetic.

2.2.2 Development of Chinese Paper-Cutting

During the Wei, Jin, and Northern and Southern Dynasties, ethnic migrations fostered cultural exchange, advancing craftsmanship and literary arts. The development of plant-based fiber paper from the late Eastern Han to Eastern Jin reduced costs and improved quality, making paper accessible to ordinary people. This shift replaced thin materials like silk for folk carving and spirit-summoning paper flags.

The earliest examples of paper-cutting in China, in the true sense, have been found from the Northern Dynasties period. Five pieces of Northern Dynasty paper-cutting were unearthed in Turpan, Xinjiang. Due to the arid sandy conditions and the low water table in the region, these paper-cuttings, dating back nearly 1500 years, have been remarkably well preserved, as shown in the image below:



Figure 8 Paper-Cut Fragment of a Horse from Astana Tomb, Turpan (541 AD, Northern Dynasty)

Source: <https://www.sohu.com/> [Accessed on Feb. 18th, 2024]

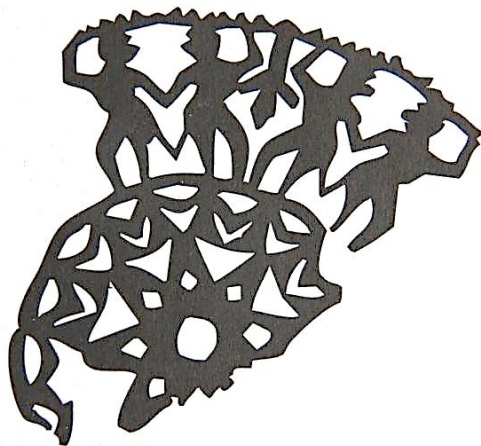


Figure 9 Paper-Cut Fragment of a Monkey from Astana Tomb, Turpan (551 AD, Northern Dynasty)

Source: <https://www.sohu.com/> [Accessed on Feb. 18th, 2024]

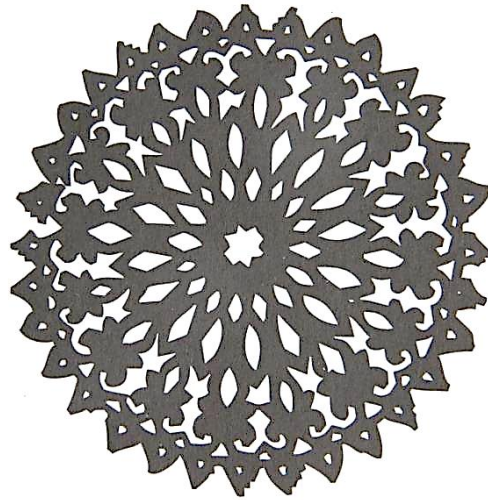


Figure 10 Paper-Cut Honeysuckle Flowers from Astana Tomb, Turpan (567 AD, Northern Dynasty)
Source: <https://www.sohu.com/> [Accessed on Feb. 18th, 2024]

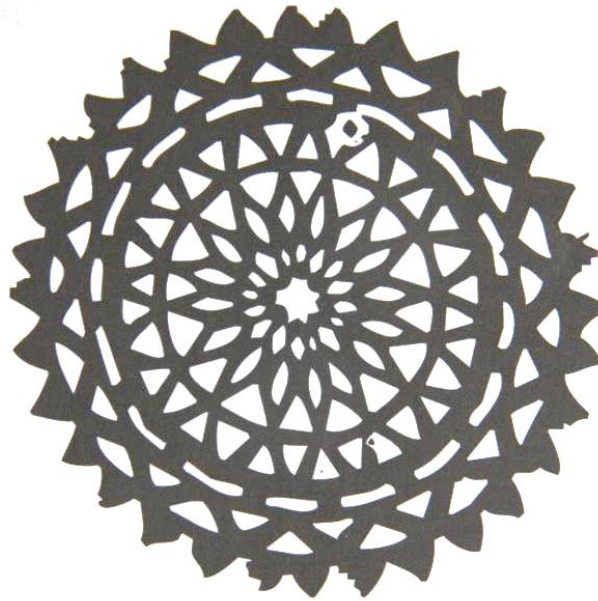


Figure 11 Paper-Cut Chrysanthemums from Astana Tomb, Turpan (567 AD, Northern Dynasty)
Source: <https://www.sohu.com/> [Accessed on Feb. 18th, 2024]

พหุ ประถมศึกษา

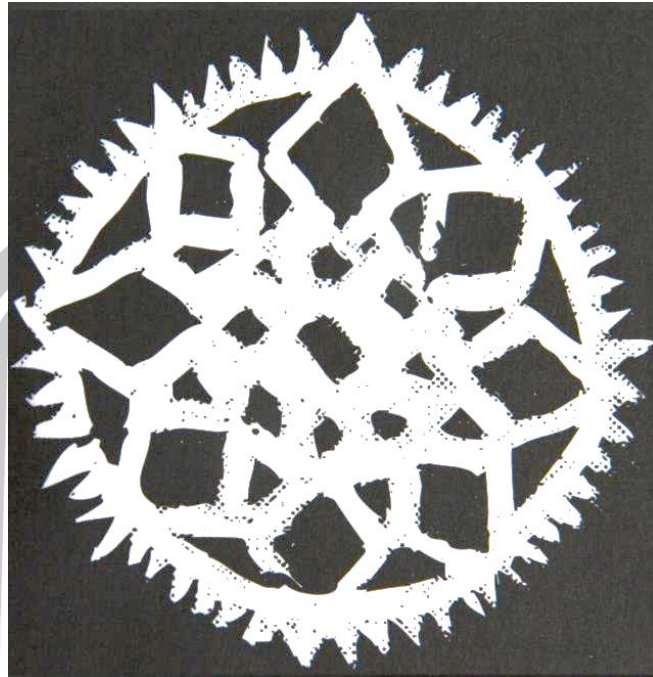


Figure 12 Paper-Cut Flowers from Astana Tomb, Turpan (Northern Dynasty)
Source: <https://www.sohu.com/> [Accessed on Feb. 18th, 2024]

Only five paper-cut pieces have been unearthed from the Astana Tomb, with little information on their specific use. These cuts reflect traditional customs of the Central Plains Han ethnicity and were likely used in funerary rituals, showing the connection between folk paper-cutting and local customs. This suggests that paper-cutting had spread from the Central Plains to remote areas, marking a milestone in its history.

The term “sheng” refers to paper or fabric cuts in various shapes. "Fangsheng" are geometric shapes, "huasheng" are flowers and plants, "rensheng" are human figures, and "caisheng" includes colorful banners or small decorative shapes.

During the Sui Dynasty, the unification of the North and South led to economic and cultural development, setting the stage for the Tang Dynasty's prosperity. Folk customs like cutting window decorations for the New Year became widespread, and paper-cutting art flourished (Benn, 2004). Emperor Yang of the Sui even ordered palace maids to create colorful fabric cuttings for decoration, highlighting the popularity of paper-cutting during this period.

During the Tang Dynasty, paper-cutting became a popular folk art due to economic prosperity and social stability. During festivals like "Renri" and "Lichun," people decorated with paper-cut shapes. People cut colorful flowers for Lichun celebrations. Four years later, the emperor ordered attendants to greet spring with colorful flowers, giving one to each person.

In **Xiyang Zazu**, Duan Chengshi recorded that during Lichun, officials' families cut small flags, which were displayed on beauties, flowers, and transformed into spring motifs like butterflies and coins (Wang & Yang, 2022). The practice, originally from the upper class, spread to the lower class and even to the emperor's concubines. For example, Xue Yaoying, a concubine of the Tang Prime Minister Yuan Zai, had over a thousand "twin flowers" made from dyed paper for the Qixi

Festival, which fluttered in the courtyard. By the Tang Dynasty, cashing expanded beyond silk and gilded paper to other materials. Historical records mention over a thousand craftsmen in Chang'an, including Shi Zihua, a skilled engraver. During the Kaiyuan and Tianbao periods, paper-cut crafts were sold in Luoyang and even exported abroad, spreading to Japan through Buddhist monks. The Tang Dynasty paper cuts housed in the British Museum showcase the high craftsmanship of the time, with works like the "Bodhisattva Standing Image" demonstrating the fusion of paper-cutting and painting. These examples highlight the widespread use and development of paper-cutting during the Tang Dynasty.

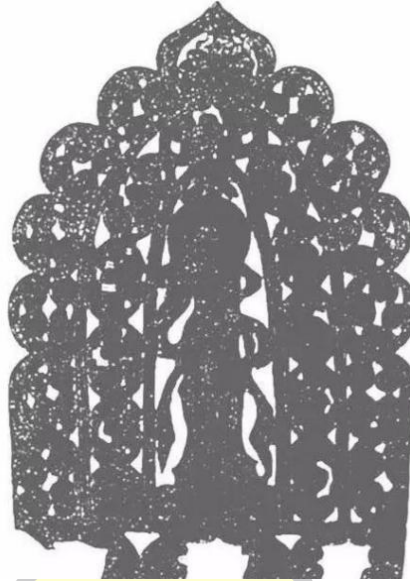


Figure 13 Tang Dynasty paper-cut "Bodhisattva Standing Statue"

Source: <http://www.ncha.gov.cn/> [Accessed on Feb. 18th, 2024]

The Song Dynasty saw a flourishing of folk art, with paper-cutting becoming immensely popular due to social stability, economic recovery, and the widespread availability of paper. Paper, once a luxury of the court, became commonly used for folk customs like printing money, making fans, decorating windows, and creating lanterns. This facilitated the production and spread of paper-cutting.

Folk paper-cutting became an essential part of festivals, life rituals, home decoration, and superstitions. The Song Dynasty placed greater importance on New Year, "Renri" (the seventh day of the first month), and "Lichun" (the beginning of spring). The custom of gifting "spring banners" (chunban) gained popularity. On Lichun, high-ranking officials were given silk banners, while prime ministers and princes received gold and silver ones. Scholars and gentry also cut colorful paper into small spring banners, which were hung on people, flowers, or shaped into spring motifs like butterflies and coins for amusement.

During the Song Dynasty, gold, silver, and colorful paper were used in early forms of paper-cutting, primarily for the upper classes (Hang, & Guo, 2006). Folk paper-cutting during the Song Dynasty shifted from using gold leaf and silk to using paper (Chandhasa, 2022). The use of silk for paper-cutting was replaced by paper materials, and metal-cutting techniques evolved into independent arts involving gold, silver, and copper. Folk artisans began to use inexpensive paper for cutting colorful

decorations, lantern flowers, shadow puppets, and window flowers for everyday life and festive celebrations.

The Song Dynasty emperors placed great emphasis on production, leading to economic growth, especially in handicrafts and the commodity economy. Frequent trade between towns and villages encouraged many skilled folk artists to enter specialized fields. During this time, professional folk artists specializing in paper-cutting began to emerge. One unique technique combining folk paper-cutting with ceramic decoration was "paper-cut flower paste". An example of this technique is a Southern Song Dynasty tea cup decorated with paper-cut flowers, representing an important cultural heritage.



Figure 14 Southern Song Dynasty paper-cut stickers tea
Source: <https://www.zhihu.com/> [Accessed on Feb. 18th, 2024]

2.2.3 Evolution of Paper-Cutting in Modern and Contemporary Times

In the early 20th century, the *May Fourth* New Culture Movement, spearheaded by progressive intellectuals such as Cai Yuanpei, Lu Xun, Liu Bannong, and Zhou Zuoren, helped lay the foundation for Chinese folklore studies. They collected a wealth of folk literature and also made efforts to gather folk art, including paper-cutting (Gao, 2019).

In the 1930s, artist Chen Zhinong began researching and creating folk paper-cuts in Beijing. Using sketches and silhouettes, he depicted numerous folk customs and scenes from old Beijing, including street vendors, workshop artisans, food stalls, tea carriers, market fairs, and idle townspeople.

In the 1940s, paper-cuts began reflecting real-life subjects. Mao Zedong's 1942 speech at the Yan'an Forum on Literature and Art called for art to serve workers, peasants, and soldiers. Following this, artists from the Lu Xun Academy of Art at Yan'an University, including Chen Shuliang, Zhang Ding, Li Qun, Gu Yuan, and Xia Feng, studied local folk paper-cutting traditions. They created numerous new paper-cuts depicting the lives and struggles of people in the Yan'an revolutionary base, using the art to express admiration for wartime heroes and love for the nation.

In 1944, a groundbreaking exhibition of new folk paper-cuts from the northwest was held in the Shaanxi-Gansu-Ningxia Border Region, marking a new stage in Chinese Paper-Cutting art. The exhibition showcased both traditional techniques and paper-cuts based on real-life themes, signaling the beginning of a new era for the art. The works displayed a unique style, combining the boldness of northern cuts with the delicacy of southern ones. These paper-cuts reflected social life and emotions, embodying strong local features and the spirit of the time. The exhibition is considered to have opened a new era for Chinese Paper-Cutting, greatly influencing its later development.

After the founding of New China, under the *Hundred Flowers Bloom, let a Hundred Schools of Thought Contend* policy in literature and art, artists created a large number of new paper-cuts reflecting the new socialist era and modern developments (Lv & Huang, 2020). These new paper-cuts expanded the creative path of the art form, enriching the forms and content of Chinese folk decorative art. Besides depicting new occupations and industries, themes such as children, sports, acrobatics, and dance became common subjects for paper-cutting. Since its inception, paper-cutting has never ceased in Chinese history. It has been deeply embedded in various folk activities, making it one of the most culturally rich art forms in Chinese folk history.



Figure 15 Modern paper-cut works "anti-Japanese Little Hero - Rain"
Source: <http://www.jszw.com.cn/> [Accessed on Feb. 18th, 2024]

Paper-cutting, a precious part of Chinese culture, has not only been preserved and developed domestically but has also become an important aspect of international cultural exchange. Since the early 21st century, it has gained recognition worldwide through cultural exchanges with Europe, America, and other regions. It continues to play decorative and symbolic roles in festivals like Christmas and Halloween, showcasing its global influence.

As time progresses, paper-cutting art has found widespread use in aesthetics, particularly in packaging, graphic, and fashion design, bridging traditional art and modern life. In public spaces like subway stations and airports, paper-cutting is presented in new forms, highlighting the charm of both urban and rural cultures. As demonstrated in the image below, this fusion of traditional and modern elements highlights the evolving role of paper-cutting art in the contemporary world.



Figure 16 "Frugality is a Blessing" Paper-Cut at Nanjing Lukou Airport
Source: Photographed by the author. Mar. 20th, 2024

In 2009, Chinese Paper-Cutting was inscribed on the UNESCO Representative List of the ICH of Humanity, marking its significant place in global cultural diversity (Wu, 2015). To inherit and protect this art form, various levels of government have implemented a series of measures. These efforts include the establishment of archival records and scientific research on paper-cutting, providing a documentary basis for its preservation. At the same time, widespread educational and promotional activities have been conducted to bring paper-cutting art into schools, communities, military camps, and enterprises, promoting cultural benefits and public training, ensuring its inheritance and development within the care and attention of the public. Through these efforts, paper-cutting art has not only been preserved in its traditional forms but has also been revitalized in modern society.

Chinese Paper-Cutting artists have expanded beyond traditional paper, exploring materials like metal foil, plastic, and fabric to create works with varied textures and visual effects. Modern technologies, such as computer-aided design and laser cutting, have made intricate patterns more accessible.

With these developments, Chinese Paper-Cutting has transformed from tradition to modernity, offering more diverse artistic expressions. It now plays a

crucial role in the social and cultural sphere, bridging ancient and modern, and blending local and global cultures.

2.2.4 Six Major Regional Styles of Chinese Folk Paper-Cutting

China's vast geography and diverse cultures have led to distinct regional styles in folk paper-cutting, shaped by survival conditions, ethnicity, customs, and historical changes. As Guo Moruo noted, northern paper-cuts are pure and deep, while southern ones are delicate and exquisite. Folk paper-cutting reflects long-standing social practices and local traditions.

Chinese folk paper-cutting is influenced by the saying "South is delicate, North is bold," with geography and architecture playing a key role in its creation. It displays regional diversity and unity, shaped by Confucian values and beliefs, while maintaining a strong tradition of inheritance. There are six major regional styles of Chinese folk paper-cutting.

Northeast China Paper-Cutting.

Northeast China, including Heilongjiang, Jilin, Liaoning, and parts of Inner Mongolia, is home to diverse ethnic groups, such as the Manchu, Mongol, Korean, and others. The region's vast landscapes, including plains, mountains, and rivers, have shaped its culture, blending nomadic, hunting, and agricultural traditions. This area is known for its rich Manchu cultural heritage, especially since the Qing dynasty.

Folk paper-cutting in Northeast China is bold and simple, reflecting the open-hearted nature of the people. These works often include regional and ethnic motifs, such as ancestral spirits, deities, and nature. Manchu Shaman paper-cutting, influenced by animism, is particularly notable, depicting themes like mountains, gods, and animals, with a distinct ethnic style compared to Central China.



Figure 17 Picture of Gods and Cows Helping the People by Liu Yanshan
Source: <https://www.163.com/> [Accessed on May 20th, 2024]

Northeast China's paper-cutting was influenced by the "Chuang Guandong" (Eastward Migration), where settlers, especially from Shandong, brought Central Plains culture to this region. Although paper-cutting in Northeast China started later than in Central China, the influx of immigrants led to the development of a unique style that blends Manchu and Han cultures.

Cultural hybridity has been a key force in history, driving development through the blending of different traditions. Despite the Manchu people initially ruling China, the agricultural culture and scholarly traditions of the Central Plains eventually prevailed, shaping the distinctive features of Northeast Chinese Paper-Cutting, which reflects the harmonious fusion of both Han and Manchu cultures.

The image below showcases representative works of Northeast China's paper-cutting art, which embody this rich cultural fusion:



Figure 18 Northeast Yangko by Hou Yumei
Source: <https://site.douban.com/> [Accessed on May 20th, 2024]

Paper-Cutting in the Yellow River Basin Region (Excluding Shandong Province).

The paper-cutting art of the Yellow River Basin has a long history, known for its rustic and resilient style shaped by the region's natural and cultural features. This style has been passed down for nearly a thousand years. Paper-cutting in this area is bold and unrefined, differing from the delicate elegance found elsewhere, reflecting the region's environment and history.

Gansu, located in the upper and middle reaches of the Yellow River, is home to ancient ethnic groups like the Rong, Di, and Xiongnu, and preserves rich cultural heritage. Gansu's paper-cutting art, part of the Central Plains culture, is deeply connected to folk traditions and reflects daily life beliefs. Popular motifs like the "Inverted Bowl Flower" and gourd symbolize fertility and life's continuation, conveying blessings for prosperity and descendants. This design embodies the Chinese cultural emphasis on reproduction and continuity, as illustrated in the accompanying figure.



Figure 19 The Buckle Bowl by Zhao Xingping

Source: <https://mp.weixin.qq.com/> [Accessed on Jun. 21st, 2024]

Folk paper-cutting art in the Luliang region of Shanxi, located in the Yellow River basin, is deeply rooted in local customs and traditions. The art reflects ancient totem worship and shamanistic beliefs, with patterns featuring animals like snakes, dragons, fish, and frogs, passed down through generations. The Summer culture, symbolized by snake and dragon totems, is prominently displayed in the region's paper-cutting.

Southern Shanxi, with its prosperous economy and rich cultural environment, is home to diverse folk arts. Xinjian, known as the "hometown of Chinese opera," features paper-cuttings of opera characters. Su Lanhua, from Beisu Village, is renowned for her intricate designs blending humor and depth. Yangquan, famous for coal production, is also known for its "Yue Kuo" paper-cut, used to bless newlyweds and symbolize fertility and reproduction, often expressed through natural objects and auspicious symbols, as shown in the image below:





Figure 20 Perfect" Wang Shuzhen "Yangquan pan cut paper" the fourth-generation inheritor

Source: <https://www.163.com/> [Accessed on Jun. 21st, 2024]

Hebei Province is known for the folk paper-cutting art of Weixian and Fengning. Weixian, a historical transit point, was influenced by cultural exchanges, which helped shape its distinctive paper-cutting style. Initially, Weixian paper-cuttings were simple designs used in embroidery for household items. Window paper-cuts, called "tianpilang," were made from mica and featured motifs like flowers, birds, and opera figures.

In the late Qing Dynasty, Mr. Wang and a Daoist priest established a workshop that popularized window paper-cutting. Wang Laoshang's work, particularly his operatic designs, became famous, refining traditional techniques and adding color. Over time, Weixian paper-cuts, small in size but diverse in themes, grew in popularity, covering opera, mythology, nature, and more. Since 1949, the craft has evolved with support from cultural departments, leading to innovations in design while preserving traditional methods, as shown in the image below:





Figure 21 Henan Yu County paper-cut: opera figures
 Source: <https://www.sohu.com/> [Accessed on Jun. 21st, 2024]

Paper-Cutting in Shandong Province.

Shandong Province is a key region for folk paper-cutting, influenced by its rich Confucian heritage (Gu, 2023). The art often features themes of etiquette, scholarly culture, and auspicious symbols, with subjects including animals, flowers, birds, opera, myths, religious beliefs, and more. Various techniques, such as dyeing, multi-color designs, and woodblock printing, enhance the beauty and intricacy of Shandong paper-cuts.

Shandong's paper-cutting traditions include festive decorations like window flowers and symbols for different holidays, such as lantern flowers, money dragons, and five-poison gourds. These decorations symbolize prosperity, protection, and cultural beliefs.

Regional styles in Shandong include the bold, robust designs from Binzhou and the delicate, intricate patterns from the Jiaodong coastal region, with the latter being highly praised both domestically and internationally. In rural areas, women typically create window flowers, wedding flowers, and ritual flowers using scissors, while professional artists use knives for more detailed designs. In fishing villages, paper-cutting is simpler and often features blue or black designs on everyday items like doors, walls, and fishing boats. Many elderly women are skilled in paper-cutting, as shown in the accompanying image.



Figure 22 Shandong Jiaodong paper-cutting "Bat"

Source: <https://zhuanlan.zhihu.com/> [Accessed on Jun. 21st, 2024]

In southern Shandong, particularly in Cangshan and Linyi, Men Jian are a distinctive form of paper-cutting. These plaques typically consist of five panels, often in colors like yellow and green, featuring symbols of peace and good fortune. The designs are especially vibrant for the New Year.

The method of creating these plaques involves layering five colored sheets of paper, which are then carved with patterns like flowers, birds, fish, and insects. After carving, the layers are separated and arranged alternately within the frame, creating a colorful, multi-layered decoration known as "carved hall Men Jian ". This unique style reflects both craftsmanship and cultural significance.



Figure 23 Linyi Tancheng Paper-cut Men Jians

Source: <https://mp.weixin.qq.com/> [Accessed on Jun. 21st, 2024]

Paper-Cutting in the Southeastern Coastal Region and Southwest Minority Areas.

Paper-cutting in the Southeastern Coastal region, including Guangdong, Fujian, and Jiangxi provinces, is an important branch of Chinese folk art. Known for its exquisite craftsmanship, it has gained both domestic and international fame. Male artisans are the primary creators, and the art form has evolved to suit various applications, including decorative flowers for clothing, gifts, and religious ceremonies.

In Foshan, paper-cutting is practiced with diverse techniques and materials, including copper-backed, dyed, woodblock-printed, and copper-carved designs. These include fish flowers, wedding flowers, and lantern flowers, which are common in Guangdong and Fujian. Foshan paper-cutting features nine main techniques, such as using copper, silver, or paper as a base and carving or coloring to enhance the designs. High-end items often use copper-tin foil inlays with red and green paper backgrounds, creating a layered, vibrant visual effect.

Foshan paper-cutting combines drawing and engraving techniques, resulting in a delicate and lively style that stands out regionally, as shown in the accompanying image.

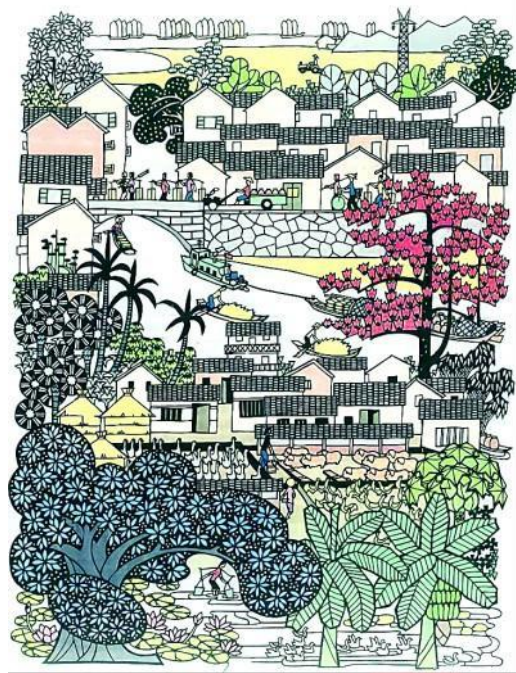


Figure 24 Spring Morning in Water Country, Liang Zhiyan, Guangdong Folk Craft Museum

Source: <https://www.gmw.cn/> [Accessed on Jun. 21st, 2024]

Chaozhou, an important region in Guangdong for folk paper-cutting, has a rich tradition dating back to the Ming and Qing dynasties. The migration of Chaozhou people to Southeast Asia brought foreign influences, which, when combined with local culture, shaped the distinctive Chaozhou paper-cutting style. This art form is deeply embedded in local customs, especially in weddings and celebratory events, with "dowry flowers" often cut for wedding gifts. Paper-cutting also plays a crucial role in traditional festivals and religious processions in the Chaoshan area.

In Fujian, paper-cutting styles vary by region. Coastal areas like Zhangpu and Quanzhou are known for their vivid, marine-themed designs, while Putian and Xianyou focus on elegant gift flowers. Zhangpu paper-cutting originated from the migration of Central Plains Han people, blending Central Plains culture with local traditions, leading to its widespread use in folk activities. The second influence comes from Lingnan and Minnan folk customs, which served as a platform for the development of Zhangpu paper-cutting, allowing it to rapidly develop its own style and variety, as illustrated in the accompanying image.



Figure 25 She and Han Together Plant Xi Hua, Zhuang Ah Qing

Source: <https://h5.fjsen.com/> [Accessed on Jun. 21st, 2024]

Folk Paper-Cutting in Southwest Minority Regions.

Folk paper-cutting in Southwest China, including Yunnan, Guizhou, and the Xiangxi area, reflects the traditions of various ethnic minorities. Notable examples include Buddhist paper-cutting by the Dai people, costume paper-cutting by the Miao people in Guizhou, and carved flower paper-cutting from Xiangxi, along with embroidered patterns depicting the customs of the Bai, Dong, Shui, Yi, and Buyi peoples. These traditions are marked by complexity and diversity.

Dai paper-cutting is mainly found in the Dehong Dai and Jingpo Autonomous Prefecture, especially Luxi City. During festivals, colorful paper strips are placed on Buddha altars, and paper-cutting is common in Dai villages for rituals and offerings. Unlike Han Chinese Paper-Cutting, which is traditionally a female craft, Dai paper-cutting is primarily practiced by men, particularly those who learned it in Buddhist temples from a young age. This male dominance in the art form is one of the distinctive characteristics of Dai paper-cutting, as shown in the image.

พหุวัฒนธรรม ชีว

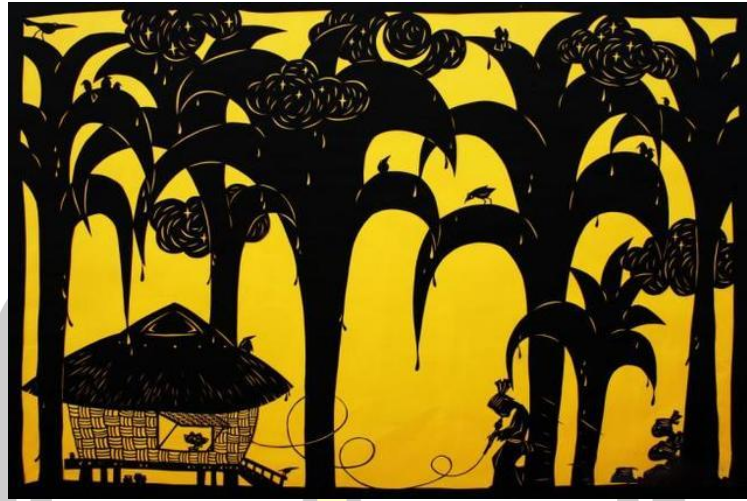


Figure 26 The Village by Fan Yong

Source: <https://mp.weixin.qq.com/> [Accessed on Jun. 21st, 2024]

Naxi paper-cutting is closely tied to the Naxi people's beliefs and customs. It blends Han Chinese and Naxi cultures, especially through the "Fushouhua" (Fortune and Longevity Flowers) design, which symbolizes good fortune and is often displayed on doors and cabinets during the Spring Festival. Influenced by Dongba culture, Naxi paper-cutting features simple, folkloric designs, with a focus on decoration and symbolic meanings of harmony between heaven, earth, and humanity.

In southern Yunnan, the Yi people's paper-cutting represents female freedom and is used for clothing, home decoration, and offerings. Common motifs include flowers, animals, and deities, with symbols like dragons, phoenixes, tigers, and auspicious motifs representing ancestral spirits and good omens. The designs, often symmetrical and balanced, reflect the Yi people's natural beliefs and hopes for a prosperous life.

Bai paper-cutting in Dali is widely practiced, with designs such as "Deer and Crane in Spring," "Prosperous Peony," and "Carp Leaping over the Dragon Gate." These works emphasize harmony and rhythm, often depicting animals, people, and buildings, and reflecting the Bai people's aspirations for happiness and prosperity.

Embroidery is one of the main tasks of Miao women throughout their lives. From a young age, they are taught how to embroider and often design and cut their own patterns. Before marriage, a Miao woman must embroider several sets of quilts, pillows, canopy curtains, and shoes. After marriage, she continues to embroider sleeve flowers, waist flowers, backpack flowers, children's hat flowers, and shoe flowers. Those who are less skilled in embroidery may ask others for help. Women who are particularly skilled at cutting and designing embroidery patterns often sell their work at markets. These semi-professional, skilled artisans, who produce fine and intricate paper-cuttings, have played a significant role in the development and refinement of the art form. Miao Xiu Hua Paper-Cutting patterns mainly include clothing-related designs like edge flowers for garments, apron flowers, shoe flowers, hat flowers, pants corner flowers, and children's clothing patterns, as well as daily item designs such as canopy flowers, pillow flowers, purse flowers, and canopy ribbons, as shown in the image.



Figure 27 Miao women use paper-cuts for embroidery

Source: <https://baijiahao.baidu.com/> [Accessed on Jun. 21st, 2024]

Paper-Cutting in the Yangtze River Basin.

Paper-cutting in the Yangtze River Basin is known for its delicate and elegant southern Chinese style, with each region developing its own distinct tradition. In Sichuan, Zigong is famous for lantern-shaped paper-cuts, while Yilong is known for refined, simple embroidery patterns and colorful window cuts. Hubei's paper-cutting, influenced by Chu culture and carving traditions from the Eastern Jin and Northern and Southern Dynasties, is characterized by carved styles, especially in cities like Wuhan and Xiaogan. Zhejiang is recognized for its fine lines, particularly in Yueqing, and Jiangsu is known for intricate works from cities like Yangzhou, Nanjing, and Nantong. Anhui's Fuyang blends southern and northern styles, creating a unique balance of grace and strength.

In Hubei, carved paper-cutting, especially in Ezhou, has a long history dating back to the Western Jin Dynasty. It evolved with both cutting and carving techniques, producing detailed designs for religious, wedding, and festival decorations. Nantong's paper-cutting, which developed in the Qing Dynasty, is known for its precision and rhythmic balance. Initially used for folk decorations, it became a respected art form after the founding of the People's Republic of China.

In Jiangsu, southern regions favor delicate designs, while Pizhou in northern Jiangsu is known for its bold, simple style, influenced by the Han image-stone carvings of Xuzhou. Pizhou paper-cutting, with its strong folk roots, reflects the emotional highs and lows of life through striking, unadorned shapes. Many artists, coming from poor families, created these works as a means of survival, adding a down-to-earth, folk atmosphere to the art form.

Yueqing, in Zhejiang province, is known for its fine-line carved paper-cutting, with a history dating back over 700 years. The town's paper-cutting tradition, described in the Dade Yueqing County Gazetteer from the Yuan Dynasty, includes colorful designs used in folk rituals, especially during the dragon boat festival. Here, intricate "dragon boat flowers" are created to honor thirty-six heroic warriors who fought Japanese pirates. Villages compete to create the most elaborate flowers, refining Yueqing's paper-cutting techniques and establishing its distinctive fine-line style.

Yongkang, also in Zhejiang, is known for paper-cutting with clear, fluid lines, often depicting opera characters and scenes from classics like "The Romance of the Three Kingdoms" and "Dream of the Red Chamber." The works are detailed, dynamic, and lifelike, offering a unique aesthetic.

In Anhui, paper-cutting from Xiu County, She County, and Fuyang is notable for combining thick and thin lines, creating a balance of rigid and soft forms. Fuyang's paper-cutting, influenced by local culture, features bold, ancient styles (YU Wenshan et al., 2019). Prominent artist Cheng Jianli's works blend the mystery of Guizhou Miao embroidery with the grandeur of Central Plains bronze culture, covering a variety of subjects, often accompanied by folk songs, highlighting the connection to local traditions. This fusion of cutting and song makes Fuyang paper-cutting an invaluable part of China's folk-art heritage, as seen in the accompanying images.



Figure 28 Riding a Horse by Cheng Jianli

Source: <https://cul.sohu.com/> [Accessed on Jun. 21st, 2024]

Yangzhou is one of China's earliest centers for paper-cutting, with traditions dating back to the Tang and Song dynasties. During the Spring Festival (Li Chun), people crafted paper flowers, butterflies, and coins to enhance the festive atmosphere. Yangzhou paper-cutting was also used in folk rituals, such as creating paper horses and figures for worship. Its themes are diverse, featuring figures, mythical creatures,

flowers, birds, and landscapes, with flowers and birds being especially notable. Influenced by Chinese literati painting, Yangzhou paper-cutting is known for its concise compositions, smooth lines, and elegant style. The works exude delicate beauty, combining intricate details with graceful forms, reflecting a strong regional identity as shown in the image :



Figure 29 Pearl Ball by Zhang Yongshou

Source: <https://mmbiz.qpic.cn/> [Accessed on Jun. 21st, 2024]

Nanjing Paper-Cutting is a traditional art form from Nanjing City, Jiangsu Province, and is popular in Nanjing and its surrounding areas. One of the main forms of traditional folk Nanjing Paper-Cutting is Xiu Hua Paper-Cutting, which is used as a pattern for embroidery. In the past, Nanjing Paper-Cutting artists would use a single pair of scissors and make a living by performing street art, primarily relying on Xiu Hua Paper-Cutting. There are many types of embroidery, mostly focused on certain parts of clothing, including shoe flowers, shoe sole flowers, pillow flowers, collar flowers, sleeve flowers, handkerchief flowers, and pouch flowers. The embroidery patterns are cut in a loose and balanced way, reflecting the poetic beauty of the Jiangnan region. The technique is also quite skilled; no sketches are needed, and the artist uses a flexible wrist to guide the scissors in a systematic and curving motion. The cut patterns are simple and vivid, forming a traditional "one-stroke drawing" style, which has greatly influenced the later development of Nanjing Paper-Cutting. The works are characterized by smooth lines, natural curves, and clean, neat cuts, rarely giving the feeling of being roughly carved. The unique characteristics of Nanjing Paper-Cutting stand out, blending the rough style of northern paper-cutting with the delicate style of southern paper-cutting. There are flowers within flowers, themes within themes, roughness combined with refinement, and clumsiness that reveals vitality, all resulting in an exceptionally beautiful artistic form.

2.3 Artistic Characteristics of Nanjing Paper-Cutting

2.3.1 Historical Origins

The origins of Nanjing Paper-Cutting can be traced back to the early Ming Dynasty, as recorded in the *Baixia Suoyan* written by Gan Xi during the Daoguang period of the Qing Dynasty (Gu, 2023). According to the text, Nanjing already featured paper-cutting for door decorations and lantern adornments during this time. The development of Nanjing Paper-Cutting is also closely tied to local embroidery traditions, as many households in the past kept books of paper-cut patterns for embroidery purposes. Nanjing Paper-Cutting, characterized by the smoothness and delicacy typical of Jiangnan-style paper-cutting, truly developed as a distinctive art form in the 1920s and 1930s. During this period, many folk artists in the Confucius Temple area specialized in cutting shoe patterns and designs for embroidered undergarments. After 1912, artists such as Wu Laotai, Ma Zhihong, and Zhang Jigen gained recognition as modern paper-cutting artisans by establishing their craft in Nanjing.

Before 1949, folk paper-cutting artists had strong mobility, and no fixed schools of paper-cutting had formed. It wasn't until after 1949 that Nanjing, under the influence of Wu Laotai, established a new "flowers within flowers, themes within themes, roughness with refinement, clumsiness with vitality" artistic style.

In 1952, Jiangsu Literature and Art Publishing House published a collection of Nanjing Paper-Cutting works called "Hundred Flowers Blooming", primarily created by Zhang Jigeng and Wu Shan, with contributions from Wu Zhifang, Yu Jigao, Rui Jinfu, and Qian Zhongzhang. The collection was themed around the poetry of Guo Moruo's "Hundred Flowers Blooming"

That same year, the Nanjing Cultural Bureau organized paper-cutting artists such as Zhang Jigeng, Wu Zhifang, Wang Mingchang, and others to spend nearly five years collecting and reviving traditional Nanjing folk paper-cutting patterns that had long been forgotten. Art critics such as Chen Zhifo, He Yanming, Wu Shan, and Zhang Daoyi participated in the project. From the hundreds of works that were restored and compiled, dozens of representative pieces were selected for the book "Nanjing Paper-Cutting," which was published in 1956 by Shanghai People's Fine Arts Publishing House. This book laid the foundation for the unique "happy flower" style of Nanjing Paper-Cutting and elevated its artistic value as shown in the image :





Figure 30 Book Nanjing Paper-Cutting

Source: Photographed by the author. Mar. 3rd, 2023]

2.3.2 Artistic Forms and Styles

Nanjing Paper-Cutting primarily consists of four artistic forms: Xiu Hua Paper-Cutting, Xi Hua, Dou Xiang Hua, and Men Jian.

1. Xiu Hua Paper-Cutting.

Xiu Hua Paper-Cutting is a refined art form within Nanjing Paper-Cutting, known for its delicate patterns and intricate craftsmanship. This style is typically used to design embroidery patterns, which is why it is referred to as Xiu Hua Paper-Cutting. It not only provides a visually exquisite impression similar to embroidery, but also demonstrates the unique pursuit of detail and craftsmanship in Nanjing Paper-Cutting art. The designs are intricate and delicate, with flowing lines that preserve the lively essence of traditional paper-cutting while incorporating the elegance of embroidery art. The patterns and contours of the works resemble the stitchwork of embroidered flowers, emphasizing the layering effect. The fine lines are complex yet detailed, reflecting the superb manual skills and graceful artistry involved. As one of the earliest forms of Nanjing Paper-Cutting, it is considered a prime example of the meticulous nature of this craft as shown in the image :



Figure 31 Nanjing Paper-Cutting - shoe paper-cutting
 Source: <https://www.baike.com/> [Accessed on Jun. 21st, 2024]

1. Xi Hua.

Xi Hua is a traditional art form in Nanjing Paper-Cutting that are highly distinctive to the region. Known for their meticulous, rounded compositions, elegant yet simple shapes, and celebratory, rich symbolism, Xi Hua have gained widespread popularity and have been passed down in the Jiangsu, Zhejiang, and Shanghai regions over the years. This form of paper-cutting initially developed from embroidery pattern templates for items such as shoe flowers and pillow flowers. It was primarily used to decorate and beautify the environment during folk wedding ceremonies, enhancing the festive atmosphere and conveying best wishes.

The content of Xi Hua paper-cutting often employs symbolic techniques, using puns, dual meanings, and metaphors to convey meanings of happiness and auspiciousness. This form directly reflects the hopes of ordinary people for a happy and prosperous life. For example, characters such as "福" (fortune), "禄" (wealth), "寿" (longevity), "喜" (joy), "和" (harmony), "春" (spring), "缘" (fate), and "吉" (good luck) are common in Xi Hua designs. These symbols are centered around the desire for good fortune and the avoidance of misfortune, as shown in the image.



Figure 32 Double Fish Lotus by Zhang Fanglin

Source: <https://www.sohu.com/> [Accessed on Jun. 21st, 2024]

Xi Hua paper-cutting often draws inspiration from beloved folk motifs, focusing mainly on flowers, birds, fish, and fruits, and infuses them with auspicious meanings. One of the most distinctive features is the use of the "flower-in-flower" format, where within the outer contours of a specific floral pattern, related patterns are organized around the central theme, creating a harmonious and complete design. This approach imbues the artwork with a sense of joy and abundant symbolism.

2) Dou Xiang Hua.

Dou Xiang Hua is a highly decorative and playful traditional colored collage paper-cutting art form that is unique to Nanjing Paper-Cutting. Historically, during the Mid-Autumn Festival or temple fairs for deity worship, people would burn tower-shaped incense, and the top of the incense was decorated with four-cornered or six-cornered shapes made from colored paper-cuttings, hence the name Dou Xiang Hua. In addition to the top decoration, the incense was also adorned with layers of colorful paper-cuts, collectively referred to as Dou Xiang Hua, which exuded a strong folk cultural atmosphere.

These works are brightly colored, typically made using seven wax paper colors: gold, red, peach, green, blue, orange-yellow, and black. The vibrant color contrasts create a strong visual effect, lending the art its unique aesthetic appeal. Each fighting fragrant flower paper-cutting maintains consistent patterns but varies widely in color, making it a one-of-a-kind art form in China. This uniqueness adds to the luster of Nanjing Paper-Cutting and enhances the charm of Chinese folk art.

Dou Xiang Hua belong to the layered color paper-cutting genre. Each work consists of various vibrant colors with strong contrasts, producing a brilliant visual impact. This form of paper-cutting represents an innovation in Nanjing's traditional craft, incorporating rich color expression to convey well-wishes for happiness and good fortune, resonating with the audience. as shown in the image.



Figure 33 12 Zodiac animals - Monkey, by Zhang Fanglin
Source: Photographed by the author. May 20th, 2024]

3) Men Jian.

Men Jian are another major traditional style in Nanjing Paper-Cutting. This type of paper-cutting is found in both northern and southern China, though it may go by different names such as "Men Jian," "hanging plaques," or "door money." These paper-cuttings are typically hung above doorways during the Chinese New Year, serving as a form of decorative auspicious charm.

Nanjing Men Jian resemble small hollow-out banners, often with wide borders on both sides that contrast sharply with the more delicate central patterns. The bottom of the plaque features a row of tassels, allowing it to sway gently in the breeze when hung. The designs commonly incorporate auspicious symbols and characters, typically featuring a single idiom or character, and are often displayed as a set. Common phrases might include "Four Seasons of Peace" or "Five Blessings Enter the Door", as shown in the image.

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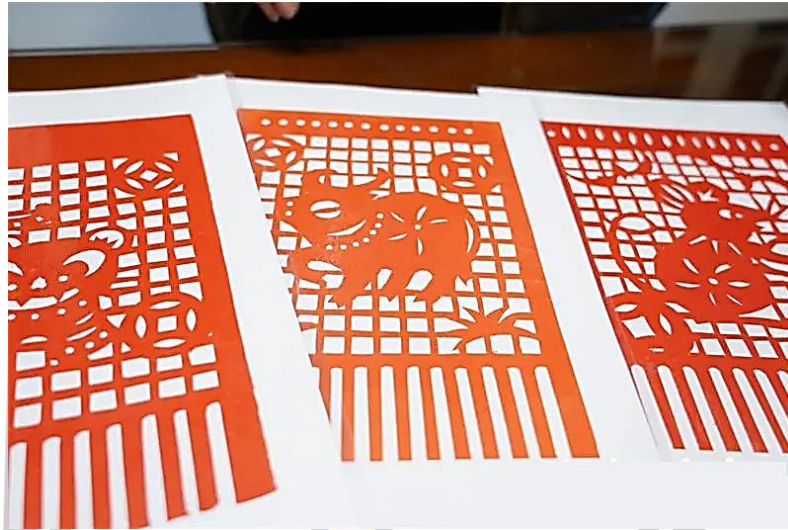


Figure 34 Men Jian by Chen Hesheng

Source: <https://mp.weixin.qq.com/> [Accessed on Jun. 21st, 2024]

These four styles were the main forms commonly found in traditional Nanjing Paper-Cutting. In terms of practical use, the scope of traditional folk paper-cutting extends far beyond these examples. Whether used for appreciation, as embellishments, or embroidery patterns, they all serve as vibrant folk artworks. However, with the development of society and changes in people's lifestyles, some of these paper-cutting styles have disappeared, some are no longer fashionable, and some have transformed into purely ornamental art pieces. Nanjing Paper-Cutting techniques combine boldness with delicacy and clumsiness with spirit. The works blend the robust and rugged style of Northern Chinese Paper-Cutting with the delicate and elegant style of the South. The style is light and neat, with fine and translucent lines. If modern design concepts are applied while inheriting the essence of traditional forms, a new look will surely emerge.

Simplifying is the starting point for the creative reinvention of Nanjing Paper-Cutting (Huang, 2022). Although traditional paper-cutting patterns are also selective and processed representations of natural images, most of them are realistic and intricate, with complex structures and outdated forms. After the "less is more" revolution in modern design, people have become more accustomed to and inclined toward simple, lively, formal, and uniquely creative patterns. Therefore, traditional paper-cutting patterns should not be used directly; instead, they need to be simplified and abstracted. Simplifying means removing complicated parts and preserving the typical characteristics. On this basis, through simplification and refinement, the shapes become clear, distinct, and aligned with contemporary aesthetic standards. Deconstruction and reconstruction are fundamental methods in modern graphic design. The visual characteristics of this approach are novel and unique, with the core being deconstruction and reorganization. Deconstruction requires a more detailed observation of objects and, through profound understanding, breaks down their original form to extract the characteristic elements, forming entirely new visual symbols. This modeling technique significantly enriches the expressive language of modern design and will surely enhance the expressive forms and artistic styles of Nanjing Paper-Cutting.

The delicacy and craftiness of Nanjing Paper-Cutting rely on intricate and translucent lines. There is a saying among paper-cutting artists: "Small arcs use the front part of the scissors, medium arcs use the middle part, and large arcs use the back part." Various lines in Nanjing Paper-Cutting art are highly valued and skillfully applied. Curved, straight, and sharp lines are the basic forms of lines. With more curves, the shapes become softer and more elegant; with more straight and sharp lines, the artistic style becomes more upright, righteous, and direct. According to the theme, artists arrange the lines in a balanced and harmonious way to create a symmetrical and aesthetically pleasing visual effect. Exaggerated and distorted techniques are also used.

2.3.3 Subject Matter Types

The subject matter of Nanjing Paper-Cutting reflects the simple and sincere emotions of the working people (Wu, 2015). Everyday elements such as fruits and vegetables, poultry and livestock, and iconic flora like plum blossoms, orchids, bamboo, and chrysanthemums are transformed by artisans into vivid and delightful artistic expressions. As a form of folk art, Nanjing Paper-Cutting is rich in regional characteristics, with auspicious patterns playing a particularly significant role, fulfilling people's aspirations for a happy life.

Themes related to life worship are particularly prominent in Nanjing Paper-Cutting works, with frequent depictions of reverence for ancestors and the concept of reproduction (Wu, 2015). For example, dragon and phoenix motifs symbolize marital harmony, where the dragon, representing imperial authority, signifies masculinity, and the phoenix, as the "king of all birds," represents femininity. Together, "dragon and phoenix bringing prosperity" conveys the blessing of a happy marriage. Additionally, auspicious patterns often employ homophones and metaphors in their design, such as "Growing old together" "Abundant joy and celebration", and "Double blessings of fortune and longevity". These festive and blessing-laden motifs express the heartfelt emotions and fervent hopes of the working people for a better life.

The commonly used themes in Nanjing Paper-Cutting can be broadly categorized as follows:

1) Animal Themes.

In Nanjing Paper-Cutting, animal themes hold a significant place and are primarily categorized into cultural animals and real-life animals. Cultural animals, such as dragons, phoenixes, and the twelve zodiac animals, carry symbolic meanings of auspicious protection. Real-life animals, such as lions, tigers, chickens, and fish, reflect the likes and familiarity of people's everyday lives. Bird-themed motifs, particularly mandarin ducks, magpies, swallows, and cranes, symbolize beautiful and harmonious life aspirations.

In traditional agrarian society, domestic animals were closely connected to people's lives, which is why they frequently appear as key elements in folk paper-cutting. Nanjing Paper-Cutting not only vividly depicts the images of domestic animals but also imbues more artistic expressions into powerful animals. For example, in paper-cutting, the tiger not only symbolizes the expulsion of evil, the avoidance of disasters, and peace, but it also carries connotations of wealth protection. In folklore, the tiger is believed to possess great strength and courage, capable of driving away evil and ensuring safety. Therefore, after a child is born, parents often

prepare tiger-head hats and tiger-head shoes as a means of wishing for the child's protection from harmful influences and for healthy growth. Additionally, the homophonic connection between "tiger" and "fortune" in Chinese culture further elevates the tiger as a symbol of people's hopes for a happy life, as shown in the image:



Figure 35 A Vision of the Future by Zhang Fanglin
Source: Photographed by the author. May 20th, 2024]

Animal themes in Nanjing Paper-Cutting are also renowned for their playfulness and symbolic significance. The graceful and approachable image of the sika deer, the lively and mischievous monkey, and the agile and alert rat all convey humor and whimsy through exaggerated artistic techniques. Fish, an important element in paper-cutting, symbolize "abundance every year," representing harvests and festive joy. The combination of "fish and qing" (a traditional musical instrument) symbolizes "auspicious joy," while "fish and lotus" represents the harmonious and fulfilling love between a man and a woman. Among these, the image of "a carp leaping over the dragon gate" is particularly iconic, symbolizing people's hopes for escaping poverty and achieving prosperity with optimism and perseverance.

Through the artistic expression of Nanjing Paper-Cutting, these animal images not only vividly convey the aesthetic tastes of traditional culture but also reflect the people's pursuit of and longing for a happy life.

2) Plant Themes

Plant motifs are widely popular in Nanjing Paper-Cutting, with representative patterns such as peonies, lotuses, chrysanthemums, plums, peaches, pomegranates, pine trees, and bamboo. Each plant, due to its unique form and symbolic meaning, serves as an important material for paper-cutting creation. The peony, with its bright colors and graceful posture, is regarded as a symbol of wealth and nobility. The lotus, known as the "precious flower" in Buddhism, signifies purity and good fortune. The chrysanthemum, known for its cold resistance and toughness, symbolizes strength and resilience, as shown in the image:



Figure 36 Nanjing Paper-Cutting "Double Herons in the Lotus Pond"

Source: Photographed by the author. May 20th, 2024]

In addition, pine trees, bamboo, and plum blossoms, known collectively as the "Three Friends of Winter" for their resilience in the face of harsh conditions, symbolize noble character and are often featured as classic themes in Nanjing Paper-Cutting. Through the medium of paper-cutting, these plants not only highlight the delicacy and diversity of Nanjing Paper-Cutting art but also convey profound cultural connotations and spiritual aspirations.

2) Human Figure Themes

The human figure themes in Nanjing Paper-Cutting are renowned for their vivid expressions and deep cultural connotations, serving as an important manifestation of the integration of traditional art and local culture. These works can be primarily divided into two categories: folk figure themes and historical and mythical figure themes. Folk figure themes focus on daily life and festive activities, such as scenes of farming, tea picking, dragon dancing, and dragon boat racing, vividly portraying the labor scenes of ancient common people and the customs of festivals, filled with strong local flavor.

Historical and mythical figure themes are often derived from classic stories and local legends, such as Dream of the Red Chamber, The West Chamber, The Legend of the White Snake, and Water Margin. These works, through delicate carving and vivid modeling, bring the characters' personalities and emotions to life. Many paper-cutting works related to traditional operas are placed on the bed or windowsills of cottages, like frozen scenes from plays, continuing to tell the timeless stories. This unique art form not only records the essence of traditional culture but also breathes new life into history and mythology, becoming an essential part of Nanjing Paper-Cutting culture, as shown in the image:



Figure 37 Daiyu Burying Flowers by Wu Zhifang
Source: <https://news.jstv.com/> [Accessed on Jun. 21st, 2024]

3) Urban Image Themes.

The city image themes in Nanjing Paper-Cutting showcase the city's unique cultural heritage and the emotional attachment of its citizens. Common motifs in these paper-cuttings include historical landmarks such as Sun Yat-sen Mausoleum, Ming Xiaoling Mausoleum, the ancient city wall, and Confucius Temple, which are skillfully portrayed to convey the profound historical significance of Nanjing. Natural landscapes, such as Xuanwu Lake, Yuhuatai, and Qixia Mountain, also frequently appear as themes, with flowing lines and rich details capturing the ecological beauty of Nanjing's four seasons, providing the viewer with an immersive visual experience.

Nanjing Paper-Cutting also incorporates unique symbols representing the city, such as the plum blossom, which symbolizes resilience and purity and is depicted in full bloom as Nanjing's city flower. The phoenix tree, symbolizing longevity and prosperity, is depicted with simple, bold lines. By combining these urban symbols with natural landscapes, Nanjing Paper-Cutting not only serves as a medium for artistic expression but also as a heartfelt representation of the city's image. It blends traditional paper-cutting art with the modern urban atmosphere, enhancing the expressive power and innovative spirit of Nanjing Paper-Cutting, as shown in the image:

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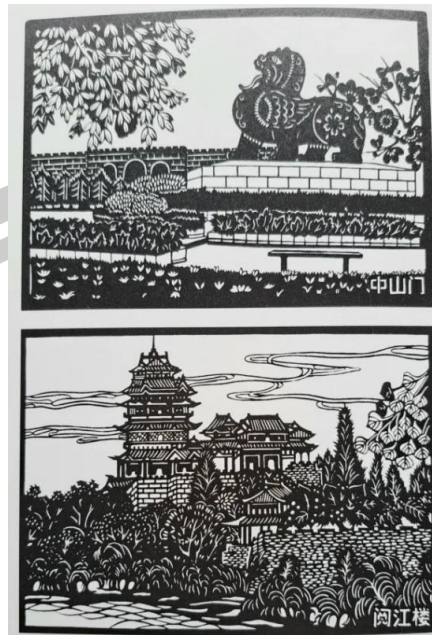


Figure 38 Nanjing Paper-Cutting "Zhongshan Gate and Yuejiang Tower"
Source: <https://news.jstv.com/> [Accessed on Jun. 21st, 2024]

3) Folk Cultural Activities.

Nanjing's folk cultural activities, such as the Qinhuai Lantern Festival and Dragon Boat Festival, are vividly depicted in paper-cutting art, showcasing the lively and dynamic folk customs of the city. These traditional events, rich in cultural significance, are represented through detailed and expressive designs in paper-cutting, capturing the festive atmosphere and the deep cultural roots of Nanjing. Whether it's the colorful lanterns illuminating the night during the Lantern Festival or the excitement and energy of the dragon boat races, these images reflect the joyful spirit of Nanjing's urban life and folk traditions, as shown in the illustration.

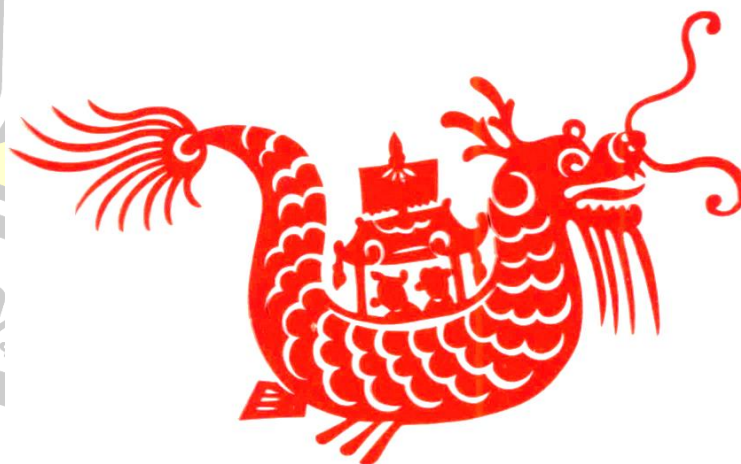


Figure 39 Nanjing Paper-Cutting dragon Boat, Shanghai Museum
Source: <https://www.shanghaiuseum.net/> [Accessed on Jun. 21st, 2024]

2.3.4 Tools and Materials

In the creation of Nanjing Paper-Cutting, the most commonly used tool is the scissors, as it allows for quick and precise execution of continuous patterns. Xuan paper, known for its soft texture and ease of folding, is the primary material, making it ideal for intricate cutting. Although carving knives and other auxiliary tools are occasionally used, their application in Nanjing Paper-Cutting is relatively limited, typically reserved for detailing or finishing touches. The focus in Nanjing Paper-Cutting is on the flexibility of the scissors and the operability of the Xuan paper, enabling artisans to create rich and coherent patterns on a single sheet of paper, showcasing the unique artistic style of Nanjing Paper-Cutting.

2.4 Cultural Connotation and Value of Nanjing Paper-Cutting

2.4.1 Connection with Nanjing's Historical and Cultural Background

As an ancient capital with over 2,500 years of history, Nanjing is one of China's most significant historical and cultural cities (Yuan et al., 2016). It has served as the capital for several dynasties, making it a major symbol of Chinese culture. Nanjing Paper-Cutting, as a form of folk art, is deeply influenced by the city's rich history and cultural heritage, reflecting the profound historical depth of Nanjing.

Historically, Nanjing has been a central political, economic, and cultural hub in China, with several dynasties choosing it as their capital, leaving behind numerous historical landmarks. The Qinhuai River, regarded as the "mother river" of Nanjing, was once the commercial and cultural center of China during the Ming and Qing dynasties (Hu, 2014). The riverbanks were home to vibrant lanterns, painted boats, and gatherings of literati, forming a unique Qinhuai culture. This culture is often reflected in Nanjing Paper-Cutting, with themes like the Qinhuai Eight Beauties and lantern festivals, symbolizing the local people's love for and continuation of these cultural icons.

Nanjing is also an important center for both Buddhism and Taoism in China, home to numerous Buddhist temples, such as Jiming Temple, Linggu Temple, and Qixia Temple, as well as Taoist temples like Chaotian Palace and Xuanwu Temple. These religious elements have had a profound influence on the daily life of Nanjing's citizens and are frequently depicted in Nanjing Paper-Cutting, reflecting the people's reverence for religious beliefs.

As a hub for Chinese literature and the arts, Nanjing is the birthplace of many classical literary works and art forms (Wooldridge, 2015), including *Dream of the Red Chamber* and Peking opera. Nanjing Paper-Cutting often portrays iconic characters and scenes from these literary works, such as Jia Baoyu and Lin Daiyu from *Dream of the Red Chamber*, or the female roles from Peking opera, showcasing the unique charm of Nanjing's literary arts. Additionally, historical events and local legends of Nanjing are reflected in paper-cutting, preserving the city's historical memory and local wisdom. Nanjing's rich historical and cultural features provide endless creative material for paper-cutting art, making it a valuable part of traditional Chinese culture.

2.4.2 Reflection of Local Customs and Folk Beliefs

Nanjing's folk festivals are colorful and widely celebrated, including traditional holidays like the Spring Festival, Lantern Festival, Dragon Boat Festival, and Mid-Autumn Festival. As an important element of festival decoration, Nanjing Paper-Cutting, in the form of window flowers, lanterns, and paper-cut designs, expresses people's best wishes for the holidays and their hopes for a prosperous life.

Nanjing Paper-Cutting is closely tied to local customs and folk beliefs, becoming an integral part of the city's cultural life. During traditional festivals like the Spring Festival, Lantern Festival, and Mid-Autumn Festival, paper-cutting serves not only as decoration but also as a cultural symbol of emotional expression and the transmission of good wishes. For instance, during the Spring Festival, families commonly decorate their windows with paper-cutting images of the characters for "fortune", "spring", and auspicious symbols such as flowers, birds, fish, and insects, which represent happiness, prosperity, and vitality. These images convey the collective desire for a bright and prosperous future, as depicted in the illustration.



Figure 40 Nine Fish Happiness by Zhang Fanglin

Source: <https://m.thepaper.cn/> [Accessed on Jun. 21st, 2024]

During the Lantern Festival, the Qinhuai Lantern Festival in Nanjing is renowned across the country for its unique paper-cutting decorations. Paper-cutting is used on the lanterns to enhance the festive atmosphere. In the Mid-Autumn Festival, paper-cut designs often feature themes like "Xi Hua, full moon", "Chang'e flying to the moon", and "Jade Rabbit", symbolizing wishes for family reunions and a harmonious, fulfilling life.

In significant life events such as weddings and birthday celebrations, Nanjing Paper-Cutting plays an important role. For weddings, paper-cut patterns such as the character "Double happiness", "Mandarin ducks playing in the water", and "Dragon and phoenix presenting auspiciousness" symbolize a blissful marriage and happy life. These patterns are often used to decorate the windows, furniture, and banquet venues of newlyweds' homes, creating a festive and joyful atmosphere. For birthday celebrations, paper-cut designs such as "Fortune and longevity combined" and "Pine and crane extending years" express wishes for the birthday celebrant's long and

healthy life, symbolizing good health and longevity while conveying respect and blessings for the elders' well-being, as illustrated.

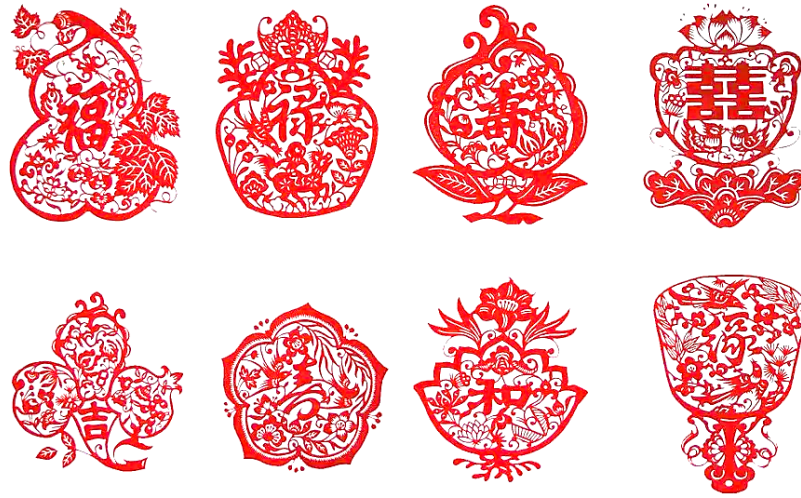


Figure 41 Nanjing Paper-Cutting "Xi Hua"
Source: Photographed by the author. May 20th, 2024]

Nanjing Paper-Cutting not only serves as a decorative element in festive and life ceremony settings but also carries profound emotions and cultural significance, showcasing the richness of local folk beliefs and traditional culture in Nanjing. Additionally, it vividly reflects the folk beliefs of the local people. Auspicious patterns in paper-cutting, such as "Joy on the brow" and "Fortune and longevity combined", convey prayers for family happiness and long-lasting health. Common religious themes also find expression, such as depictions of the Buddhist Guanyin Bodhisattva and Maitreya Buddha, symbolizing compassion and the pursuit of happiness. Daoist motifs, such as the Eight Immortals crossing the sea and the God of Longevity holding a peach, reflect the longing for longevity and auspiciousness. As an important center for Daoism and Buddhism, Nanjing incorporates these religious elements not only in temple and Daoist shrine decorations but also widely in folk festivals and ritual activities.

Nanjing Paper-Cutting also has distinct local characteristics, reflected both in the craftsmanship and in the choice of patterns. For example, motifs related to the Qinhuai River highlight the unique regional culture and customs of Nanjing. In addition, frequently appearing elements such as the plum blossom and the phoenix tree reflect the natural environment and cultural atmosphere of Nanjing. These regional features enrich Nanjing Paper-Cutting both in terms of cultural heritage and artistic expression, making it an indispensable part of the daily life of local people, as shown in the images.



Figure 42 Confucius Temple by Zhang Lindi

Source: <https://wlt.jiangsu.gov.cn/> [Accessed on Jun. 21st, 2024]

2.4.3 Relationship with Other Handicrafts in the Nanjing Area

Nanjing Paper-Cutting has a close relationship with other handicrafts in the Nanjing region, influencing and drawing inspiration from one another, collectively enriching the cultural and artistic heritage of Nanjing. These handicrafts include Yun Brocade, embroidery, gold leaf, ceramics, and carving, which, together with Nanjing Paper-Cutting, form a diverse and vibrant system of arts and crafts in the city.

Nanjing Yun Brocade is one of China's four famous brocades, renowned for its luxurious colors and intricate patterns. Nanjing Paper-Cutting artists draw inspiration from the designs of Yun Brocade, incorporating its exquisite floral, animal, and auspicious motifs into their paper-cutting creations. The pattern designs of Yun Brocade often feature symmetry and geometric beauty, characteristics that are fully reflected in paper-cutting works. The use of color and design in Yun Brocade also influences the color coordination and composition of paper-cutting, making Nanjing Paper-Cutting works more colorful and vibrant.

Nanjing embroidery and paper-cutting have also borrowed from each other, resulting in a unique artistic style. In traditional embroidery works, paper-cutting patterns are often used as design templates. The delicate portrayal of these patterns in silk thread brings the paper-cutting designs to life, making them more vivid and three-dimensional. For example, common floral and bird motifs in embroidery often originate from paper-cutting designs. Additionally, the fine craftsmanship of embroidery has influenced the detailed treatment of paper-cutting, making Nanjing Paper-Cutting more intricate and expressive when depicting figures, flowers, birds, and other themes.

Nanjing gold leaf is another traditional craft, famous for its thinness and brilliant shine. The combination of Nanjing Paper-Cutting with gold leaf has led to a unique form of gold-leaf paper-cutting, an innovation built upon traditional paper-cutting. Gold-leaf paper-cutting involves attaching gold leaf to the paper-cutting, using the contrast between the gleam of the gold leaf and the lines of the paper-cutting to create a more luxurious and refined visual effect, elevating the art of paper-cutting to new heights, as shown in the accompanying image.



Figure 43 Gold Leaf Paper-cut Butterfly Love Flowers, Zhang Jun

Source: <https://english.cctv.com/> [Accessed on Jun. 21st, 2024]

Nanjing ceramics also have a close relationship with paper-cutting. The decorative patterns on ceramic objects, especially on blue-and-white porcelain and colored porcelain, often draw inspiration from paper-cutting art. The simplicity, symmetry, and patterned characteristics of paper-cut designs make them ideal for ceramic decoration. Ceramic artists apply these paper-cut patterns to porcelain surfaces, creating unique decorative effects. Meanwhile, the painting techniques in ceramics have also inspired paper-cut artists, encouraging them to focus on smooth lines and the overall aesthetic of their patterns during the creative process.

Traditional carving crafts in Nanjing, such as wood carving, bamboo carving, and stone carving, are also closely linked to paper-cutting art. Paper-cut designs are often used as templates for carving works, and the patterns are vividly recreated on materials such as wood, bamboo, and stone. The three-dimensional techniques and fine detailing used in carving have also influenced paper-cutting, giving two-dimensional paper-cut works a sense of depth and layered texture. For example, many floral and dragon-phoenix patterns in Nanjing wood carving borrow elements from paper-cut designs, making the works more intricate and artistically compelling.

Nanjing also has many other handicrafts, such as lacquerware, gold and silver filigree, and straw weaving, all of which have a close connection to paper-cutting. The decorative patterns on lacquerware often borrow from paper-cut designs, making the lacquerware more exquisite and beautiful. The hollowing technique used in gold and silver filigree is similar to the hollowing in paper-cutting, with both crafts drawing from each other and developing together. The weaving patterns in straw crafts are also often influenced by paper-cut designs, adding more decorative and artistic value to woven works.

The relationship between Nanjing Paper-Cutting and other regional handicrafts reflects the rich and diverse craft culture of Nanjing. Paper-cutting artists draw inspiration from Yun Brocade, embroidery, gold leaf, ceramics, carving, and other crafts, combining multiple techniques to create unique paper-cut works. At the same time, paper-cutting also provides rich design elements and creative inspiration for other crafts, promoting the collective development of Nanjing's arts and crafts. This reciprocal exchange and fusion contribute to a more complete and

diverse system of Nanjing's craftsmanship, making it an integral part of the city's cultural heritage.

2.4.4 The Value of Nanjing Paper-Cutting as an ICH

Nanjing Paper-Cutting, as part of the world-renowned Chinese Paper-Cutting tradition, holds significant cultural value and historical importance. It is not just an art form but also a carrier of history and culture, playing a crucial role in the inheritance and promotion of excellent traditional culture. Nanjing Paper-Cutting techniques are highly refined, with no need for preliminary sketches, and its continuous lines demonstrate impressive artistic skill and cultural depth. Nanjing Paper-Cutting is included in both the provincial and national ICH lists and has been recognized by UNESCO as a representative work of human ICH, becoming an important vehicle for spreading Chinese culture.

Cultural Inheritance and Historical Witness.

As a traditional craft, Nanjing Paper-Cutting embodies centuries of cultural wisdom, documenting the changes in history and society. Each paper-cut work tells a story and conveys a cultural spirit. For example, traditional auspicious patterns, folk tales, and religious themes in Nanjing Paper-Cutting reflect people's aspirations for a happy life and a bright future. These patterns and stories not only possess artistic value but also serve as witnesses to the cultural history of Nanjing and China, carrying deep cultural meaning and historical memory.

1. Artistic Value and Skill Inheritance.

The craftsmanship of Nanjing Paper-Cutting is exquisite, with continuous lines that demonstrate (Wu, 2015) the artist's high skill and sharp artistic sensibility. This technique requires long-term training and accumulation and reflects the artist's creativity and observation of life. The artistic value of Nanjing Paper-Cutting is reflected not only in the aesthetics of the works but also in the inheritance and innovative spirit embodied in the creative process. Nanjing Paper-Cutting artists continue to innovate within tradition, such as the creation of gold leaf paper-cutting, which has elevated the art form to new heights.

2. Social and Cultural Value.

As an ICH, Nanjing Paper-Cutting plays an important cultural role in modern society. It is not only a representative of folk art but also an integral part of the cultural life of the citizens of Nanjing. Nanjing Paper-Cutting is often used for decoration and to convey blessings during important occasions such as traditional festivals, weddings, and birthday celebrations, enriching people's cultural lives and enhancing community cohesion and cultural identity. Furthermore, through various cultural exchange activities, Nanjing Paper-Cutting has showcased the unique charm of Chinese traditional culture to the world, promoting international cultural exchange and understanding.

3. Economic Value and Industrial Development.

As an ICH, Nanjing Paper-Cutting holds not only cultural and artistic value but also certain economic value. In today's thriving cultural industry, Nanjing Paper-Cutting has entered the modern market through souvenirs, cultural creative products, and other forms, becoming an important component of the cultural industry. The industrial development of Nanjing Paper-Cutting provides a platform for paper-cut

artists to create and injects new vitality into the local economy. Through market-oriented operations, Nanjing Paper-Cutting has achieved the modern inheritance and sustainable development of traditional culture.

4. Educational and Dissemination Value.

The protection and inheritance of Nanjing Paper-Cutting have received significant attention from the government and various sectors of society. Initiatives such as the establishment of professional museums, the filming of ICH videos, and the hosting of exhibitions featuring ICH have strengthened the protection and inheritance of Nanjing Paper-Cutting and other ICHs. These efforts not only contribute to the preservation and transmission of paper-cutting techniques but also play an essential role in educating and disseminating traditional culture. For example, the establishment of the Nanjing Paper-Cutting Museum provides the public with a platform to learn about and experience paper-cutting art, allowing more people to access and learn this traditional craft.

Nanjing Paper-Cutting as ICH, holds immense cultural, historical, artistic, and social value. It is not only a vital part of Chinese culture but also a crucial vehicle for preserving and promoting excellent traditional culture. In the process of protecting and inheriting Nanjing Paper-Cutting, it is essential to focus on both the transmission and innovation of the craft while promoting education, dissemination, and industrial development to give new life to this traditional art form in modern society. The inheritance and development of Nanjing Paper-Cutting not only contribute to preserving and promoting Chinese traditional culture but also play a significant role in promoting international cultural exchange and understanding.

2.5 Application of Nanjing Paper-Cutting in Modern Society

2.5.1 Promotion and Teaching in Education

In China's primary and secondary education system, paper-cutting courses are often incorporated into art classes (L. Chen, 2024), where students learn about the history, cultural background, and basic techniques of paper-cutting through theoretical instruction and hands-on practice. These courses not only help students develop practical skills and artistic creativity but also foster an interest in and appreciation for traditional culture. Outside of regular classes, paper-cutting interest groups or clubs are often formed, inviting paper-cutting artists to conduct live teaching sessions and performances. Through interactions with these artists, students can experience the charm of paper-cutting art more directly, which inspires their enthusiasm for learning, as illustrated below:

พหุ ม ประถมศึกษา



Figure 44 Zhang Jun instructs students in Nanjing Jinling Middle School to cut paper
Source: <https://www.sohu.com/> [Accessed on Jun. 21st, 2024]

In the higher education and research stage in China, art universities offer specialized courses in paper-cutting art, systematically teaching paper-cutting techniques and creative concepts, while encouraging students to engage in innovative design and research. Universities can also collaborate with paper-cutting museums and ICH (ICH) protection institutions to conduct specialized research on paper-cutting art, promoting the transmission and development of paper-cutting techniques. In academic research, through papers, books, and exhibitions, the historical origins, cultural connotations, and modern applications of paper-cutting art are explored, providing theoretical support for the protection and inheritance of paper-cutting art.



Figure 45 Ministry of Education Chinese Traditional Culture and Art Heritage Foundation - Nanjing University of Aeronautics and Astronautics
Source: <http://nuaa.edu.cn/> [Accessed on Jun. 21st, 2024]

In the realm of public education in China, such as social training, paper-cutting workshops are offered at community cultural centers or cultural institutes to teach paper-cutting techniques to the general public. By organizing paper-cutting competitions and exhibitions, public interest and participation in this art form are enhanced. Public welfare activities, including introducing paper-cutting into schools, communities, and rural areas, provide more people with opportunities to experience and learn about paper-cutting, fostering the widespread dissemination of this cultural tradition, as illustrated in the figure.



Figure 46 Chen Yao participated in the community public welfare activities of Huaihai Road, Qinhuai District, Nanjing

Source: <http://www.js.xinhuanet.com/> [Accessed on Jun. 21st, 2024]

2.5.2 Utilization and Development in the Tourism Industry

Nanjing Paper-Cutting plays a significant role in the tourism industry, serving as both a cultural highlight that attracts visitors and a popular product in the tourism goods market. At major attractions and souvenir shops across Nanjing, paper-cutting artworks are widely sold and have become highly sought-after keepsakes for tourists. Additionally, hands-on paper-cutting workshops have become a part of tourism programs, allowing visitors to engage in the craft and experience the charm of traditional art firsthand.

Efforts have been made to develop paper-cutting-themed souvenirs, such as bookmarks, postcards, and ornaments. These items combine artistic value with practicality and portability, making them highly favored by tourists. Custom paper-cutting services are also offered, where artists create personalized designs based on the preferences of visitors ranging from family portraits to iconic landmarks allowing tourists to take home unique and memorable keepsakes, as illustrated in the figure.



Figure 47 Chen Yao for the Nanjing Red Temple fair for foreign friends ‘paper-cut portraits

Source: <https://baijiahao.baidu.com/> [Accessed on Jun. 21st, 2024]

Dedicated exhibition zones for paper-cutting art can be set up at tourist sites, showcasing both traditional and modern paper-cutting works to captivate visitors and encourage purchases. Live demonstrations and interactive experiences enable tourists to witness the intricate process of creating paper-cutting art, enhancing their overall travel experience. Integrating paper-cutting workshops into travel itineraries allows visitors to craft their own pieces under the guidance of skilled artists, fostering a deeper sense of engagement and enjoyment.

During traditional festivals and peak tourism seasons, events such as paper-cutting festivals, exhibitions, and competitions can be organized to draw more participants. These dynamic activities not only enhance the visibility of paper-cutting art but also increase its cultural impact and popularity.

2.5.3 Opportunities and Challenges in Virtual Cultural Spaces

The rise of the internet and social media has presented unprecedented opportunities for the dissemination of Nanjing Paper-Cutting in virtual cultural spaces. Digitized paper-cutting artworks can be shared rapidly through online platforms, greatly expanding their reach and influence. Developing digital creative products themed around paper-cutting—such as wallpapers, emojis, and video games—further diversifies its applications and draws the attention of younger audiences.

Cross-industry collaborations also play a crucial role in the development of Nanjing Paper-Cutting. Partnerships with fashion, film, and advertising industries have led to the creation of products like clothing designs featuring paper-cutting motifs, animated films, and creative advertisements. These ventures not only enhance the commercial value of paper-cutting art but also open up new markets for its growth, as illustrated in the figure.



Figure 48 Nanjing Paper-Cutting combined with mobile games
Source: <https://www.163.com/dy/media/T1468579868243.html> [Accessed on Jun. 21st, 2024]

However, alongside the widespread adoption of digital dissemination, Nanjing Paper-Cutting faces several challenges. The transmission of traditional craftsmanship becomes more complex in virtual cultural spaces, as traditional paper-cutting heavily relies on manual skills and hands-on teaching. Developing effective methods to pass down these techniques in a digital environment remains a pressing issue.

Furthermore, the ease of reproduction and sharing in digital spaces raises concerns about protecting the intellectual property rights of paper-cutting artists. In the context of cultural homogenization and globalization, preserving the local characteristics and cultural depth of paper-cutting art is also a challenge. Artists must learn new technologies to adapt to the demands of digital dissemination.

Despite these challenges, the opportunities for Nanjing Paper-Cutting in virtual cultural spaces are immense. Online exhibitions and interactive experiences, such as online teaching programs like "Heritage Heirloom Classroom," provide learning opportunities for paper-cutting techniques, breaking geographical barriers and expanding the audience reach. Additionally, cross-industry collaborations and the development of digital creative products continue to open new possibilities for the promotion and dissemination of Nanjing Paper-Cutting, as illustrated in the figure.



Figure 49 Nanjing Paper-Cutting ICH inheritor Zhang Ying online class
Source: <https://ass.nanjing.gov.cn/> [Accessed on Jun. 21st, 2024]

2.6 Chapter Summary

2.6.1 Review of Chapter Content

This chapter provided a comprehensive overview of the historical, cultural, and artistic value of Nanjing Paper-Cutting. It explored its profound historical origins, rich artistic features, unique cultural connotations, and diverse applications in modern society, highlighting its significant role in Chinese traditional culture.

Nanjing Paper-Cutting not only encapsulates the historical memories and local customs of the Nanjing region but also reflects its distinctive regional characteristics and folk beliefs through its artistic techniques and thematic choices. As an ICH, Nanjing Paper-Cutting demonstrates vast potential in areas such as promotion, education, and tourism in contemporary society.

Notably, in the realm of virtual cultural spaces, Nanjing Paper-Cutting is presented with new opportunities and challenges, opening up innovative possibilities for its future development and preservation.

2.6.2 Research Findings of This Chapter

Table 3 Chapter 2 Research Results

Serial Number	Achievement Name	Specific Content
1	Historical Origins and Development Process	Highlights the cultural significance and regional traits of Nanjing Paper-Cutting, emphasizing its role in local cultur
2	Artistic Feature Analysis	Analyzes the distinctiveness of Nanjing Paper-Cutting in themes, styles, tools, and materials, showcasing its role in skill and artistic heritage
3	Cultural Connotations and Social Value	Stresses Nanjing Paper-Cutting's importance in life customs, folk beliefs, and religious culture as an ICH
4	Relationship with Other Handicrafts	Examines the relationship between Nanjing Paper-Cutting and other local crafts, showing its unique place in the regional cultural landscape
5	Exploration of Modern Application Scenarios	Summarizes the practical uses of Nanjing Paper-Cutting in education, tourism, and virtual cultural spaces, highlighting its potential for modern dissemination

Source: Author. Jul. 4th, 2024

2.6.3 Relationship with the Next Chapter

This chapter's analysis of the historical, cultural, and artistic value of Nanjing Paper-Cutting lays a solid foundation for the subsequent exploration of its digital presentation in virtual cultural spaces. A thorough understanding of the traditional essence of Nanjing Paper-Cutting will enable the next chapter to more accurately capture its core values and achieve innovative expressions of this art form through digital technologies. The insights into the cultural essence and artistic characteristics discussed in this chapter will guide the design process in virtual environments, ensuring that the digital presentation not only embraces innovation but also preserves

Chapter III

Paper-Cutting Art in Virtual Cultural Spaces Supported by Digital Technology

3.1 Introduction

3.1.1 Research Background

With the rapid development of digital technology, traditional methods of cultural heritage protection and dissemination are undergoing profound changes. As an important part of Chinese Paper-Cutting, Nanjing Paper-Cutting is listed as a world intangible cultural heritage by UNESCO and has attracted widespread attention because of its unique cultural value and artistic style. However, with the evolution of modern lifestyle, Nanjing Paper-Cutting faces challenges in inheritance, and innovative presentation and dissemination methods are urgently needed.

The development of digital technologies, particularly virtual reality (VR), augmented reality (AR), artificial intelligence (AI), and interactive game design, provides novel avenues for the preservation of Nanjing Paper-Cutting. These technologies transcend the limitations of time and space, enabling the integration of paper-cutting art into digital spaces through interactive games. This approach enhances public interest and understanding of traditional culture, creating new pathways for the inheritance of Nanjing Paper-Cutting.

3.1.2 Research Objectives and Significance

This chapter aims to analyze the presentation methods of Nanjing Paper-Cutting in virtual cultural spaces and the application of digital technologies. It explores how static paper-cutting art can be transformed into more interactive digital content. By examining the forms of expression and dissemination of paper-cutting art within virtual cultural spaces, the study investigates how digital methods can innovate its presentation, thereby promoting the inheritance and development of Nanjing Paper-Cutting.

1) The core objectives of this chapter include:

Application Value of Digital Technologies: Investigating how digital technologies contribute to cultural heritage preservation and identifying associated challenges.

2) Virtual Cultural Spaces: Exploring their definition, characteristics, and role in supporting cultural heritage transmission.

3) Digital Representation of Paper-Cutting Art: Analyzing its presence in material databases, animation, interactive design, and interdisciplinary collaborations.

4) Interactive Games and Cultural Dissemination: Examining the role of digital games in enhancing cultural outreach and fostering innovative heritage inheritance.

5) Integration Strategies: Proposing methods to effectively integrate digital technologies with cultural heritage preservation and transmission.

3.1.3 Chapter Structure

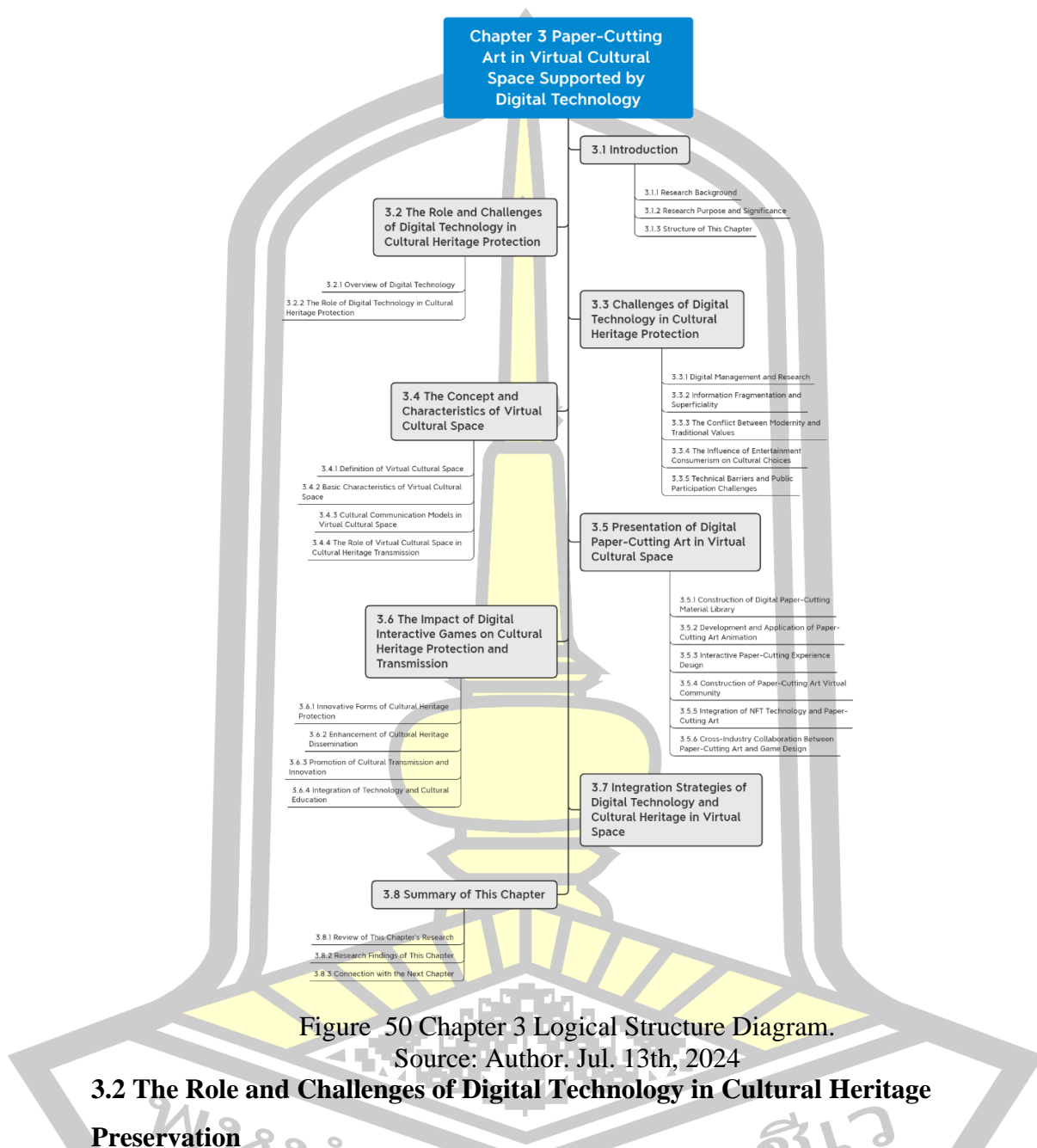


Figure 50 Chapter 3 Logical Structure Diagram.

Source: Author. Jul. 13th, 2024

3.2 The Role and Challenges of Digital Technology in Cultural Heritage Preservation

3.2.1 Overview of Digital Technology

The development of digital technology has evolved from basic numerical computation and data processing to multidimensional technologies (Andonovski et al., 2019) such as artificial intelligence and virtual reality. The earliest applications of digital technology emerged in the mid-20th century (Sofroniou, 2019), advancing with the rise of computer technology. Over time, it expanded into fields such as the internet, big data, and the Internet of Things. In the 21st century, cutting-edge technologies represented by artificial intelligence (AI), augmented reality (AR), and

virtual reality (VR) have developed rapidly, significantly broadening the application scenarios of digital technology. Today, digital technology is not only applied in industries and commerce but also demonstrates immense potential in the cultural and artistic fields, providing innovative methods for the preservation and inheritance of ICH.

3.2.2 The Role of Digital Technology in Cultural Heritage Preservation

The innovative application of digital technology in the display and dissemination of cultural heritage has brought revolutionary changes to preservation methods.

1) Virtual Reality and Augmented Reality

Virtual reality (VR) and augmented reality (AR) technologies create immersive and interactive virtual environments, offering users a lifelike cultural experience. Using VR or AR, users can explore ancient sites, restored buildings, and artifacts in virtual spaces or even "travel" back to historical events, allowing for a more intuitive understanding of the background and value of cultural heritage.

AR technology can overlay digital content onto real-world scenes, enhancing the interactivity and realism of cultural experiences. The establishment of digital museums and libraries enables online access to a vast array of digitized cultural heritage, including artworks, historical documents, and rare collections, overcoming geographical and temporal limitations and significantly promoting the popularization and education of cultural heritage.

VR and AR technologies further expand the breadth and depth of digital presentations. With VR, users can immerse themselves in historical scenes and cultural sites, gaining a profound cultural experience. Meanwhile, AR enriches the presentation of cultural heritage by overlaying digital information onto the real world, offering engaging interactive content that greatly enhances the appeal and interest of cultural heritage.

Mobile devices such as smartphones and tablets, along with social media platforms and digital media, provide convenient and efficient channels for disseminating cultural heritage. These tools facilitate broader reach and accessibility, enabling cultural heritage to connect with diverse audiences on a larger scale.

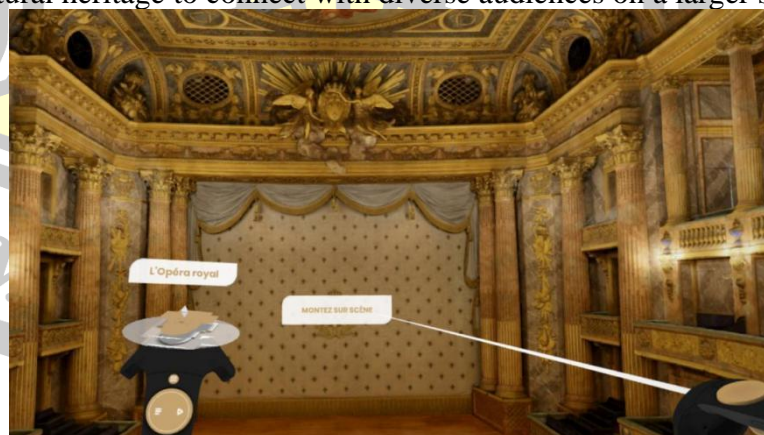


Figure 51 The Palace is Yours is a virtual representation of the Royal Opera House from a VR perspective

Source: <https://www.sohu.com/> [Accessed on Jul. 13th, 2024]

2) Digital Collection and Storage Technologies

Digital collection and storage technologies use high-precision equipment to convert cultural heritage into digital formats(Lu & Pan, 2011), providing technical support for long-term preservation. High-resolution scanners and digital cameras are employed to meticulously scan and photograph documents, archives, manuscripts, and artworks, generating high-definition digital images. This approach not only minimizes damage caused by frequent physical handling but also ensures reliable digital backups for cultural heritage preservation.

For audio-visual cultural heritage, recording and video technologies are used to comprehensively preserve original sounds and dynamic information, making the digital collection process more systematic and complete. In terms of storage, the widespread application of cloud storage and distributed storage technologies further ensures the security and durability of digitized cultural heritage. By storing digital content on secure and reliable servers and implementing redundant backups, the risk of data loss is significantly reduced, as illustrated in the following diagram:



Figure 52 Relics "dragon head" digital collection site
Source: <http://www.news.cn/> [Accessed on Jul. 13th, 2024]

3) Digital Processing and Restoration Technology

Digital processing and restoration technologies enable the repair and reconstruction of cultural heritage within digital spaces(Basu et al., 2023), ensuring the quality of presentation and information integrity. Through precise modeling and simulation using digital twin technology, highly accurate digital replicas of cultural heritage can be created, achieving comprehensive documentation and protection. Image and video processing technologies are further used to eliminate noise from the collection process, enhancing color and brightness to make digital images and videos closer to their original state. Supported by 3D scanning technology, cultural heritage can be scanned in detail to obtain three-dimensional data, which is then combined with modeling software to generate realistic 3D models. This allows for the three-dimensional visualization and dynamic display of cultural heritage, bringing innovative breakthroughs to research and dissemination. 3D modeling technology plays a crucial role in cultural heritage digitization. With high-precision 3D modeling, artifacts, buildings, and other cultural assets can be recorded as detailed digital models, providing accurate references for academic research and future restoration efforts. 3D printing technology is particularly useful in physical restoration, enabling

the reproduction of damaged or missing parts of artifacts or the reconstruction of historical building structures, facilitating their display and preservation. The comprehensive application of these technologies greatly enhances the ability to digitally preserve and restore cultural heritage, as shown in the figure.



Figure 53 3D modeling of Saint Anne d'Ore statue in France

Source: <https://www.sikantech.com/> [Accessed on Jul. 13th, 2024]

4) Artificial Intelligence

Artificial intelligence (AI) plays a critical role in the preservation, restoration, and dissemination of cultural heritage (Yu et al., 2022). By leveraging image recognition and big data analysis, AI can automatically classify and annotate large volumes of artifacts, documents, and artworks, enhancing data management efficiency and supporting scientific preservation efforts.

Deep learning models enable intelligent predictions of missing or damaged parts, accurately restoring the shapes and colors of cultural heritage (Mishra, 2021). Additionally, AI-powered natural language processing technologies assist in deciphering and translating ancient texts, fostering cross-linguistic cultural exchange. AI-driven intelligent guide systems offer personalized explanation services while optimizing promotional strategies through user behavior analysis, increasing the appeal of cultural dissemination.

Generative AI can create new content based on traditional cultural styles, preserving heritage (Rane, 2023) while inspiring young people to engage in cultural innovation, promoting the transmission and development of cultural heritage in modern contexts.

For damaged or lost artifacts, AI can generate precise restoration models using existing data. Through deep learning models, AI can predict the original forms and details of incomplete murals, sculptures, or inscriptions, aiding scholars in reconstructing lost historical and cultural information. Moreover, AI can automatically produce virtual images or restoration renderings, facilitating academic research and public appreciation, as illustrated in the following diagram:



Figure 54 AI intelligent restoration of the exterior walls of ancient Roman Colosseum
Source: <https://www.sify.com/ai-analytics/how-technology-is-saving-art/> [Accessed on Jul. 13th, 2024]

In museums and heritage sites, AI-driven intelligent guide systems provide personalized explanation services for visitors. AI can adjust the content of explanations in real time based on visitors' interests, automatically recommending relevant cultural information to offer an immersive cultural experience. Combined with virtual reality (VR) technology, AI-guided tours can create immersive virtual exhibitions, allowing visitors to deeply explore the background and significance of cultural heritage, as illustrated in the following diagram:



Figure 55 Henan Museum AI digital human docent
Source: <https://baijiahao.baidu.com/> [Accessed on Jul. 13th, 2024]

At the same time, AI's user preference analysis capabilities help cultural institutions better understand audience needs (Capatina et al., 2020), enabling them to develop dissemination strategies aligned with public interests. AI can analyze user feedback on specific cultural content through social media, designing more targeted promotional plans that enhance the appeal and interactivity of cultural heritage while expanding its influence.

Moreover, generative AI can create innovative artistic content based on specific cultural styles, such as designing new artworks inspired by traditional

patterns or incorporating traditional elements into modern product designs. This approach not only aids in preserving and promoting traditional culture but also revitalizes it within modern design contexts, attracting more young people to engage with and contribute to cultural creation. This integration fosters the contemporary transmission and innovation of traditional culture, as illustrated in the following diagram:



Figure 56 Jinling Map AI digital exhibition
Source: Photographed by the author. Jul. 13th, 2024]

Blockchain Technology

Blockchain technology, with its immutable and traceable characteristics in data storage and provenance (P. Zhu et al., 2023), plays a vital role in the copyright protection and traceability of cultural assets. By establishing a unique "digital identity" for artifacts and digitalized content, blockchain ensures clear records of cultural assets' origins and ownership, preventing illegal transactions and counterfeiting. Furthermore, blockchain enhances the transparency and sharing of cultural resources, improving the security and reliability of cultural heritage management.

These digital technologies collectively offer significant advantages, supporting cultural heritage in terms of preservation, exhibition, research, and management. They provide comprehensive solutions for safeguarding and promoting humanity's historical and cultural legacy.

3.3 Challenges of Digital Technology in Cultural Heritage Protection

3.3.1 Digital Management and Research

As the digitalization of cultural heritage progresses, digital management and research technologies have become central to its protection. The establishment of cultural heritage databases supports the efficient management of digitalized content. The application of large AI models further enhances the ability to manage and study cultural heritage data, enabling rapid data retrieval, classification, and analysis. Metadata and content management systems effectively organize, classify, and retrieve digital cultural heritage data, thereby promoting its reasonable application and in-depth research.

3.3.2 Information Fragmentation and Superficiality

While digital technologies facilitate the dissemination of cultural information, they also bring challenges of information fragmentation and superficiality. Platforms such as short videos and social media simplify cultural content into easily consumable snippets, potentially reducing cultural comprehension to superficial levels. Traditional culture requires systematic learning and understanding, yet fragmented dissemination risks diminishing public recognition of its deeper values.

The rapid pace of digital information dissemination and the diversification of communication channels make accessing cultural information convenient but fragmented. This tendency undermines the systematic and profound understanding of traditional culture. Additionally, fragmented dissemination often reduces traditional culture to symbolic elements or formalized icons, stripping away its inherent cultural depth and historical connotations.

3.3.3 Conflicts Between Modernity and Traditional Values

The digital age has reshaped societal structures, posing challenges to traditional values (Balkin, 2007). Emerging cultural forms like online literature often deconstruct collective values, emphasizing individualism and self-expression. This disrupts the harmony and collectivism central to traditional cultures such as Confucianism.

The participatory and interactive nature of digital culture has also redefined public aesthetics and artistic expression. Modern audiences prefer interactive and customizable aesthetic experiences via digital platforms, diverging from the static, symbolic, and ritualistic expressions of traditional culture. This shift marginalizes traditional aesthetics in favor of more diverse, dynamic formats.

3.3.4 Entertainment-Driven Cultural Preferences

Digital media, especially social platforms and short-video applications, has steered youth toward light-hearted, entertainment-oriented cultural products. Traditional culture, perceived as more serious and profound, struggles to engage younger audiences amid this demand for entertainment.

The diversity of cultural choices offered in the digital age allows audiences to select content based on personal preferences. While this enriches life experiences, it also places traditional culture at a disadvantage in a competitive, diverse cultural landscape, further diminishing its appeal among the youth.

3.3.5 Technical Barriers and Public Engagement

While digital technologies expand traditional culture's reach, they also present technical challenges. The rapid proliferation of advanced technologies requires audiences to possess digital literacy. This creates barriers for older adults and those with limited technical knowledge, restricting their access to and engagement with traditional culture.

Differences in generational and technical backgrounds lead to imbalanced participation in the digital dissemination of traditional culture. Overcoming these technical barriers to enhance engagement across various demographics remains a critical challenge in the digital age.

3.4 The Concept and Features of Virtual Cultural Spaces

3.4.1 Definition of Virtual Cultural Spaces

A virtual cultural space is a non-material spatial form constructed through digital technology (Cheesman et al., 2001). Originating from cultural activities in the real world, it is extended and recreated within virtual online environments. The concept can be traced back to Canadian science fiction author William Gibson's term "cyberspace" in his novel *Neuromancer*, later widely adopted to describe internet-created virtual worlds (Lavorgna, 2020).

Virtual cultural spaces are not mere digital replicas of physical spaces but independent entities with unique attributes and functions. Leveraging cutting-edge technologies such as cloud computing, big data, and artificial intelligence, these spaces encode, store, disseminate, and consume cultural content in novel ways.

For example, virtual museums allow individuals to remotely explore historical sites and art treasures worldwide, offering immersive, near-real experiences. Online games and social media platforms provide users with opportunities to create, share, and interact with cultural experiences, fostering unique online communities and subcultures.

3.4.2 Basic Characteristics of Virtual Cultural Spaces

1) Timeless and Space-Breaking Nature.

Virtual cultural spaces transcend the limitations of traditional physical spaces (Relph & Philosophy Documentation Center, 2007) allowing users to access and participate in cultural activities without being constrained by geographical location. This characteristic enables virtual cultural spaces to overcome time and space barriers, facilitating global cultural sharing and dissemination. For example, through virtual museums, people can explore collections from museums around the world from the comfort of their homes without having to visit in person.

2) Openness of Space.

Virtual cultural spaces are often highly open and inclusive, enabling easy access and participation in cultural exchanges and creations (Davidson, 2008). The free flow of information allows users to share and disseminate knowledge freely, promoting equal access to information and widespread knowledge distribution. This openness fosters a culture of free expression and democratizes participation in the cultural conversation.

3) Cultural Participation.

In virtual cultural spaces, users are not only passive consumers but also active participants and creators (Burri-Nenova, 2010). Platforms such as social media, online forums, and user-generated content (UGC) encourage users to share personal insights and create content, forming unique online communities and cultural ecosystems. This participatory nature promotes co-creation of culture and the blending of diverse cultures, as users interact and communicate, jointly shaping the form and content of the virtual cultural space.

4) Immersive Experience.

The application of cutting-edge technologies such as Virtual Reality Augmented Reality and holographic technology enables virtual cultural spaces to provide highly immersive experiences that closely mimic reality. Users feel as though they are physically present in the virtual environment, enjoying an experiential cultural encounter. This immersive experience enhances users' cultural perception and emotional resonance, making virtual cultural spaces highly attractive as cultural consumption venues.

Virtual cultural spaces are not only technologically constructed environments but also platforms for social interaction, reflecting societal structures, values, and interpersonal relationships. The interactions and behaviors of users within virtual cultural spaces form specific social norms and community cultures, adding complexity and dynamism to virtual cultural spaces similar to those in real society.

Virtual cultural spaces also present new business models and economic growth opportunities for the cultural industry, such as digital rights trading, online advertising, and virtual goods sales, driving the development of the cultural economy. For instance, the rise of digital collectibles offers new market opportunities for artists and collectors while providing regular users with options for investment and collection.

Furthermore, virtual cultural spaces provide a broad stage for cultural innovation and experimentation, where artists and creators can explore novel expressive methods and technological applications to produce unprecedented cultural products and experiences. This innovation not only enriches cultural content but also drives the evolution of artistic forms and the iteration of technology.

These characteristics of virtual cultural spaces work together to make them an important platform for connecting global cultures, promoting knowledge dissemination, stimulating cultural innovation, and advancing social progress. As technology continues to evolve, the boundaries of virtual cultural spaces will expand further, and their functions and influence will continue to deepen.

3.4.3 Cultural Dissemination Modes in Virtual Cultural Spaces

The cultural dissemination mode in virtual cultural spaces is a complex and multidimensional concept, involving interactions across technology, society, economics, and culture. The main dissemination modes currently include:

3.4.3.1 Hybrid Integration of Virtual and Physical Platforms

This mode emphasizes the effective connection between digital cultural enterprises and market demand through platforms in virtual cultural spaces. These platforms serve not only as information exchange carriers but also as hubs for matching demand and supply efficiently. This leads to the emergence of new digital cultural industry forms. For example, the integration of culture with technology, tourism, sports, and other industries, as well as social entertainment platforms like WeChat and Weibo, have emerged. One notable example is Tencent's "Digital Palace Museum" project. This initiative uses digital technology to bring the artifacts and historical stories of the Forbidden City online, complementing the physical space (the Palace Museum). Even if visitors cannot be physically present, they can still experience the charm of the Forbidden City through virtual platforms. Tencent has

also collaborated with the Palace Museum to launch cultural products, such as "Forbidden City Lipstick," combining traditional culture with modern aesthetics and innovating the integration of online and offline resources.

This development model represents a significant step in merging digital culture with traditional heritage and leveraging technology to enrich cultural experience.



Figure 57 Digital Palace Museum" home page

Source: <https://www.dpm.org.cn/bottom/friend.html> [Accessed on Jul. 13th, 2024]

3.4.3.2 "Cultural Creativity+" Scenario-Based User Production Model

The "Cultural Creativity+" scenario-based user production model enables users to take an active role in cultural creation and dissemination through virtual exhibitions, gamified experiences, short video production, AR interactive experiences, and DIY customization. This model transforms users into proactive drivers of cultural transmission.

For example, using Virtual Reality (VR) and Augmented Reality (AR) technologies, users can immerse themselves in museum exhibitions or experience local cultures firsthand. On platforms like gaming, short videos, and DIY, users integrate traditional cultural elements into personalized creations, expressing themselves while also spreading culture.

This model breathes new life into traditional culture in the digital era, offering innovative pathways for its preservation, innovation, and widespread dissemination. The fusion of traditional culture with digital technologies enables a dynamic, participatory approach to cultural communication. This creates opportunities for greater audience engagement and the global sharing of cultural heritage.

This approach exemplifies how virtual platforms empower users to become co-creators in cultural content, thus fostering deeper cultural participation and broadening the scope of cultural exchange.



Figure 58 Cultural and creative platform - NetEase Da Da

Source: <https://d.news.163.com/#/h5> [Accessed on Jul. 13th, 2024]

Big data plays a central role in this model by helping businesses analyze consumer identity traits, preferences, and habits with precision, constructing user scenarios, and fostering long-term, interactive connections with consumers. This model enables more customized, collaborative cultural product promotion and services, enhancing user experience and meeting personalized demands.

For instance, Alibaba's e-commerce promotion utilizes a full-scenario big data-driven approach. By integrating data from various online user behaviors, Alibaba offers personalized recommendations, improving user experience and conversion rates. The company has accumulated vast amounts of data on platforms such as Taobao and Tmall, including user browsing history, search preferences, shopping cart records, purchase habits, geographic locations, and social interactions. Through big data analysis and machine learning models, Alibaba performs user profiling and demand forecasting.

In virtual cultural spaces, the flow of innovative factors like knowledge, information, and talent ultimately forms innovation clusters at certain nodes. This model emphasizes an open network structure, promoting the sharing of knowledge and technology, and facilitating the linkage and symbiosis of regions and industries. This generates endogenous power for the digital cultural industry and drives the creation of innovation spaces. A prime example is the tech innovation ecosystem of Silicon Valley, where a concentration of technology companies, venture capital, universities, and research institutions create a mutually dependent, resource-sharing ecosystem. In this system, innovation factors flow freely, enabling rapid matching of businesses, talent, and capital, propelling innovation capabilities and industrial upgrading.

For example, Huaqiangbei in Shenzhen, known as "the first street of electronics," is home to thousands of electronics component and equipment suppliers, creating a highly open innovation and manufacturing community. Startups and creators can quickly obtain components and use the local supply chain and processing resources for prototype design and product testing. Through vertical integration of the supply chain and efficient logistics networks, Huaqiangbei enables rapid circulation of products and information. Companies share information and collaborate on production, driving product innovation.

These four models complement each other and collectively construct a development framework for the digital cultural industry in virtual cultural spaces, aiming to activate the vitality of virtual spaces and stimulate industrial innovation by

fostering interaction between platforms, users, markets, and producers, ultimately achieving the sustainable development of the digital cultural industry.

3.4.4 The Role of Virtual Cultural Spaces in Cultural Heritage Preservation

Virtual cultural spaces play a crucial role in cultural preservation, reflected in the following aspects:

Digital Protection and Preservation.

Virtual cultural spaces use digital technologies such as high-definition photography, 3D scanning, and virtual reality to digitally archive intangible and tangible cultural heritage, ensuring cultural information is preserved over time. For example, virtual reality can be used to reconstruct and recreate historical sites, allowing people to experience their past glory even if the original site no longer exists.

Living Transmission of ICH.

Virtual cultural spaces help preserve practices of ICH, such as traditional crafts, folk arts, music, and dance, facilitating their transmission to younger generations. Through online tutorials and interactive platforms, users can learn traditional musical instrument playing techniques or dance steps.

Wider Access to Cultural Education.

Virtual cultural spaces lower the barriers to education, making high-quality cultural education accessible to more people, particularly in remote areas. People can access rich cultural knowledge through the internet.

Cross-Cultural Communication and Exchange

Virtual cultural spaces break down geographical boundaries, promoting communication and understanding between different cultures. People can participate in cultural festivals, learn different languages, and understand various traditions, enhancing global cultural diversity awareness and respect.

Cultural Innovation and Recreation

Virtual cultural spaces provide artists and cultural workers with new creative platforms, where they can innovate by combining traditional elements with modern technologies, creating new products and experiences. For example, digital artists might incorporate traditional patterns into modern designs, producing digital art with ethnic cultural characteristics.

Community Participation and Cultural Identity

The rise of social media and virtual communities allows people to gather around shared cultural interests, share experiences (Mirzaei & Esmailzadeh, 2021), and participate in the planning and execution of cultural activities, thereby strengthening their identification with and pride in local culture.

In these ways, virtual cultural spaces not only preserve and protect cultural heritage but also promote its transmission, innovation, and education, making significant contributions to cultural inheritance and development.

3.5 Digital Paper-Cutting Art in Virtual Cultural Spaces

3.5.1 Building a Digital Paper-Cutting Material Library

A digital paper-cutting material library is a collection of traditional paper-cutting artworks converted into digital formats using modern information technologies, providing an accessible resource for storage and display. The emergence of this material library not only facilitates the preservation, dissemination, and recreation of paper-cutting art but also serves as a rich source of inspiration for designers, artists, and enthusiasts.

The library typically includes paper-cutting works of various styles and themes, such as traditional patterns, holiday themes, and modern designs, catering to different user needs. The images of paper-cutting works in the library are usually high-resolution to ensure no distortion when enlarged or printed, suitable for high-quality design and artistic creation. Users can easily access the digital material library via the internet, eliminating the need to visit physical locations, making it quick and convenient.

These materials can be used in various design projects, such as graphic design, web design, illustration, and animation production. Digital paper-cutting materials are often editable, allowing users to modify designs according to their creativity, such as changing colors, resizing, or rearranging elements. In the educational field, digital paper-cutting libraries can be used as teaching tools to help students understand and learn about paper-cutting art.

The digital preservation of paper-cutting art helps protect and transmit this traditional craft, allowing it to be appreciated by more people across time and space. Some digital paper-cutting libraries may include online communities or forums where users can share their works and exchange creative ideas. When using the digital material library, users should respect copyright information and use the materials legally to avoid infringement.

For commercial designers, the digital paper-cutting material library offers inspiration and convenience, assisting them in completing design tasks and meeting client demands. The establishment and maintenance of such libraries require professional technical support and aesthetic judgment to ensure the quality and diversity of the materials. As technology advances, these libraries are continuously updated and improved to meet evolving market demands and user preferences, such as those found on international design platforms like Pinterest, which offer a wide range of paper-cutting designs suitable for Asian and Eastern aesthetics. These platforms provide both free and paid access to paper-cutting elements, which can be used for commercial design, web design, and more.



Figure 59 Pinterest website screenshot

Source: <https://www.pinterest.com> [Accessed on Jun. 17th, 2024]

3.5.2 Development and Application of Paper-Cutting Art Animation

Paper-cutting art animation combines traditional paper-cutting art with modern animation techniques, preserving the essence of paper-cutting while giving it new life and expressive power through dynamic images. The content of paper-cutting art animation is mainly divided into two categories: one is educational or display content that introduces the art of paper-cutting itself, and the other is narrative content that uses the paper-cutting art style to tell a story. In terms of presentation, paper-cutting art animation is primarily represented in stop-motion animation, 2D animation, and 3D animation.

Stop-motion animation, also known as frame-by-frame animation, is a form of animation that involves carefully adjusting the position of paper-cutting pieces by hand. Each adjustment is followed by photographing one frame, and the movement of paper-cut figures or objects is captured through consecutive frames. When these frames are played back in sequence, a fluid animation effect is achieved. This method allows for the delicate and detailed movement of paper-cut pieces to be showcased, capturing the intricate nuances of the art form.

2D paper-cutting animation is an art form that combines traditional paper-cutting with 2D animation technology. This animation style leverages the visual characteristics of paper-cutting art to create dynamic images using 2D animation software. The process begins by designing paper-cut patterns, which are typically simple lines and distinct contours that are easy to recognize and display in animation. These patterns are then hand-cut or laser-cut into actual paper-cut artworks. Once the paper-cut pieces are created, they are scanned or photographed to convert them into digital images for animation production. The paper-cut images are imported into 2D animation software, such as Adobe Animate or Toon Boom Harmony, where keyframe techniques are used to create dynamic effects, such as movement, rotation, and scaling. The paper-cut animations are then combined with backgrounds, sound effects, and other animation elements to complete the final animation piece.

Paper-cutting 2D animation retains the flatness and silhouette effects of paper-cut art, giving it distinctive visual appeal and artistic features. The lines and contours in paper-cut animations are sharp and clear, with strong color contrasts, making them stand out in the animation. Through animation techniques, the paper-cut designs come to life with vivid dynamic effects, adding to their visual appeal. Chinese paper-cut

animation often incorporates traditional cultural elements, such as folk tales and holiday celebrations, creating a rich cultural atmosphere.



Figure 60 China's first paper-cut animation "Pig Eating Watermelon"
Source: <https://www.bilibili.com/video/> [Accessed on Jul. 24th, 2024]

Paper-cutting art 3D animation is an art form that combines traditional paper-cutting art with modern 3D animation technology. It transforms paper-cutting art into dynamic images in three-dimensional space through digital means, giving traditional art new forms of expression and vitality. Technically, 3D modeling software is used to create three-dimensional models of paper-cutting patterns. Material and texture techniques are applied to simulate the tactile and visual effects of paper-cutting. Keyframe animation technology is used to achieve dynamic representation of the models. Simulation techniques such as particle systems and cloth simulation enhance the realism of the animation. Advanced rendering techniques are employed to strengthen the visual impact and artistic beauty of the animation. In terms of artistic and cultural value, the traditional style of paper-cutting art is preserved while introducing innovative dynamic visual effects. This provides the audience with a completely new, immersive viewing experience, enhancing the expressiveness and dissemination of paper-cutting art, and revitalizing it in contemporary society.

3.5.3 Interactive Paper-Cutting Experience Design

Interactive paper-cutting experience design is an innovative form that combines traditional paper-cutting art with modern technology to provide participants with a more immersive, interactive, and personalized artistic experience. This design typically utilizes digital technology alongside traditional paper-cutting art to create new and innovative experience models. Through digital technology, participants can immerse themselves in a virtual paper-cutting art world and enjoy more realistic visual and auditory effects. Participants are not just viewers but can interact with the artwork through gestures, sound, or other methods, such as "cutting" patterns on a screen or controlling the transformation of virtual paper-cut designs with their movements. Interactive experience design often provides tools and platforms, allowing participants to design and create unique paper-cut works based on their preferences and creativity. By integrating fun learning, participants can explore the history, cultural significance, and techniques of paper-cutting, increasing their understanding and interest in Chinese traditional culture. The design considers different age groups and cultural backgrounds to ensure the inclusivity and accessibility of the experience, as shown in the image.

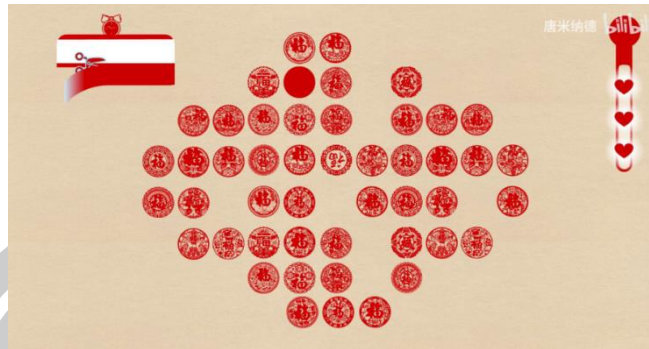


Figure 61 Interactive paper-cut animation "Xiao Xiao Le"

Source: <https://www.bilibili.com/video> [Accessed on Jul. 24th, 2024]

Interactive design can attract more participants, especially the younger generation, increasing their interest and engagement with paper-cutting art. In places like shopping malls, museums, and art festivals, interactive paper-cutting experience design can serve as a means to attract crowds and enhance brand image, providing commercial value.

3.5.4 Construction of a Paper-Cutting Art Virtual Community

A paper-cutting virtual community is an online platform or space based on the internet that brings together paper-cutting artists, enthusiasts, educators, and audiences, forming an interactive environment focused on paper-cutting art. This community is not bound by geographical location, and members can communicate and share through various online tools and social media platforms. The main forms are as follows:

Social media has become a new frontier for the dissemination of paper-cutting art.

Social media platforms such as WeChat, Facebook, Instagram, etc., have become important places for paper-cutting artists and enthusiasts to share works and exchange experiences. Through these platforms, paper-cutting art spreads rapidly, reaching a broader audience. Artists can attract attention and spark more interest in paper-cutting art by posting tutorial videos, showcasing the creation process, and sharing the details of their works, as shown in the image.

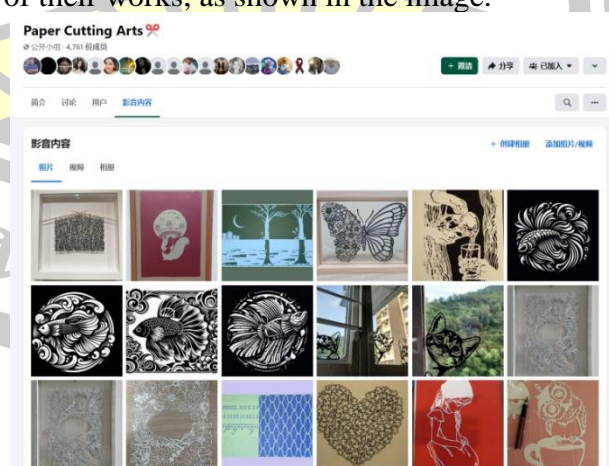


Figure 62 FaceBook page Paper-cutting Arts

Source: <https://www.facebook.com/groups/473245406664417/media> [Accessed on Jul. 24th, 2024]

WeChat Official Accounts, as an important component of the WeChat ecosystem, provide a dedicated platform for the dissemination of paper-cutting art. Through official accounts, artists and enthusiasts can create specialized paper-cutting communities and publish high-quality content, including paper-cutting tutorials, artwork showcases, cultural background introductions, and more. The push mechanism of the official accounts allows content to be directly delivered to followers, enhancing interactivity and engagement, as shown in the image.



Figure 63 Screenshot of Zhongmin ICH paper-cut wechat public account

Source: <https://mp.weixin.qq.com/> [Accessed on Jul. 24th, 2024]

New Exhibition Experience Breaking Time and Space Limits. By utilizing 3D technology, Virtual Reality (VR), and Augmented Reality (AR), digital art galleries such as the Han Yan Paper-Cutting Digital Art Gallery offer audiences an art appreciation space free from the constraints of time and space. Regardless of location, viewers can immerse themselves in the world of paper-cutting art and experience a completely different exhibition experience compared to traditional exhibits. This approach not only facilitates easier access for audiences but also provides paper-cutting artists with a broader stage for display. For example, the online exhibition "Top 100 Chinese Folk Paper-Cutting Special Exhibition, Second Session" held by Shanghai Academy of Fine Arts showcased paper-cutting works through an online platform, attracting a large number of viewers' attention, as shown in the image.

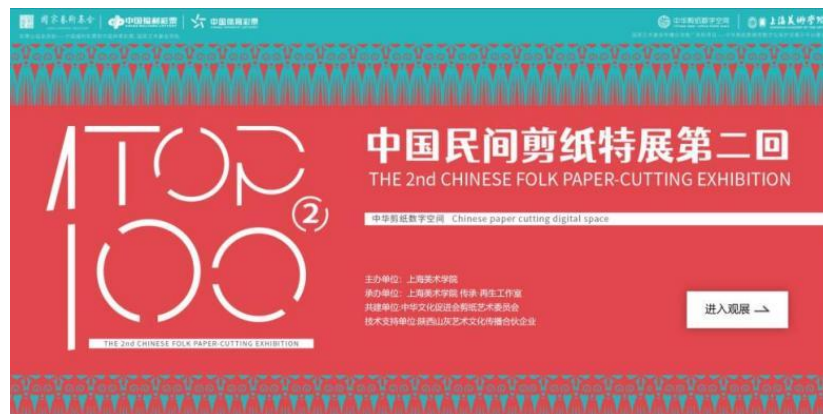


Figure 64 "Chinese Folk paper-cut exhibition Top100 second" online exhibition home page

Source: <http://www.papercutexhibition.safa.cn> [Accessed on Jul. 24th, 2024]

Online Education Platforms as a New Path for the Inheritance of Paper-Cutting Skills.

Online education platforms, by offering paper-cutting courses and workshops, have removed geographic limitations for learning and passing down paper-cutting techniques. Beginners can learn basic skills through online courses, while experienced enthusiasts can further enhance their craft through advanced lessons. This method of online education not only breaks geographical barriers but also provides more opportunities for the dissemination of paper-cutting art. As shown in the image:



Figure 65 National higher education smart education platform "Chinese Paper-Cutting" course

Source: <https://higher.smartedu.cn/course/66c91528711dc30c3464e451> [Accessed on Jul. 24th, 2024]

Databases and Repositories as a Knowledge Repository for Paper-Cutting Art.

Databases and repositories dedicated to paper-cutting art collect a wealth of paper-cutting works, artist information, and craft knowledge, providing valuable learning resources for researchers and enthusiasts. The establishment of these resource repositories contributes to the systematization and popularization of paper-cutting art knowledge. For example, the "Chinese Paper-Cutting Digital Space" platform includes abundant paper-cutting resources, offering researchers and enthusiasts a comprehensive window into the art of paper-cutting.

Video Platforms as a Visual Communication Channel for Paper-Cutting Art.

Video platforms such as YouTube and Bilibili serve as important windows for paper-cutting artists to showcase their works and skills. By posting tutorial videos and demonstrating the creative process, artists can attract more viewers and promote the spread of paper-cutting art. The visual and interactive nature of video content makes learning and appreciating paper-cutting art more engaging and enjoyable, as shown in the image:



Figure 66 Nanjing Paper-Cutting video Internet propaganda video

Source: https://www.bilibili.com/video/BV16K4y1r7FZ/?spm_id_from=333.337.search-card.all.click&vd_source=dc612cdeed834426f7a0175f79f690f5 [Accessed on Jul. 24th, 2024]

Online Marketplaces and Auction Platforms as a Means of Commercial Promotion for Paper-Cutting Art.

Online marketplaces and auction platforms primarily serve to commercially promote paper-cutting art. These platforms offer opportunities for showcasing and trading paper-cutting works, driving the commercialization of the art form. This not only provides financial rewards for artists but also fuels the promotion of paper-cutting art. Through these platforms, paper-cutting works can be discovered and appreciated by a wider audience, thereby increasing their market value, as shown in the image:



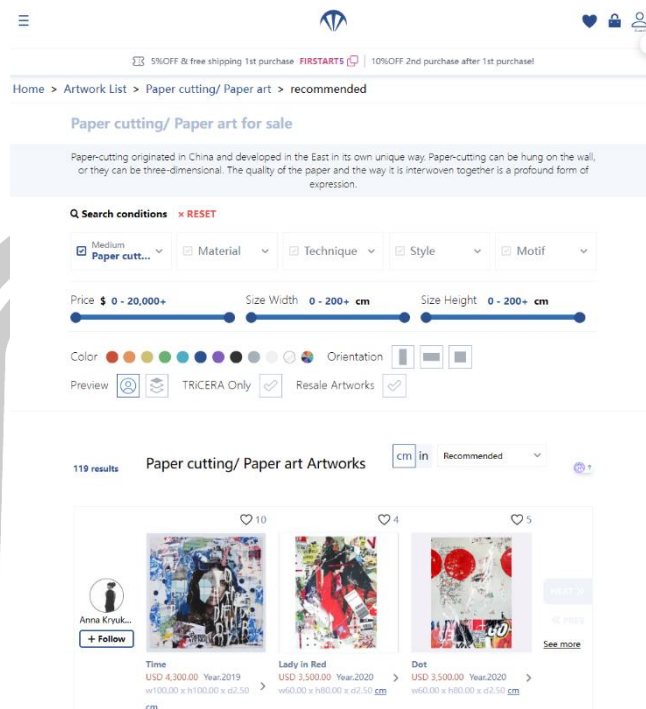


Figure 67 TRiCERA website paper-cut online shopping platform
 Source: <https://www.tricera.net/artworks/paper-cutting-and-paper-art?sort=recommended> [Accessed on Jul. 24th, 2024]

Online Seminars as a Tool to Facilitate Real-Time Communication and Learning.

Online meetings and seminars provide a platform for paper-cutting artists, researchers, and enthusiasts to engage in real-time communication and learning. Through these platforms, community members can share experiences, discuss challenges, and collaboratively promote the development of paper-cutting art.

3.5.5 Integration of NFT Technology with Paper-Cutting Art

The integration of Non-Fungible Tokens (NFTs) with paper-cutting art creates a new pathway for traditional art forms to enter the digital age. NFTs are encrypted assets based on blockchain technology, which provide unique ownership proof for digital artworks (Beckman, 2021), ensuring each piece is one-of-a-kind and non-replicable. This encourages artists to explore new expressive techniques, merging traditional paper-cutting art with digital media to create a completely new artistic experience. NFT projects can form communities around specific themes or artists, where fans and collectors can participate, creating a closer interactive and shared platform. NFTs give paper-cutting art works scarcity and collectible value, allowing collectors to buy, hold, and resell these digital artworks just like physical artworks. The "Terracotta Warrior Paper-Cutting" NFT uses digital technology to encrypt and authenticate each NFT, ensuring its uniqueness and authenticity. The direction of this project is to integrate the same artwork, transmit the same block, and broadcast on the same blockchain. Through digitization, the "Terracotta Warrior Paper-Cutting" promotes Chinese Qin Dynasty culture to the world, as shown in the image below:



Figure 68 Qin Dynasty terracotta Army paper-cut works

Source: <https://baijiahao.baidu.com/> [Accessed on Jul. 24th, 2024]

3.5.6 Cross-Border Collaboration between Paper-Cutting Art and Game Design

The integration of paper-cutting art with digital games represents a creative field that blends traditional paper-cutting techniques with modern digital technology, creating a new form that is both culturally rich and has contemporary entertainment value. The rise of digital games has provided paper-cutting art with new channels for dissemination and exhibition, enabling it to be presented to a wider audience, particularly younger generations, in a more vivid and intuitive way. This combination not only adds a unique artistic style to games but also helps traditional art forms revive and promotes their global spread and recognition. Common forms of integration include:

Paper-Cutting Style Visual Design: Games can incorporate paper-cutting art visual effects in character designs, scenes, and UI interfaces. Digital technology can be used to transform static paper-cutting works into dynamic scenes or cutscenes, enhancing the narrative and immersion of the game. For example, the mobile game *League of Legends* introduced a "Paper-Cutting Fairy" New Year theme skin inspired by paper-cutting art during the Chinese New Year. This initiative not only showcased the unique charm of paper-cutting art but also introduced the art form to a broader, younger audience through the digital game format. Additionally, the China Paper-Cutting Museum collaborated with *League of Legends* to release a special promotional video on paper-cutting art, further expanding its influence, as shown in the image below:



Figure 69 League of Heroes mobile game "paper-cut theme

Source: <https://lol.qq.com/act/a20230112mythmaker/> [Accessed on Jul. 24th, 2024]

The interactive paper-cutting of the Eight Immortals in the mobile game *Fantasy Free* not only showcases the unique charm of paper-cutting art but also offers a rich interactive experience, as shown in the image below:



Figure 70 "Fantasy Free" eight immortals interactive paper-cut style modeling
Source: <https://shouyou.3dmgame.com/news/40101.html> [Accessed on Jul. 24th, 2024]

The "Edutainment" style paper-cutting mini-games design various levels or mini-games that allow players to directly participate in the paper-cutting creation process, such as simulating the steps from folding paper to cutting out specific patterns. For example, the *Genshin Impact* official H5 mini-game activity, "Cutting Ribbon to Reflect the Rainbow," is a game that simulates the paper-cutting process. Through simple and intuitive interactions, it demonstrates essential paper-folding and stitching techniques used in paper-cutting and creates multiple paper-cut shapes filled with Chinese artistic charm. The well-placed paper-cutting puzzle segments add an extra layer of interactive fun, as shown in the image below:



Figure 71 "Original God" paper-cut game page screen
Source: http://inews.gtimg.com/newsapp_bt/0/15638663820/641 [Accessed on Jul. 24th, 2024]

3.6 The Impact of Digital interactive games on the Protection and Inheritance of Cultural Heritage

3.6.1 Innovative Forms of Cultural Heritage Protection

Digital interactive games provide a non-contact experience of cultural heritage, reducing the physical interaction between visitors and heritage sites, thus lowering the potential for damage. For example, in the "Virtual Great Wall" project, users can experience an immersive, game-based "digital Great Wall" without visiting the site, contributing to the protection of this valuable cultural heritage.

3.6.2 Enhancement of Cultural Heritage Dissemination

Digital interactive games, accessible via the internet and mobile devices, overcome geographical and temporal barriers, enabling global audiences to engage with cultural heritage. Their interactivity and entertainment value attract young users, presenting heritage in a gamified format that enhances engagement, immersion, and awareness. For instance, an ancient music arrangement game allows players to compose music while learning about Yungang artifacts and experiencing their cultural charm.

The *Digital Games for Spreading Traditional Chinese Culture Report* released by the Digital Creative Media Research Center at Beijing Normal University, in collaboration with Tencent Social Research Center, reveals the public's attitudes toward games that promote traditional culture. As illustrated in the image below:

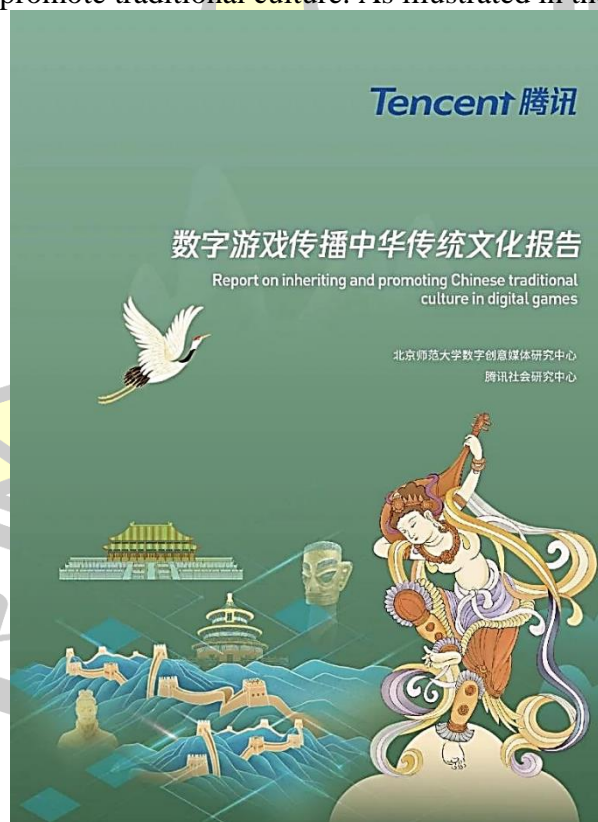


Figure 72 Report on Digital Games Spreading Traditional Chinese Culture (2022)
Source: https://m.thepaper.cn/baijiahao_19315936 [Accessed on Jul. 24th, 2024]

This report provides the first statistical analysis of all domestic games with valid licenses and still active in the past decade, focusing on their role in promoting traditional Chinese culture. We found that The proportion of popular domestic mobile games spreading Chinese traditional culture is as high as 64.80%, as shown in the figure below:

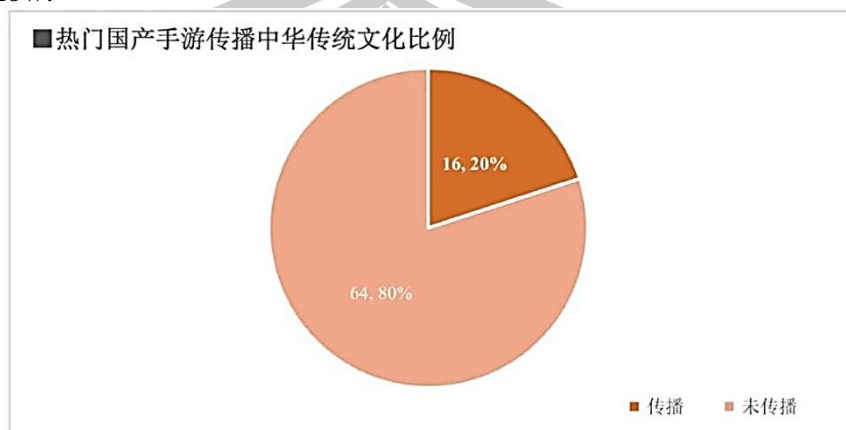


Figure 73 Popular domestic mobile games spread the proportion of traditional Chinese culture

Source: https://m.thepaper.cn/baijiahao_19315936 [Accessed on Jul. 24th, 2024]

The impact of digital interactive games on cultural heritage is multifaceted, enhancing the visibility, understanding, and appreciation of cultural heritage in novel and engaging ways.

The report also found that the dissemination of traditional Chinese culture is positively correlated with the game lifecycle. Role-playing and strategy games are the primary game types for promoting traditional culture, and themes such as the Three Kingdoms, martial arts, and immortality are the main subjects for cultural transmission.

The dissemination of Chinese culture in games can reach three realms: the "Symbolic Realm," which makes use of traditional cultural elements and forms; the "Knowledge Realm," which incorporates authentic traditional cultural information and conveys knowledge; and the "Conceptual Realm," which inherits and updates the spiritual and value-based aspects of traditional culture through narrative and interaction. The three dimensions—characters, environment, and actions—serve as specific channels for presenting traditional culture in games and enabling players to experience it.

The report pointed out that in recent years, the proportion of active domestic mobile games spreading Chinese traditional culture has exceeded 35%, they wish to further explore related traditional culture outside of the game, as shown in the figure below:



Figure 74 Currently active domestic mobile games spread the proportion of traditional Chinese culture and its release time distribution

Source: https://m.thepaper.cn/baijiahao_19315936 [Accessed on Jul. 24th, 2024]

The spread of traditional Chinese culture through digital games is not about indoctrination or preaching, but rather about a gentle, subtle influence, like spring rain nurturing everything quietly. With the collective efforts of the gaming industry and various sectors of society, domestic games will make greater contributions to the creative transformation and innovative development of China's outstanding traditional culture.

3.6.3 Promotion of Cultural Heritage and Innovation

As a cultural communication medium, digital interactive games can transmit the knowledge and value of cultural heritage to the younger generation. By presenting cultural heritage in a gamified way, young people can learn and inherit traditional culture through entertainment. For example, in the "Digital Dunhuang" project, the "Digital Mogao Caves" web game allows users to understand the history and cultural background of the Dunhuang Mogao Grottoes through game technology, thereby deepening their understanding and appreciation of traditional culture, as shown in the figure below:



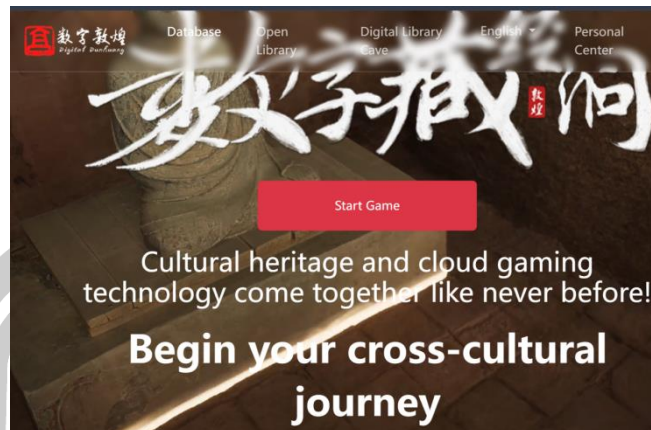


Figure 75 Screenshot of Digital Sutra Cave web game

Source: <https://dlc.e-dunhuang.com/> [Accessed on Jul. 24th, 2024]

Digital interactive games also provide numerous possibilities for the creative development of cultural heritage. Game developers can utilize advanced technologies to innovatively express and reinterpret cultural heritage, creating unique digital cultural products. These products not only meet the diverse needs of users but also inject new vitality into the industrial development of cultural heritage.

3.6.4 Integration of Technology and Cultural Education

The development of digital interactive games is closely supported by technology. With the continuous progress of big data, cloud computing, artificial intelligence, and other technologies, the application of digital interactive games in cultural heritage protection and dissemination will become even more widespread and in-depth. These technologies provide strong support for the digitalization and intelligence of cultural heritage, promoting the deep integration of culture and technology.

The development of digital interactive games also fosters cross-sector collaboration. With the support of game technologies, cultural heritage protection institutions, technology companies, universities, and other stakeholders can jointly participate in the digital protection and dissemination of cultural heritage, forming a synergy that promotes the prosperity and development of the cultural heritage sector. A notable example of user experience and cultural identity in cultural digital games is the "Digital Great Wall" project. By using game technology, it combines the protection of the Great Wall of China with the concept of digital twins, creating a surreal experience and showcasing the potential of digital technology in cultural heritage protection. Additionally, NetDragon has also integrated games with various cultural heritages, such as Fujian Tulou, ICH shadow puppetry, and paper-cutting art, to inspire the younger generation's interest and love for traditional culture, as shown in the figure below:



Figure 76 Screenshot from The Great Wall of Numbers
Source: <https://wapbaike.baidu.com/> [Accessed on Jul. 24th, 2024]

Digital interactive games, by combining entertainment and education, not only provide a new display window for cultural heritage but also open up innovative paths for its protection and transmission (Todorova - Ekmekci, 2021).

3.7 Integration Strategies of Digital Technology and Cultural Heritage in Virtual cultural spaces

The development strategy of the digital cultural industry focuses on four key areas: technological innovation, content innovation, cross-industry integration, and internationalization, all aimed at strengthening the digital-driven industry. Firstly, technological innovation provides the foundational support for the digital cultural industry. Cutting-edge technologies such as artificial intelligence, big data, blockchain, 5G, and virtual reality assist cultural enterprises in accurately grasping user demands, offering personalized products, and enhancing production efficiency and market competitiveness. Content innovation is the core competitiveness, as it involves the modernization of traditional cultural content to attract young audiences and meet their diverse needs (Park et al., 2023). In terms of cross-industry integration, the digital cultural industry actively collaborates with sectors such as technology, e-commerce, education, and tourism, driving the emergence of new economic growth points and application scenarios. At the same time, internationalization strategies expand the global market, enhancing the international influence of Chinese culture through cooperation with international cultural institutions.

In terms of policy, recent documents such as the "14th Five-Year Plan for Cultural Industry Development" and "Opinions on Promoting High-Quality Development of Foreign Cultural Trade" have been issued, guiding the deep integration of digitalization and cultural heritage preservation. These policies support the digitalization of cultural resources in rural areas, optimize the digital equipment configuration of public cultural institutions, and provide tax incentives, loan support, and other preferential policies to attract capital investment in the digital cultural industry, accelerating the digital transformation of traditional culture. The collaboration of governments, enterprises, academia, and civil organizations jointly promotes cultural heritage digitization. Governments provide policy and financial support, enterprises play a key role in digital projects, academic institutions provide technical support, and the public enhances cultural identity through participation in digital cultural experiences.

Sustainable development relies on technological innovation, market expansion, and the improvement of economic benefits. Technological innovation increases the added value and competitiveness of the industry, bringing diverse forms of cultural product presentation. Market expansion and internationalization strategies accelerate the global dissemination of cultural products, enhancing economic benefits. While preserving the core values of traditional culture, innovative methods stimulate new vitality in cultural heritage, achieving the integration of cultural inheritance and modern lifestyles, laying a solid foundation for the sustainable development of the digital cultural industry.

3.8 Chapter Summary

3.8.1 Review of This Chapter

This chapter, by analyzing the specific applications of digital technology in cultural heritage protection, delves into the role of technologies in the protection, storage, and dissemination of cultural content. In conjunction with the design needs of the Nanjing Paper-Cutting interactive game, this chapter explored how to integrate these digital technologies into the digital protection and transmission of Nanjing Paper-Cutting, providing innovative ideas and technical support for the interactive game design.

3.8.2 Research Findings of This Chapter

Table 4 Chapter 3 Research Results

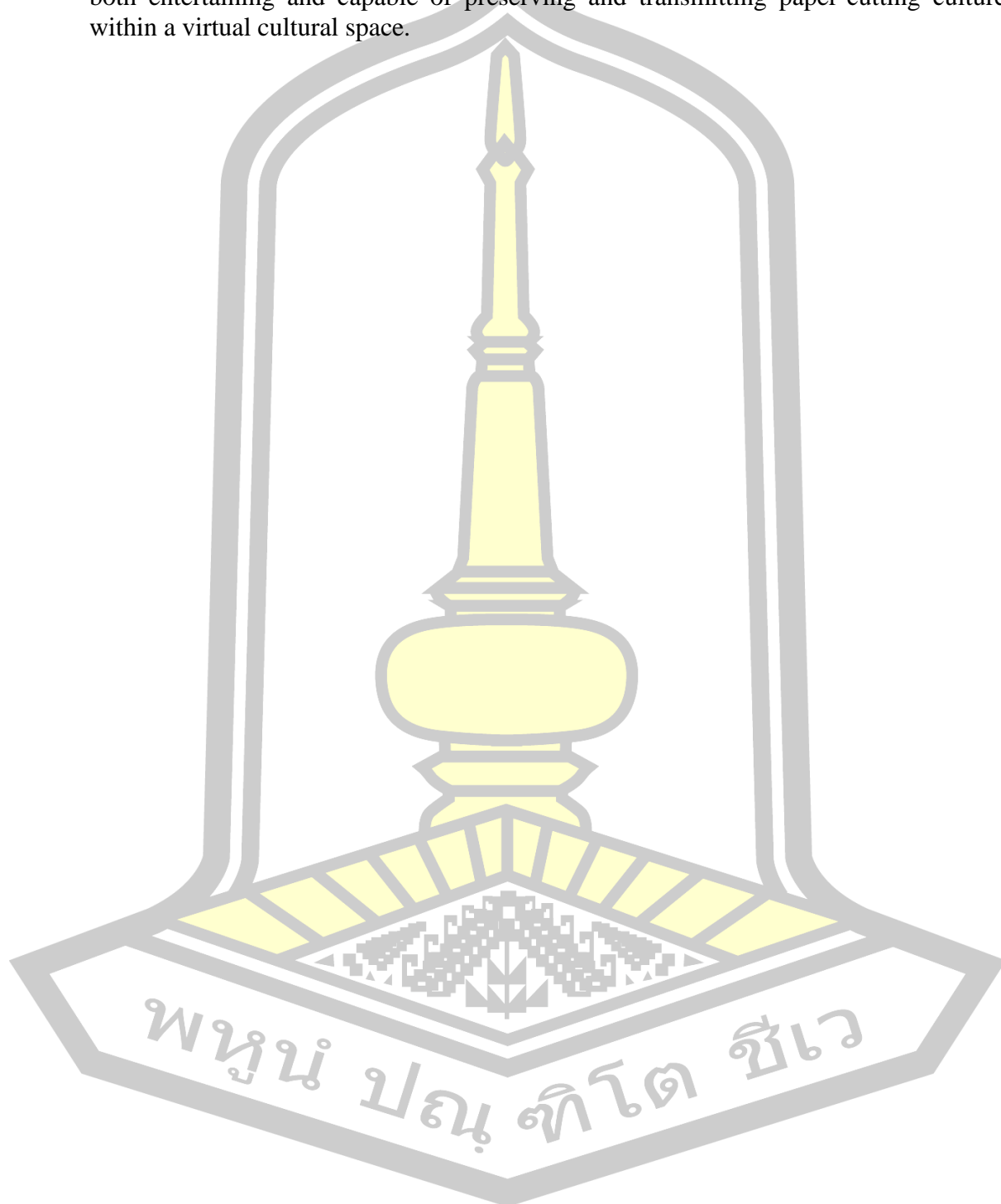
Serial Number	Achievement Name	Specific Content
1	Role and Challenges of Digital Technology in Cultural Heritage	Digital technology aids cultural heritage with tools like virtual reconstruction and digital archiving but faces standardization and technical challenges.
2	Concept and Features of Virtual Cultural Space	Virtual cultural spaces enable cross-border cultural exchange and innovation through digital platforms, overcoming time and space limitations.
3	Methods of Digital Paper-Cutting Art	Digital paper-cutting art broadens traditional forms with material libraries, animations, interactivity, virtual communities, and NFT technology, applied in education, entertainment, and commerce.
4	Impact of Digital Games on Cultural Heritage	Interactive games combine entertainment and education, engaging young audiences and innovating cultural heritage dissemination.
5	Strategies for Integrating Digital Technology with Cultural Heritage	Standardization, collaboration, public input, and innovation support digital heritage preservation.

Source: Author. Jul. 29th, 2024

3.8.3 Relationship with the Next Chapter

The research in this chapter provides the theoretical and technical foundation for the design and development of the *Nanjing Paper-Cutting Show* digital game. By analyzing the application of digital technologies in cultural heritage protection, this chapter summarizes the potential of these technologies in enhancing interactivity and improving user experience, offering insights for the digital innovation of paper-cutting art. The next chapter will focus on the design and development of the *Nanjing Paper-Cutting Show* digital game, specifically exploring how to apply the digital technologies discussed in this chapter to the game. It will cover the interactive and

immersive aspects of Nanjing Paper-Cutting art and present in detail the collection of digital paper-cutting materials, animation design, development of interaction mechanisms, and other stages, demonstrating how to create a digital experience that is both entertaining and capable of preserving and transmitting paper-cutting culture within a virtual cultural space.



Chapter IV

Design and Development of the *Nanjing Paper-Cutting Show* digital interactive game

4.1 Introduction

4.1.1 Research Background

This chapter focuses on the unique ICH of Nanjing Paper-Cutting. As part of traditional Chinese folk art, Nanjing Paper-Cutting boasts a long history, immense artistic value, and profound cultural connotations. Its works not only exhibit regional characteristics but also deeply reflect the history, customs, and beliefs of Nanjing and its surrounding areas, making it an integral component of traditional Chinese culture. However, with the acceleration of modernization and informatization, the inheritance of traditional crafts and art forms faces unprecedented challenges. Particularly among younger generations, the influence of traditional handicrafts has gradually diminished, leaving many cultural heritages on the brink of being forgotten. At the same time, the rapid development of digital technology has provided new opportunities for cultural preservation and innovation. Digital games, as a modern medium, have demonstrated extensive influence among younger audiences, serving as an effective tool for cultural dissemination.

Amid the trends of globalization and cultural diversification, Nanjing Paper-Cutting urgently requires modern technological approaches to transcend geographical and temporal boundaries, thereby expanding its influence and reach. Digital games, characterized by their interactivity, entertainment value, and educational potential, offer immense possibilities for cultural innovation. This study aims to digitize the traditional cultural elements, artistic techniques, and symbolic motifs of Nanjing Paper-Cutting through the interactive digital game *Nanjing Paper-Cutting Show*, opening new pathways for cultural preservation while engaging younger audiences. By leveraging this digital medium, Nanjing Paper-Cutting can transcend spatial and temporal limitations, achieving cultural education and innovative dissemination through immersive gaming experiences and further promoting its inheritance and development in modern society.

4.1.2 Research Objectives and Significance

Nanjing Paper-Cutting Show incorporates the cultural elements, artistic techniques, and symbolic motifs of Nanjing Paper-Cutting into game design, adopting a "experience + interaction + education" model targeting young players. The game aims to allow players to participate in the creation of paper-cutting art in a virtual cultural space, experiencing the intricate details and cultural depth of this traditional craft. By modernizing and gamifying the cultural experience, the game seeks to help young players rediscover and inherit the art of Nanjing Paper-Cutting in an engaging and interactive manner.

Guided by user needs, this study combines user research to identify the interests and behavioral patterns of the target audience, providing a scientific basis for game design and development. The game design integrates traditional art elements of Nanjing Paper-Cutting with modern technology through interactive scenarios that balance entertainment and education, enhancing user experience and cultural identity.

Pretesting and feedback-driven optimization have refined the game's functions and interface to ensure its cultural impact and effectiveness in dissemination. The release and promotion of the game further expand the channels for Nanjing Paper-Cutting's dissemination, offering a model for the modernization and transformation of traditional culture.

Specifically, this chapter addresses the following four core objectives:

User Research: Investigating young audiences' interests and needs regarding Nanjing Paper-Cutting to inform game design.

Game Design: Integrating Nanjing Paper-Cutting elements with interactive designs to ensure the game is both educational and entertaining.

Pretesting and Optimization: Enhancing the game through pretesting to improve user experience and cultural dissemination.

Deployment and Release: Developing release strategies to expand the game's user base and enhance the influence of Nanjing Paper-Cutting art.

4.1.3 Structure of This Chapter

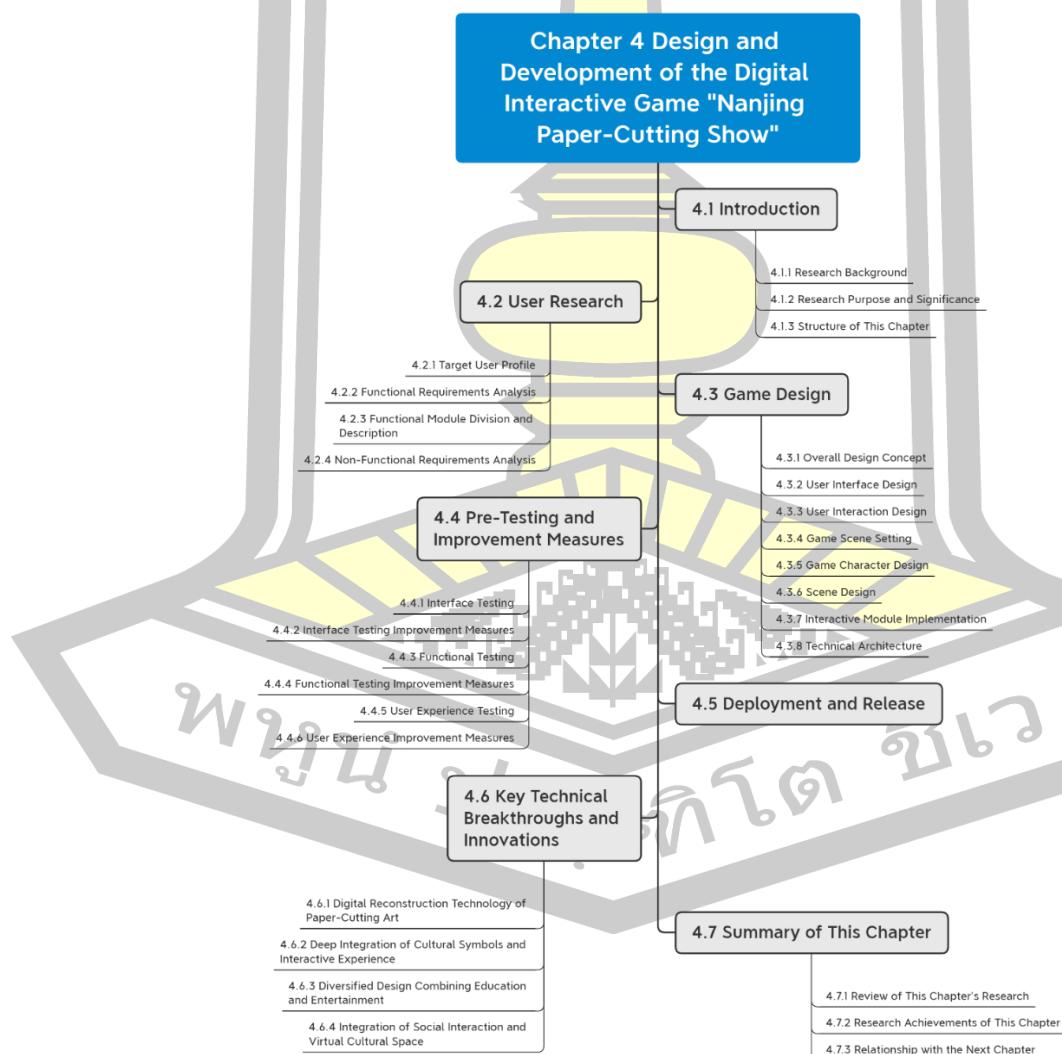
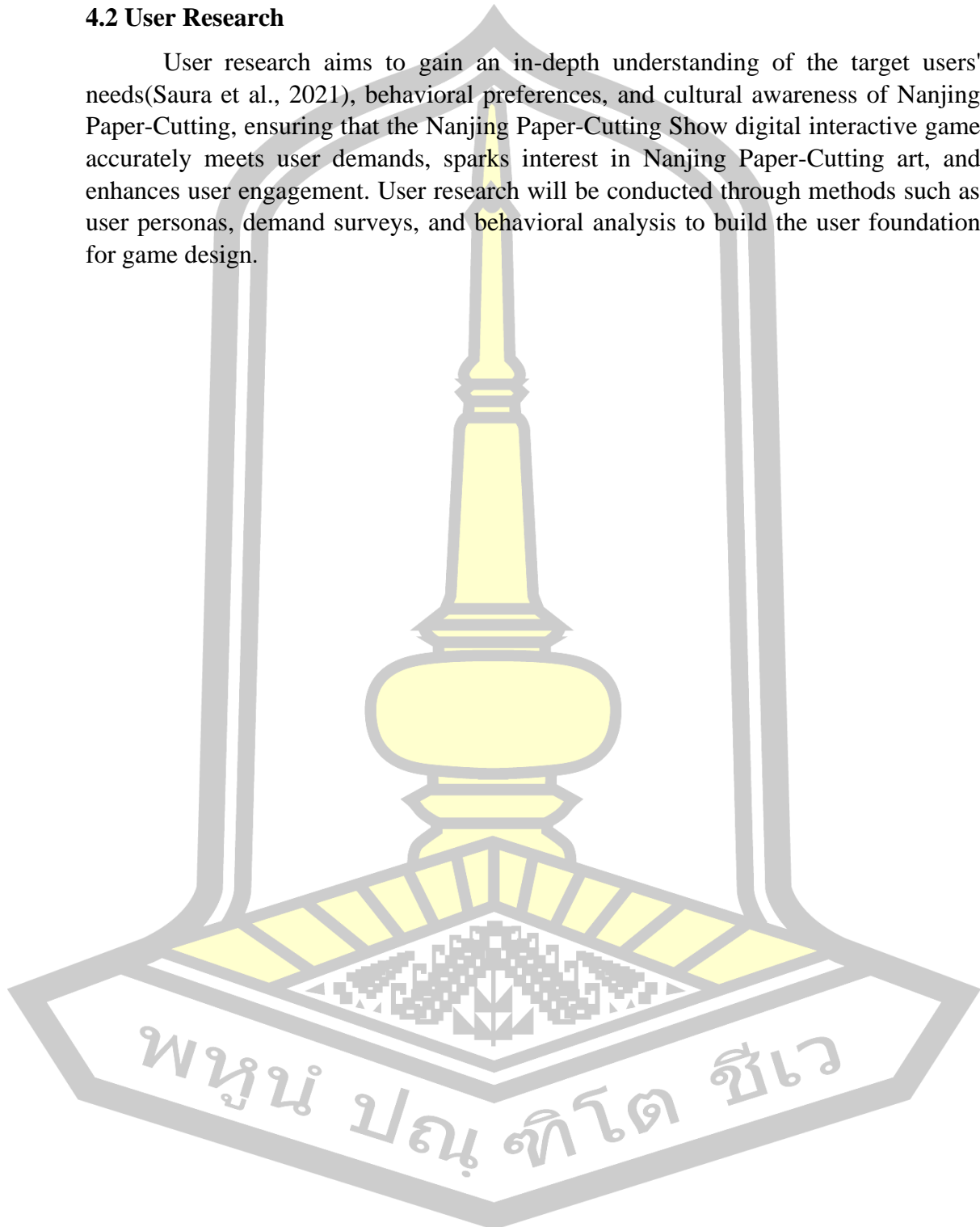


Figure 77 Chapter 4 Logical Structure Diagram

Source: Author. Jul. 29th, 2024

4.2 User Research

User research aims to gain an in-depth understanding of the target users' needs (Saura et al., 2021), behavioral preferences, and cultural awareness of Nanjing Paper-Cutting, ensuring that the Nanjing Paper-Cutting Show digital interactive game accurately meets user demands, sparks interest in Nanjing Paper-Cutting art, and enhances user engagement. User research will be conducted through methods such as user personas, demand surveys, and behavioral analysis to build the user foundation for game design.



4.2.1 Target User Persona

The target user persona is the process of creating a representative user group by collecting and analyzing user data. It helps developers better understand users' needs, behaviors, interests, and preferences, enabling the design of more accurate and expectation-aligning solutions for users.

4.2.1.1 User Age Range

The user age range is set based on the data collected from followers of Zhang Jun, a Nanjing Paper-Cutting inheritor, on the Douyin platform, as shown in the figure.



Figure 78 Nanjing Paper-Cutting ICH inheritor Zhang Jun account

Source: <https://www.douyin.com/user/MS4wLjABAAAawSXgexKp9dfX9Fi2o-bbMPwtXpaTLgZ0spxabSsGdQ0> [Accessed on Nov. 24th, 2024]

As of November 24, 2024, the number of fans is 1258, and the proportion of fans in the age group is shown in the figure

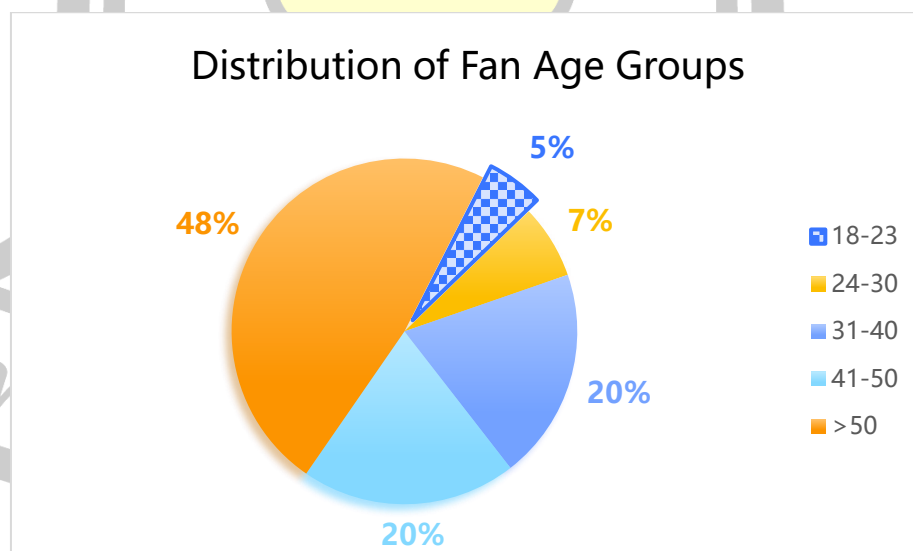


Figure 79 Account fan age analysis chart

Source: Author. Nov. 24th, 2024

As shown in the figure, the age group over 50 years old accounts for as much as 48%, the highest proportion among all age groups. Users in this age group have a strong interest in traditional culture, especially Nanjing Paper-Cutting, and have ample time to engage in paper-cutting practices. Meanwhile, the age groups 41-50 and 31-40 represent 20% each, indicating a relatively high level of attention to traditional culture. However, the 24-30 age group represents only 7%, and the 18-23 age group only 5%, the lowest among all age groups. This data reflects that the current youth group has limited attention to Nanjing Paper-Cutting, suggesting that there is still considerable room for improvement in the dissemination of traditional culture to attract a younger audience.

Therefore, the target users of the Nanjing Paper-Cutting digital interactive game should clearly focus on the middle-aged and young groups, especially the youth. First, attracting and cultivating the youth's interest in and recognition of traditional culture can help fill the significant gap in the audience structure for this age group. Second, by integrating Nanjing Paper-Cutting with modern technology in a more interactive and digital way, the game can ignite the enthusiasm of the younger generation and inject contemporary vitality into traditional culture.

Moreover, the youth, as the backbone of social development, play a key role in the cultural recognition and active participation that directly influence the inheritance and innovation of Nanjing Paper-Cutting. This not only helps to enhance the vitality of ICH but also boosts cultural confidence in the context of globalization, facilitating the sustainable transmission of culture. Therefore, focusing on the middle-aged and young groups, particularly attracting youth users, is a crucial strategic direction for the design and promotion of the Nanjing Paper-Cutting digital game.

4.2.1.2 User Needs and Expectations

A questionnaire survey was conducted to investigate the demand for the Nanjing Paper-Cutting digital game among the target group (Appendix A), with 353 valid responses. The demographic statistics of the target group are shown in the figure below.

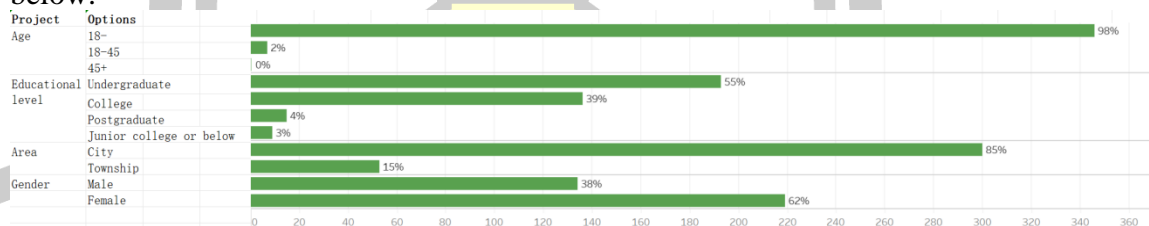


Figure 80 Demographic chart of target audience

Source: Author. Nov. Jul. 29th, 2024

The user persona for the Nanjing Paper-Cutting digital game can be described as follows: primarily young and middle-aged urban residents with a higher level of education, with a majority of female users. These users may have a certain interest in traditional culture and are willing to experience and learn paper-cutting art through digital games. The game design and marketing strategies may need to consider these user characteristics to better meet their needs and interests.

Project	Disagree	Strongly Disagree	Strongly Agree	Agree	Neutral
Improve cognition and understanding skills	8	2	101	179	63
Improve artistic ability	39	4	64	153	93
Learn paper- cutting skills	8	2	47	196	100
Learn relevant culture and spread it	10	0	88	205	50

Figure 81 Target audience needs analysis chart

Source: Author. Jul. 29th, 2024

From the data, it can be observed that the majority of the target audience holds a positive attitude towards improving cognitive and comprehension abilities, learning paper-cutting skills, and learning and spreading related culture. Particularly high proportions agree or strongly agree with "learning paper-cutting skills" and "learning and spreading related culture." However, regarding the need to enhance artistic abilities, although there is also a high agreement rate, the proportion of disagreement is relatively high, indicating that this need may have some divergence or differing opinions.

The target group users' needs for the "Paper-Cutting Digital Game" can be summarized as follows:

Efficiency in Completing Tasks.

Most respondents believe that the Nanjing Paper-Cutting digital game can significantly increase the speed of completing paper-cutting tasks. This indicates that the digital format offers a high efficiency advantage, meeting the modern user's need for convenience and speed while providing a more efficient artistic experience when time resources are limited.

Improvement of Paper-Cutting Skills.

A majority of respondents believe that participating in the Nanjing Paper-Cutting digital game can gradually improve their paper-cutting art skills. This feedback highlights the potential of such games in paper-cutting art education, as they not only stimulate users' interest in learning traditional arts but also help users master and improve paper-cutting skills through practice.

Cultural Understanding and Awareness.

Many respondents stated that the Nanjing Paper-Cutting digital game helps deepen their understanding and recognition of paper-cutting art. This suggests that the game is not only an entertainment tool but also an effective carrier for cultural transmission, helping users understand the history, techniques, and aesthetic values of paper-cutting through an engaging learning experience.

Hope for Learning and Mastery of Paper-Cutting Art.

The vast majority of respondents have high expectations for the Nanjing Paper-Cutting digital game, hoping to learn and master paper-cutting art and its cultural significance through this digital format. This indicates that digital games play a crucial role in promoting the inheritance of ICH, utilizing innovative forms to attract more users, especially the younger generation, to engage in the learning and preservation of traditional culture.

4.2.2 Functional Requirement Analysis

Functional requirement analysis is a crucial step in software development, ensuring that the system's functions align with user needs and meet core requirements. The purpose of functional requirement analysis is to define the essential features of the product and clarify the implementation details of each feature. The functional requirements analysis for the *Nanjing Paper-Cutting Show* digital game is as follows:

4.2.2.1 Paper-Cutting Art and Skill Learning Function

User Need: Learn Nanjing Paper-Cutting art and skills.

Design Goal: Enable users to learn paper-cutting art using digital tools, progressing from basic techniques to creative expression, gradually improving skills and artistic levels.

Paper-Cutting Instruction: Provide guidance on key techniques to help users understand and standardize their operations.

Creative Design Tasks: Offer a material library linked to specific themes, guiding users to innovate and enhance their comprehensive abilities.

Users can freely combine and create, exploring their personal style and artistic expression.

Artwork Display: Provide a platform for displaying users' works, encouraging communication and learning while motivating users to strive for higher levels of paper-cutting art.

4.2.2.2 Cultural Awareness Function

User Need: Enhance understanding and awareness of Nanjing Paper-Cutting.

Design Goal: Improve users' cultural awareness through rich content transmission.

Cultural Background Module: Display the history, cultural significance, and unique features of Nanjing Paper-Cutting art.

Interactive Q&A: Embed knowledge-based quizzes about paper-cutting art to stimulate user interest.

Art Appreciation Library: Provide a collection of classic Nanjing Paper-Cutting works for users to admire and reference.

4.2.2.3 Cultural Inheritance Function

User Need: Learn and spread Nanjing Paper-Cutting culture.

Design Goal: Promote the learning, inheritance, and cross-cultural dissemination of Nanjing Paper-Cutting through digital means.

ICH Inheritance Module: Use story-driven levels to narrate the inheritance story and technical features of Nanjing Paper-Cutting.

Social Sharing Function: Users can share their works, promoting cultural dissemination.

Cross-Cultural Communication: Provide bilingual support in Chinese and English and incorporate international elements to attract overseas users to learn about Nanjing Paper-Cutting.

4.2.2.4 Incentive and Immersion Function

User Need: Maintain interest in the game.

Design Goal: Enhance the interactivity and appeal of the game, motivating users to continue participating.

Reward System: Earn virtual badges upon completing tasks.

4.2.3 Functional Module Division and Description

Based on the analysis of user needs, the game features are divided into functional modules, with clear objectives and tasks for each module, as shown in the table:

Table 5 Functional Module

Module	Function	Target	Interactive mode	Priority	Dependence
A	Core function 1: Nanjing Paper-Cutting type pairing	Help users quickly understand and identify different types of Nanjing Paper-Cutting and their cultural connotations	Drag and click	high priority	None
B	Core function 2: Inheritor cleans the glass	Through gamification interaction, users can enhance their cognition of paper-cutting inheritors and their skills	Simulate sliding and touch operation	high priority	None
C	Core Function 3: Representative appreciation	Display Nanjing Paper-Cutting representative, you can click like	like	high priority	None
D	Core function 4: paper-cut greeting cards	Provide creative design materials to help users make personalized paper-cut works	Click and enter text	medium priority	Depends on function C
E	Cultural transmission function	Convey the history, skill inheritance and cultural background of Nanjing Paper-Cutting	Read the text and watch the video	high priority	None
E	Social interaction function	Promote communication and sharing among users and expand the influence of cultural communication	Screenshots, long press download, work sharing	medium priority	Depends on function D
F	Progress tracking and feedback	You get badges for completing missions	Provide real-time feedback	medium priority	Depends on function A、B、C

The core functionality modules of the Nanjing Paper-Cutting Digital Game include four main components, each with its unique objectives and interaction methods.

Firstly, the "Nanjing Paper-Cutting Type Matching" feature aims to help users quickly understand and recognize different types of Nanjing Paper-Cutting and their cultural connotations through drag-and-drop and click interactions. This feature is crucial for educating users and enhancing their understanding of paper-cutting art.

Secondly, the "Master's Glass Cleaning Interaction" function allows users to experience the skills of a paper-cutting master through sliding and touch operations within the game. This helps deepen users' understanding and respect for this traditional art form.

Thirdly, the "Representative Works Appreciation" feature enables users to evaluate and appreciate Nanjing Paper-Cutting representative works by liking them. This not only increases user participation but also helps promote excellent paper-cutting works.

Lastly, the "Paper-Cutting Greeting Cards" feature provides a platform where users can use creative design materials to create personalized paper-cutting greeting cards. This function not only encourages creativity but also makes paper-cutting art more relevant to modern life.

In addition to the core functionality modules, the Nanjing Paper-Cutting Digital Game also includes three auxiliary modules: cultural transmission, social interaction, and progress tracking and feedback. The cultural transmission module conveys the history, technique inheritance, and cultural background of Nanjing Paper-Cutting through reading texts and watching videos. This plays an essential role in preserving and transmitting this ICH. The social interaction function encourages communication and sharing between users, expanding the influence of paper-cutting culture through screenshot sharing, long press to download images, and sharing works. The progress tracking and feedback feature motivates users to continue engaging with the game through task completion badges and real-time feedback, providing a clear sense of achievement.

These auxiliary modules complement the core functionality modules, collectively forming a comprehensive, interactive, and educational digital game platform.

Functional requirement analysis is a meticulous and systematic process that involves user research, needs gathering, functional module division, detailed descriptions, prioritization, and feasibility evaluation. For a project like "*Nanjing Paper-Cutting Show*," which integrates cultural dissemination and game entertainment, functional requirement analysis must not only meet users' entertainment needs but also effectively convey the culture of Nanjing Paper-Cutting. Through precise functional analysis, the game's design can align with user needs, improving both its usability and cultural dissemination value.

4.2.4 Non-Functional Requirements Analysis

Non-functional requirements analysis focuses on aspects such as system performance, reliability, and usability, which, while not directly related to system functionality, are crucial to user experience and long-term system development. For the *Nanjing Paper-Cutting Show* digital game, non-functional requirements analysis needs to consider the following key aspects:

Performance Requirements.

Performance requirements refer to the response time, processing capability, and resource consumption of the system during functional execution. These factors directly impact the user experience, especially when the game contains rich interactivity and cultural displays.

Response Time: The response time for actions within the game must be quick enough to ensure that players do not experience delays during interactions. For example, after a user clicks a button, the game interface should respond promptly to avoid stuttering or lag.

Loading Time: The loading time for starting the game and switching between levels should be minimal to avoid keeping players waiting. The ideal loading time should be under 5 seconds.

Resource Usage: The game should not consume excessive system resources during operation, such as memory or processor usage, particularly on mobile devices. Optimizing memory and CPU usage is essential to ensure smooth gameplay.

Usability Requirements.

Usability requirements focus on the system's ease of use and the friendliness of the user interface. In *Nanjing Paper-Cutting Show*, good usability ensures smooth operation during gameplay and reduces the learning curve for users.

Interface Friendliness: The game interface should be simple and intuitive, in line with the target users' habits. For youth and cultural enthusiasts, the game should use easy-to-understand icons, button layouts, and avoid overly complex steps.

Clear Navigation: Users should quickly understand how to play the game and find the content they want. This can be achieved by providing clear instructions and help information, ensuring that users can seamlessly transition between different functional areas.

Help System: For new users, the game should provide a concise help system or tutorial to guide players on how to interact, understand game rules, and learn about the background of Nanjing Paper-Cutting.

Reliability Requirements.

Reliability requirements concern the stability and fault tolerance of the game, ensuring that users' experiences are not interrupted by system failures.

Crash Rate: The game's crash rate should be kept below a certain threshold, e.g., under 0.5%. This can be achieved by rigorous testing and bug fixes to improve system stability.

Error Handling Mechanism: When users encounter issues within the game, the game should provide friendly error messages and solutions.

Data Persistence: The game's progress and users' creative paper-cutting works should be saved in a timely manner to prevent data loss in the event of a crash or power failure. Cloud storage or local storage methods can be used to ensure data security.

Compatibility Requirements.

Compatibility requirements focus on ensuring that the game can run on different devices and operating systems, providing a consistent user experience.

Platform Compatibility: The game should support multiple platforms, such as iOS, Android, and Windows, to ensure that players can enjoy the game across different devices.

Browser Compatibility: If the game is available on the web, it should ensure that it runs smoothly on mainstream browsers, avoiding issues where certain features are incompatible with certain browsers.

Device Compatibility: The game should be optimized for various devices, ensuring a good visual experience and smooth operation across phones, tablets, and PCs, taking into account different screen sizes and resolutions.

Security Requirements.

Security requirements focus on protecting user data and privacy, preventing malicious attacks, and ensuring data protection.

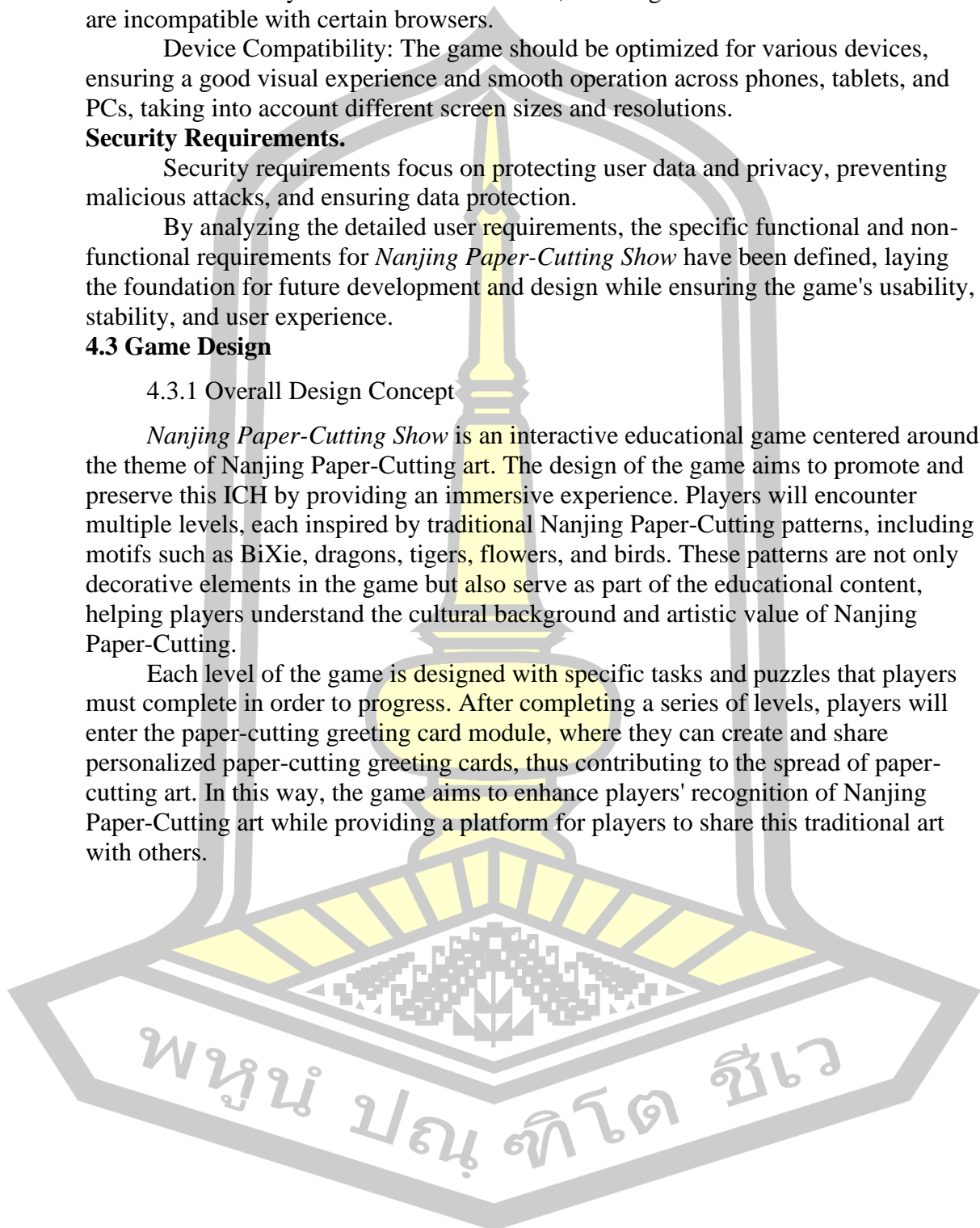
By analyzing the detailed user requirements, the specific functional and non-functional requirements for *Nanjing Paper-Cutting Show* have been defined, laying the foundation for future development and design while ensuring the game's usability, stability, and user experience.

4.3 Game Design

4.3.1 Overall Design Concept

Nanjing Paper-Cutting Show is an interactive educational game centered around the theme of Nanjing Paper-Cutting art. The design of the game aims to promote and preserve this ICH by providing an immersive experience. Players will encounter multiple levels, each inspired by traditional Nanjing Paper-Cutting patterns, including motifs such as BiXie, dragons, tigers, flowers, and birds. These patterns are not only decorative elements in the game but also serve as part of the educational content, helping players understand the cultural background and artistic value of Nanjing Paper-Cutting.

Each level of the game is designed with specific tasks and puzzles that players must complete in order to progress. After completing a series of levels, players will enter the paper-cutting greeting card module, where they can create and share personalized paper-cutting greeting cards, thus contributing to the spread of paper-cutting art. In this way, the game aims to enhance players' recognition of Nanjing Paper-Cutting art while providing a platform for players to share this traditional art with others.



A structural framework diagram of the game is shown below:

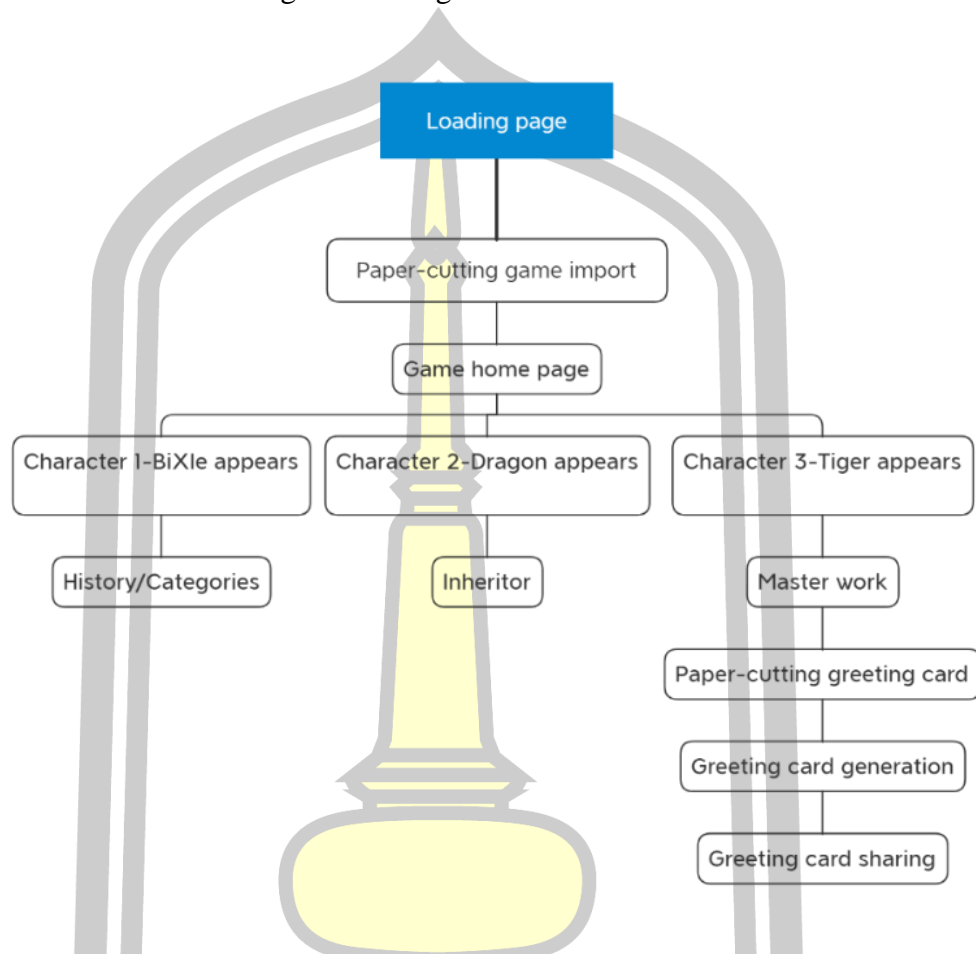


Figure 82 *Nanjing Paper-Cutting Show* game frame diagram

Source: Author. Oct. 6th, 2024

The diagram above presents the overall framework of the *Nanjing Paper-Cutting Show* digital interactive game. The framework is divided into several main sections from top to bottom:

Loading Page: This is the first page users encounter when entering the game, typically used to load game resources.

Paper-cut game import: After loading the page, through the user to simulate paper-cut action, lead out the game protagonist.

Game Home Page: Following the introduction video, users will enter the main home page of the game, which serves as the primary entry point to the game.

Character Appearances:

Character 1: BiXie: Introduces the history and main types of Nanjing Paper-Cutting.

Character 2: Dragon: Focuses on the inheritors of Nanjing Paper-Cutting art.

Character 3: Tiger: Highlights the representative works of Nanjing Paper-Cutting.

Paper-Cutting Greeting Cards:

Card Generation: Users can create their own greeting cards with paper-cutting styles.

Card Sharing: Users can share their generated greeting cards with others.

This entire framework diagram demonstrates the structure of the game and the sequence of actions users will likely experience, from loading the game, learning about paper-cutting art, to personally creating and sharing paper-cutting greeting cards. The design aims to offer an interactive experience that allows users to learn and appreciate Nanjing Paper-Cutting art while enjoying entertainment.

4.3.2 User Interface design

The user interface design for the *Nanjing Paper-Cutting Show* digital game adheres to the principles of simplicity and intuitiveness, with a focus on highlighting the artistic characteristics of Nanjing Paper-Cutting. The goal is to immerse users in the unique aesthetic of traditional paper-cutting art through cultural integration in the interface design. The User Interface design covers key parts, including the loading page, home page, level selection page, game interaction page, and sharing page. Additionally, a game introduction video was created to engage users. The design concepts for each section are as follows:

Loading Page Design Concept.

The loading page features an animation of Nanjing Paper-Cutting scissors as the central visual element, enhancing cultural immersion. A horizontal progress bar shows the loading status in percentage, providing users with clear feedback. The overall design emphasizes fluidity and intuitiveness, ensuring that the loading process is both functional and culturally rich.

Home Page Design Concept.

The home page centers around the iconic Nanjing Paper-Cutting motif, BiXie, with interactive paper-cutting animations that create a strong cultural atmosphere. The interactive paper-cutting feature allows users to directly experience the artistic charm of paper-cutting, sparking their interest and enhancing the game's appeal and immersive experience.

Main Level Page Design Concept.

Each main level page uses representative animal elements from Nanjing Paper-Cutting (such as BiXie, Dragon, and Tiger) as character settings. Each animal carries a specific cultural theme:

BiXie: Introduces the history of Nanjing Paper-Cutting, highlighting the social significance and historical span of cultural inheritance.

Dragon: Showcases the paper-cutting inheritors, emphasizing generational craftsmanship and artistry.

Tiger: Interprets the representative works of Nanjing Paper-Cutting, presenting the diversity and artistic value of the art form. These cultural divisions based on animal elements help fuse cultural information into the visual and content aspects of each level.

Game Interaction Page Design Concept

The interaction page features diverse interactive modes, including pairing, scratch-off games, electronic photo album "likes," and puzzle assembly. The overall interface is simple and clear, emphasizing ease of use and intuitiveness. Through

these interactions, users can easily experience the artistic patterns and cultural depth of Nanjing Paper-Cutting, while also enhancing the game's fun and cultural appeal.

Interaction and Sharing Page Design Concept

The sharing page allows users to create and share paper-cutting greeting cards, providing an opportunity to experience the artistic charm of Nanjing Paper-Cutting while promoting the culture through social media channels. The sharing feature also facilitates word-of-mouth promotion of the game and expands the user base, creating a dual linkage between cultural dissemination and game promotion.

Game Introduction Video Design Concept

The introduction video presents a cartoon version of the BiXie character, vividly narrating the historical background and cultural significance of Nanjing Paper-Cutting. The video emphasizes the game's operation process and includes a digital person presenting in Thai, with English subtitles to attract users and lay the foundation for further game exploration.

Through these interface design concepts, *Nanjing Paper-Cutting Show* not only digitizes traditional culture but also enhances users' cultural identity and immersive experience with the rich cultural elements embedded in the design.

4.3.3 User Interaction Design

The user interaction design of *Nanjing Paper-Cutting Show* digital game focuses on enhancing user experience and cultural perception. The goal is to provide intuitive and convenient operations with diversified interaction forms, allowing users to understand the artistic characteristics and cultural connotations of Nanjing Paper-Cutting through an immersive experience.

Interaction Design Principles.

The user interaction design follows the principles below:

Intuitiveness: All interactive operations align with the user's intuition and cognitive habits, minimizing learning costs.

Immersion: Through dynamic visual effects and multi-sensory interactive methods, the user's immersion experience is enhanced.

Cultural Integration: The interaction process incorporates cultural elements of Nanjing Paper-Cutting, allowing users to gain a deeper understanding of the cultural background of paper-cutting art.

Diversity: Various interaction modes are provided to meet the needs of different types of users, enhancing the game's fun.



Specific Interaction Design.

Table 6 User interaction design,

Pattern	Content
Touch Interaction	The mobile phone can be interacted with finger movements
Paper-cutting operation	By clicking the scissors, simulate the cutting action of the scissors, complete the virtual paper-cutting creation, and enhance the user's sense of hands-on participation
Pattern pairing	Through drag and drop operation to match paper-cut patterns, guide users to experience the matching of paper-cut types
Animation feedback	Trigger a dynamic effect when the user completes an operation, such as showing the animation of the pattern unfolding when the paper-cutting work is completed, strengthening the visual appeal
Progress prompt	Use a dynamic progress bar to mark the game loading progress
Task-based interaction	Set up quests or levels
Task Guidance	Create a mission objective for the level, such as "I will take you to meet a few representatives", so that the user knows what the mission is about
Interactive mini-game	Such as pairing, cleaning glass, assembling patterns, etc., through interesting ways to enhance the richness and challenge of user experience
Social interaction	You can socialize by typing words based on your thoughts
Share function	After completing the paper-cut creation, users can generate e-cards with one click and share them on social media to interact with others and expand the spread of paper-cut culture
Like and comment	In the electronic album module, users can like or leave comments on other players' paper-cut works, enhancing community interaction
Real time feedback	Real-time responses during operation, such as sound and animation feedback when clicking or dragging, ensure timely and enjoyable interactions
Periodic feedback	Provide rewarding feedback after completing each level quest to motivate users to keep exploring

Source: Author. Oct. 9th, 2024

Through the above user interaction design, Nanjing Paper-Cutting Show digital game achieves a deep integration of cultural inheritance and user experience. The diversified interaction modes and precise user feedback mechanisms not only enhance the fun and interactivity of the game but also provide an innovative platform for the spread of Nanjing Paper-Cutting culture.

4.3.4 Game Scene Settings

In the game scene settings of *Nanjing Paper-Cutting Show*, players will transform into traditional paper-cutting symbols such as the BiXie, dragon, and tiger, embarking on a marvelous journey across time and space. They will deeply explore the rich themes of Nanjing Paper-Cutting art, including its long history, diverse categories, outstanding inheritors, and remarkable masterpieces. Each level in the game is designed around a unique scene, and players must complete specific tasks or cleverly solve puzzles to continue progressing.

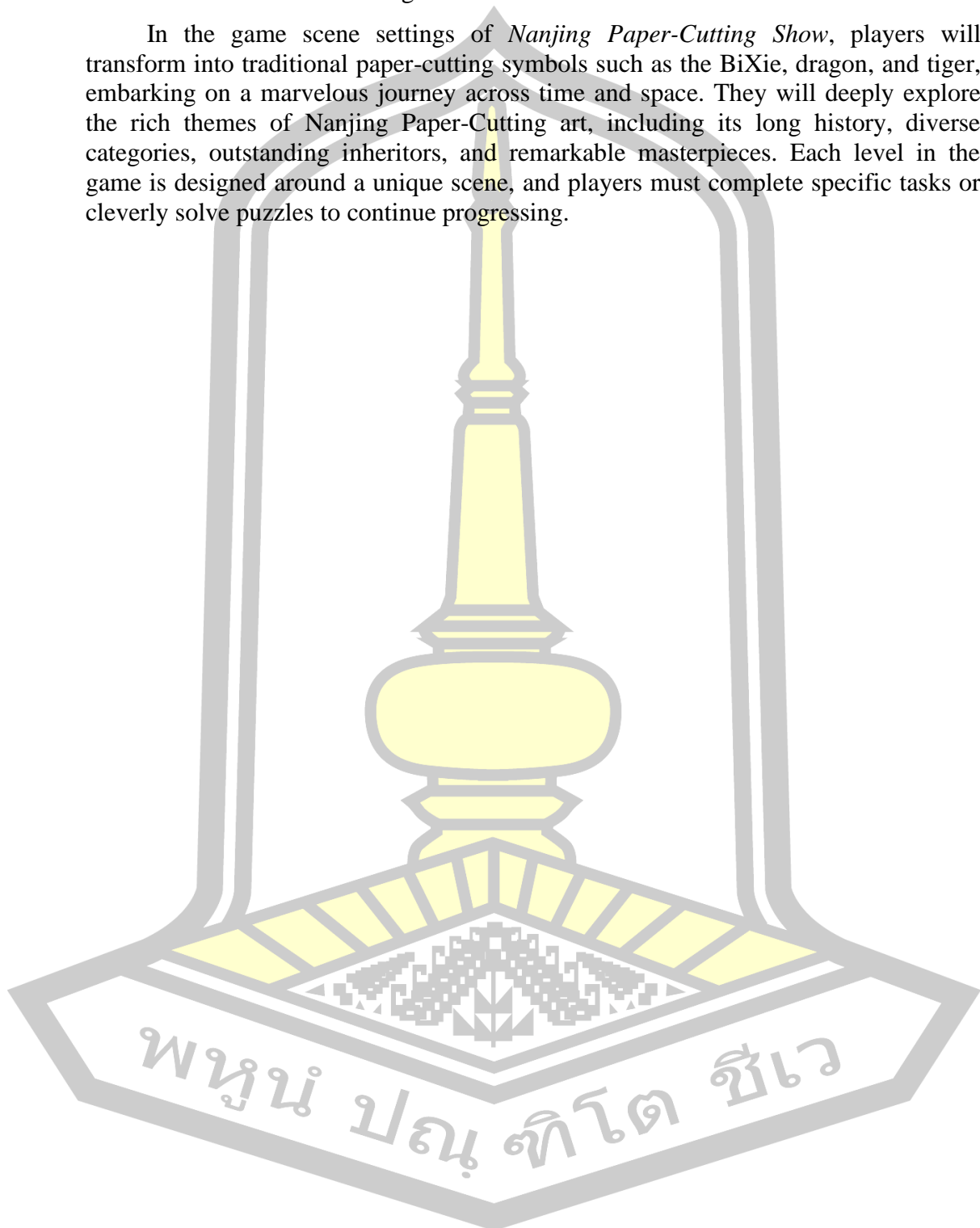












Table 7 Nanjing Paper-Cutting Show game scene design

Scene			
Plot	Using guided language, players enter the interactive story of the paper-cut of Exorcism	After the success of paper-cutting, there is a BiXie dynamic effect, BiXie introduces itself and informs the player of its function	A dragon effect appears, and the dragon introduces itself and informs the player of its functions
Scene			
Plot	A tiger action appears, where the tiger introduces itself and informs the player of its functions	Players enter the story of the game to learn the history of Nanjing Paper-Cutting	Players enter to understand the story of Nanjing Paper-Cutting type game
Scene			
Plot	Players enter the game to understand the story of Nanjing Paper-Cutting inheritors	Players enter to understand the game plot of Nanjing Paper-Cutting representative	Players enter the story of making a cut-out greeting card game
Scene			
Plot	Paper-cut cards share the plot, you can save cards, share cards and other operations		

As players progressively unlock levels, they will gradually uncover the mystery of Nanjing Paper-Cutting art, personally experiencing the unique charm of this traditional craft. After completing a series of challenges, players will reach the paper-cutting greeting card module, a stage for showcasing creativity and skill, as well as a space for sharing and spreading the knowledge they have learned. By creating personalized paper-cut greeting cards, players not only experience the cultural value of paper-cutting art but also share it through social platforms or with friends and family, allowing the beauty of Nanjing Paper-Cutting to be spread and continued on a broader scale. This module fully reflects the educational and entertaining function of the game, strengthening the emotional connection between players and traditional culture.

The storyline design of the game revolves around unlocking and challenges, progressively integrating the history, types, and inheritance of Nanjing Paper-Cutting into the player's experience. The exploration and interaction within the tasks not only deepen players' understanding of paper-cutting art but also reinforce cultural memory through entertaining formats. By completing challenges, players gain an immersive learning experience, while increasing their awareness and interest in Nanjing Paper-Cutting as an ICH.

Additionally, the game's character design incorporates visual elements of Nanjing Paper-Cutting, making each character not only a driver of the story but also a symbol of cultural transmission. For example, the BiXie, dragon, and tiger each carry different meanings within the paper-cutting culture, and their designs are both aligned with traditional artistic styles and showcased with modern animation techniques to highlight their dynamic beauty. This character design greatly enhances players' immersion and cultural connection, allowing them to naturally embrace traditional culture through their interactions with the characters.

By deeply integrating game characters with paper-cutting culture, the characters not only serve as functional guides for the game but also act as transmitters of cultural significance. Under the guidance of these characters, players experience cultural tasks, feeling both the fun of the game and the cultural value and symbolic meaning of Nanjing Paper-Cutting art. This design makes the characters a key medium for cultural expression in the game, achieving the dual goals of artistic and cultural education.

4.3.5 Game Character Design

4.3.5.1 Main Character Origins

The stone carvings of the Southern Dynasties are primarily distributed in Nanjing and its surrounding areas, especially in the eastern part of the city, including Jiangning and Qixia districts. These carvings are mainly from the early Song Dynasty, late Liang Dynasty, and Chen Dynasty, and are found in the imperial tombs of these periods. The stone carvings are relics from the Six Dynasties, with many tombs of Nanjing's nobles and royals featuring stone carvings of BiXie the guardian beasts of the tombs. These carvings are deeply tied to Nanjing's history and have become one of its cultural symbols. The "Bixi" image originates from the guardian beasts at the royal tombs of the Southern Dynasties (Song, Qi, Liang, Chen). These stone carvings are vivid and majestic, standing tall for thousands of years despite enduring the wind and rain, representing Nanjing's cultural depth and history. The image shows the main

distribution of Southern Dynasty stone carvings in the Nanjing region, reflecting the cultural legacy.

The image illustrates the main distribution of Southern Dynasty stone carvings in the Nanjing region.

Figure 1 Distribution of southern Dynasty stone carvings in Nanjing area

Source: <https://www.douban.com/> [Accessed on May 20th, 2024]

The BiXie image originates from the tomb guardian beasts of the Southern Dynasties (Song, Qi, Liang, Chen) royal tombs. The name of the Southern Dynasty stone beasts has been a topic of long-standing academic debate. Based on the number of horns on their heads, these stone beasts can be classified into three types: single-horned, double-horned, and hornless. Many scholars believe that from a typological perspective, the single-horned stone beast can be named "Qilin," the double-horned stone beast as "Tianlu," and the hornless stone beast as "BiXie." This naming convention has become widely accepted.



The BiXie has guarded royal tombs for thousands of years, witnessing the changes of the times and history. In 1996, the construction of Zhongshan Gate Square along the Shanghai-Nanjing Expressway introduced an element that was missing from the picturesque area, which combines mountains, water, city, and forest. Thus, the BiXie sculpture outside Zhongshan Gate was created. Completed in 1998 using bronze casting techniques, this sculpture has stood at the gate of Nanjing for over two

decades and has become a symbol of the city. When people see this sculpture, they immediately recognize that they have arrived at Zhongshan Gate in Nanjing. The BiXie sculpture is filled with regional characteristics, seamlessly blending with the surrounding environment, while showcasing the unique cultural identity of Nanjing, reflecting the city's deep historical and cultural heritage as the "Ancient Capital of Six Dynasties," as shown in the image.



Figure 83 Sculpture of warding off BiXie outside Zhongshan Gate, Nanjing
Source: Photographed by the author. Sept 5th, 2023]

In 1988, the BiXie began to serve as a symbol of Nanjing. During the third meeting of the 10th Nanjing Municipal People's Congress Standing Committee in 1988, the city seal design featuring the BiXie as the main element was officially recorded. Since then, the BiXie has become a symbolic emblem of the city of Nanjing. The city's flag, which was subsequently promulgated, also features this emblem, as shown in the figure.



Figure 84 Nanjing City Badge

Source: <https://www.sohu.com/> [Accessed on May 20th, 2024]

The design of this emblem was created by Mr. Bao Bin, a member of the China Artists Association, former president of Nanjing University of the Arts, and a renowned painter. The city seal is embedded in the central red section of the city flag,

in gold or yellow. It is primarily circular with a square base. The circle is divided into an outer circle and an inner circle; the outer circle is crescent-shaped, corresponding with the inner circle, symbolizing the unity of the sun and moon, and the eternal rise of the sun and moon. On the upper part of the city seal, a tiger is on the left and a dragon is on the right, representing the image of "the tiger crouching and the dragon coiling." Both the tiger and the dragon have wings, like the great roc spreading its wings, symbolizing the dynamic and thriving energy of Nanjing, as the city moves forward toward modernization.

At the center of the city seal is the BiXie, a representative figure from the stone carvings of Southern Dynasties tombs, symbolizing Nanjing's long history as the ancient capital of the Six Dynasties. It also represents a future that steadily moves forward, unaffected by any challenges or setbacks. The emblem is surrounded by three geometric ribbons, narrow at the top and wide at the bottom, symbolizing the mighty, flowing Yangtze River, representing Nanjing's development like a vast and unstoppable force. The lower part of the city seal depicts a fortress with six battlemented walls, referencing the Nanjing Ming city wall, further symbolizing the city's identity as an ancient capital of the Six Dynasties.

Today, the BiXie symbol can be seen throughout Nanjing, on trademarks, cigarette boxes, and various other items bearing BiXie patterns, as shown in the figure.



Figure 85 BiXie by Nanjing brand cigarette packaging box
Source: <https://www.baik.com/> [Accessed on May 20th, 2024]

The BiXie image is printed on Nanjing's public transportation cards, a practice that not only showcases BiXie as a representation of Nanjing's long history and brilliant culture but also serves as a symbol of contemporary Nanjing. The widespread use of the BiXie image has effectively enhanced the city's brand influence and the cultural identity of its residents, becoming a bridge connecting history and modernity, as well as local and international cultures. As shown in the figure:



Figure 86 BiXie by Jinlingtong Transportation Card

Source: Photographed by the author. May 20th, 2024

These ubiquitous BiXie patterns have undoubtedly become a distinctive symbol of Nanjing, as well as an important image in the city's modern urban promotion. By 2023, Nanjing South Railway Station, the largest high-speed rail station in Asia, has incorporated a design concept blending classical Chinese architectural elements with modern architectural style, reflecting the unique character of the ancient capital of Nanjing. On the second floor of the North Square of Nanjing South Railway Station, you will find a bronze BiXie, as shown in the figure:



Figure 87 Nanjing South Railway Station BiXie sculpture

Source: Photographed by the author. Oct. 24th, 2024

The BiXie sculpture at Nanjing South Railway Station symbolizes the city's profound historical and cultural heritage and unique urban image. With the form of an ancient mythical beast, it conveys the solemnity and mystery of Nanjing as an ancient capital of the Six Dynasties. This sculpture is not only a continuation of Nanjing's traditional culture but also a modern interpretation of the city's spirit, showcasing the respect of Nanjing's citizens for their historical heritage and their hopes for future development.

Inside the waiting hall of Nanjing South Railway Station, the image of BiXie can also be seen, as shown in the figure:



Figure 88 Nanjing South Railway Station waiting hall publicity column "BiXie" image

Source: Photographed by the author. Oct. 24th, 2024

The image of BiXie in the waiting hall of Nanjing South Railway Station symbolizes the historical heritage and cultural characteristics of Nanjing as the ancient capital of the Six Dynasties. It also represents the city's spirit and its outward image.

As the IP image of the 2024 Nanjing Art Exhibition, BiXie not only reflects Nanjing's profound historical and cultural heritage but also, with its unique artistic appeal and modern design, has gained popularity among the younger generation. It has become a bridge connecting tradition with modernity, history with trends. The figure shows the promotional image for the 2024 Nanjing Science and Technology Museum Art Exhibition.



Figure 89 2024 Nanjing Science and Technology Museum Art Exhibition BiXie Image

Source: <https://www.163.com/> [Accessed on May 20th,2024]

Contemporary Nanjing Paper-Cutting, themed around the distinctive culture of Nanjing, creates works that highlight the unique features of the city. These pieces, in harmony with the ancient city that boasts a 2500-year history, once again shine with new vibrancy, as shown in the image:



Figure 90 Nanjing Paper-Cutting "Chaoyang Gate" by Mao Yitong
Source: <https://www.thepaper.cn/> [Accessed on May 20th, 2024]

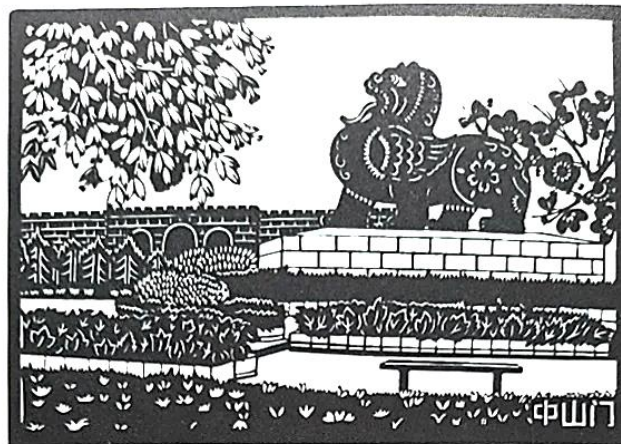



Figure 91 Nanjing Paper-Cutting "Zhongshan Gate"
Source: <https://news.jstv.com/> [Accessed on May 20th, 2024]

4.3.5.2 Major Character Design

As a mythical beast in Chinese traditional culture, and an important symbol of Nanjing, the BiXie infuses the character in the Nanjing Paper-Cutting Show digital interactive game with unique cultural significance. It becomes not just a game character, but an embodiment of traditional culture, attracting players who are passionate about Chinese culture. The distinctive physical features and majestic aura of BiXie give it high visual recognizability, providing rich inspiration for character design. However, to avoid the character being confused with other mythical beasts or monsters, it is essential to conduct in-depth research into the historical image and cultural meaning of BiXie, ensuring that the character remains faithful to traditional culture while being innovative and modern in design.

Table 8 Image Analysis of BiXie

Historical Image	Cultural Function Characteristics	Image Characteristics	Cultural Meaning and Symbolism
	A divine beast that drives away BiXie and protects people's safety, symbolizing wealth, representing a brave warrior, and bringing good fortune	Resembles a lion with wings, no horns, muscular and robust, standing upright with head held high, open mouth and extended tongue, round eyes, raised eyebrows, long neck leaning backward, back forming an inverted S-shape, long tail, strong limbs, and four c	It is a mythical beast that drives away BiXie and foreign objects, protects people's safety, and attracts wealth. It symbolizes force and brave warriors and welcomes good luck and blessings

From the table, we can deduce that BiXie is a guardian deity found in ancient architecture, tombs, and other sacred spaces, often seen in tombstone sculptures, temple decorations, and decorative patterns on artifacts. Its main function is to protect and ward off evil. BiXie is a mythical beast tasked with expelling malevolent spirits and foreign entities, while also symbolizing prosperity, wealth, and good fortune. As a brave "warrior," it embodies strength and authority.

Its appearance resembles that of a lion, with wings but no horns. Its posture is upright, with a muscular and robust frame that gives it an imposing presence. The facial features include an open mouth with a tongue extended, fierce eyes, and raised eyebrows, which enhance its intimidating power. The body generally has an S-shaped back, a long tail, and strong limbs, with four claws on each foot.

BiXie is a cultural symbol of warding off evil and bringing good fortune. Its image reflects both power and divinity. It represents the ancient people's awe and hope for supernatural forces, as well as their wish for peace and prosperity, carrying rich cultural and folk values.

Table 9 BiXie Character Settings

Role	Name	Style	Character Function
	BiXie	Paper-cut Style	Character, Guide, Button



4.3.5.3 Representative Symbol Semantics Analysis

This section focuses on selecting representative symbols from traditional Nanjing Paper-Cutting art and conducting a semiotic analysis. The results are shown in the table below:

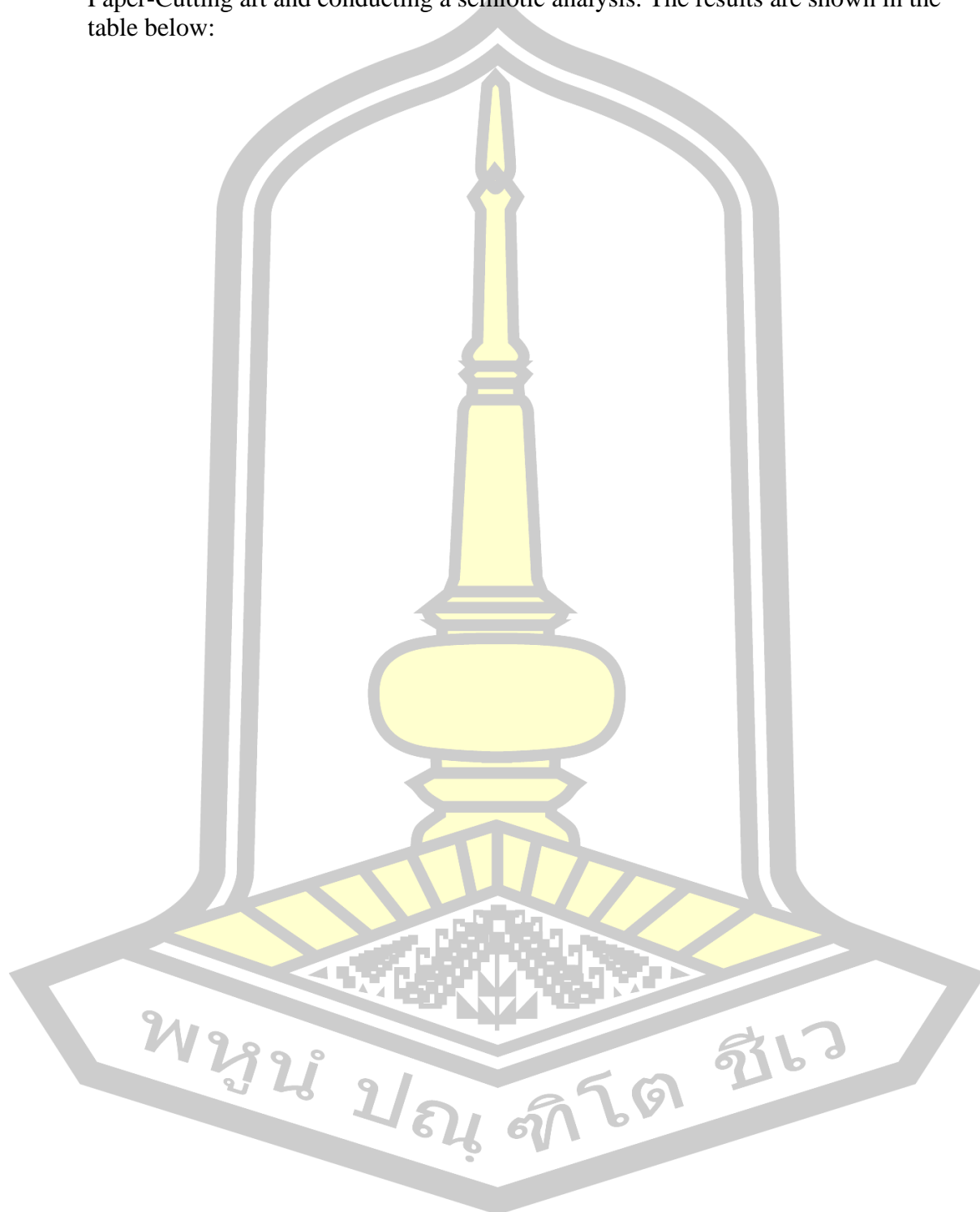












Table 10 Semiotic Framework of Nanjing Paper-Cutting Symbol Elements

Category	Signifier	Signified	Cultural Connection	Example
Plant Symbol	Plum Blossom	Symbolizes resilience and noble character	Nanjing's city flower, Meihua Mountain known as "Number One Plum Mountain in the World"	
	Lotus	Purity and tranquility, often appearing with fish, symbolizing a prosperous life	"Lotus Viewing Festival" custom, place names: Big Lotus Lane, Small Lotus Lane, Lotus Pond	
	Osmanthus	Symbolizes auspiciousness, goodness, and happiness, the fragrance of osmanthus is considered a symbol of autumn	Foods made with osmanthus: Osmanthus duck, Osmanthus cake	
Animal Symbol	Dragon	A mythical creature in ancient Chinese mythology, representing power, majesty, nobility, and sanctity.	Place names: "Longpan Road," "Wulong Pond"	
	BiXie	A mythical creature in ancient Chinese mythology, symbolizing protection, BiXie, and auspiciousness	The animal image on Nanjing's city emblem	
	Swallow	Symbolizes spring and a new beginning.	"First Jit of the Yangtze River": Swallow Cliff	

Category	Signifier	Signified	Cultural Connection	Example
	Tiger	Symbolizes nobility and authority, also a symbol of protection and safeguarding people's safety.	Place name: Lion Bridge; stone lions in front of the main gate of Chaotian Palace	
Building Symbol	City Wall	Witnessed the prosperity and changes of Nanjing as an ancient capital, a symbol of Nanjing city.	City Wall	
	Presidential Palace	As a witness to modern Chinese history, it carries the profound connotations of national independence, national construction, and historical changes, and has extremely high historical value and cultural significance.	Presidential Palace	
	Confucius Temple	Not only a memorial to Confucius and his thoughts but also reflects the profound cultural heritage and historical inheritance of Nanjing	Confucius Temple	

Source: Author. Oct. 25th, 2024

Nanjing's cultural symbols, with their deep historical roots and unique symbolic meanings, showcase the distinct charm of this ancient city. From plants and animals to architectural structures, these symbols not only carry people's emotions and wishes but also reflect Nanjing's natural and cultural characteristics.

Plant symbols like the plum blossom, lotus, and osmanthus symbolize resilience, purity, and auspiciousness, and are closely tied to Nanjing's place names and customs. For instance, the "Plum Blossom Mountain" is renowned as "the world's number one plum mountain," the "Lotus Festival" is a celebrated local tradition, and foods like "osmanthus duck" and "osmanthus cake" are traditional delicacies, blending nature with culture harmoniously.

Animal symbols combine mythology with reality, reflecting Nanjing's profound historical and cultural heritage. Mythical creatures such as the dragon and BiXie represent authority and good fortune, with BiXie being a prominent figure on Nanjing's city emblem. Real animals like the swallow and tiger are associated with local place names and landmarks, such as Swallow Cliff and Lion Bridge, symbolizing new beginnings and protection.

Architectural symbols bear witness to Nanjing's historical transformations and cultural brilliance as an ancient capital. The city's walls represent its military and planning wisdom, the Presidential Palace marks significant changes in modern history, and the Confucius Temple is a tribute to the inheritance and commemoration of Confucian thought, highlighting Nanjing's unique position as a cultural city.

4.3.5.4 Semantic Transformation of Paper-Cutting Symbols in Digital Games

This section analyzes how Nanjing Paper-Cutting symbols are used in digital games as characters, scene elements, and props, exploring their visual design and cultural expression. The "signifier" focuses on the visual representation of symbols in the game and their design techniques, while the "signified" focuses on the cultural meaning of the symbols and how they are reinterpreted within the game context. For example, how symbols from traditional culture are transformed into meaning in a game scenario. The "semantic transformation" analyzes the function and positioning of symbols in the game, including symbolic meaning, emotional guidance, task prompts, and how these influence the player's game experience and behavior. As shown in the table:

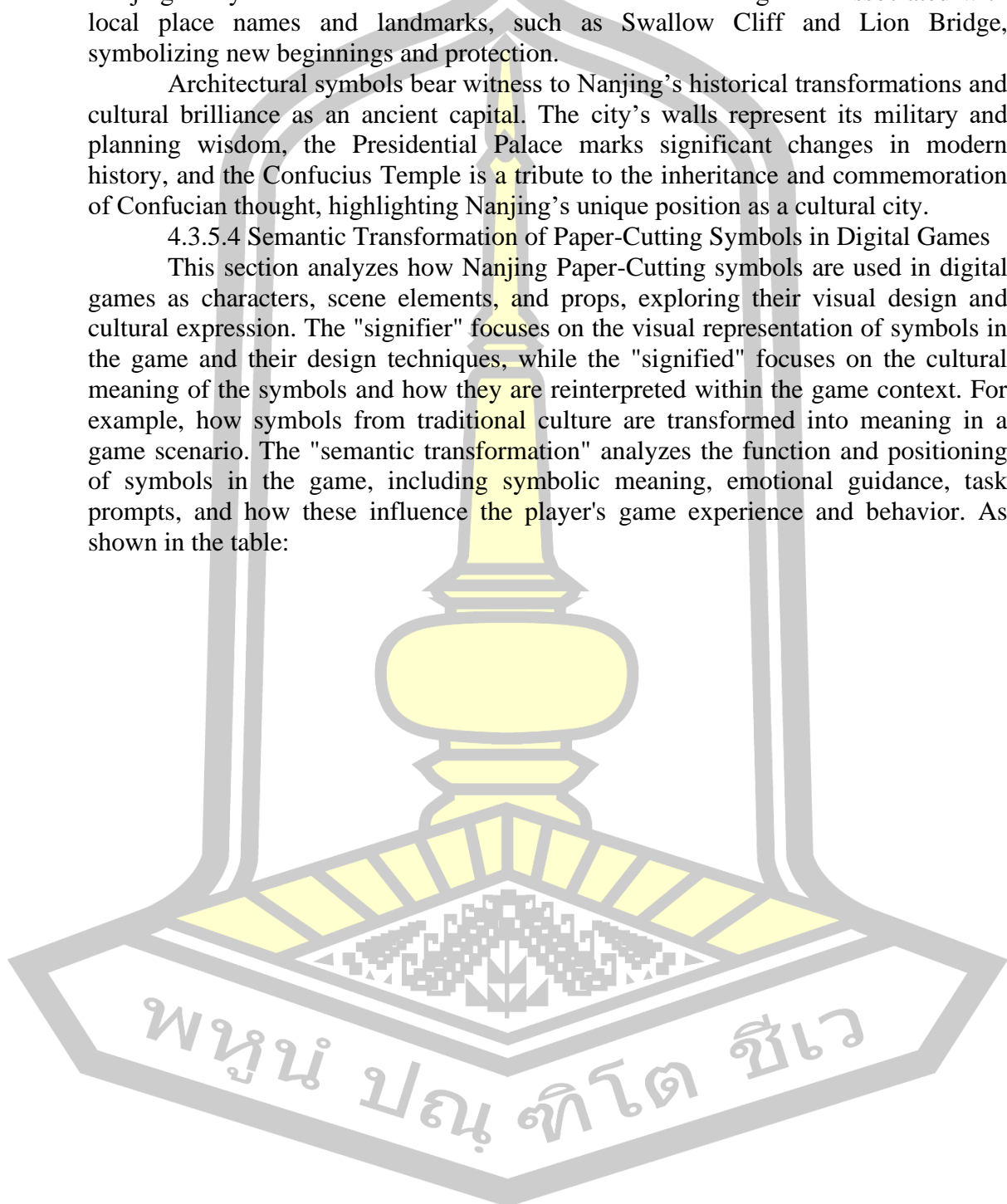





Table 11 Semantic Transformation of Paper-Cutting Symbols in Nanjing Paper-Cutting Show Game

Symbol Element Category	Signifiers in games (game elements)	Signified in games (reinterpretation of cultural meanings)	Semantic Transformation	Graphic symbol	Prototype	Type
Plant Symbol	Scene decoration, props.	Display the time and space where the scene occurs, also symbolizing the player's character.	Used to guide scene loading.		Plum Blossom	Animation
Animal Symbol	Character image, dynamically designed and given interactive functions.	Represents the player character, manifested as having the symbolic meaning of the animal symbol.	Used for emotional guidance and task prompts, players need to choose to use characters to complete specific tasks.		BiXie	Animation
Building Symbol	Scene element, providing scene introduction and decorative functions.	Transformed into specific scene markers.	Prompt players to enter specific areas to complete tasks related to cultural inheritance.		Dacheng	Picture men

Source: Author. Nov. 2nd, 2024

In game design, the introduction of symbolic elements can effectively enhance cultural depth while enriching the player's immersive experience. Through the creative transformation of plant, animal, and architectural symbols, traditional culture is given a fresh form of expression and interactive functionality within digital games. Plant symbols are designed as scene decorations and props, used to display the temporal and spatial background of the scene while symbolizing the player's character and growth. When the scene is loaded, plant symbols such as plum blossoms can be represented through animation to express their connotations of resilience and purity, becoming guides for culture and emotion, allowing players to naturally immerse themselves in the game world.

Animal symbols appear as dynamic character images, with interactivity and core mission-bearing roles. The BiXie symbol, as a representative character of the player, not only showcases its cultural symbolism of protection and warding off evil but also guides the player's emotions and behavior through mission design, strengthening the cultural immersion in the game. Players engage with and operate animal characters to complete tasks, thus deepening their understanding of the symbolic meanings behind these figures.

Architectural symbols are used as core decorations in scenes, appearing as significant landmarks. Architectural symbols such as the Dachen Gate provide scene introductions through images, while also serving a guiding function by prompting players to enter specific areas related to cultural heritage and complete associated tasks, enhancing the combination of cultural narrative and game interaction. Through semantic transformation, these symbols retain the core meaning of traditional culture while being reinterpreted through modern game formats. This not only provides players with a rich visual and functional experience but also furthers the digital inheritance of traditional culture.

4.3.6 Scene Design

The scene design is based on iconic landmarks of Nanjing and traditional festival settings, such as the city wall, the banks of the Qinhuai River, and traditional festive markets. These elements are integrated with paper-cutting decorations to infuse the entire scene with rich local cultural flavor.

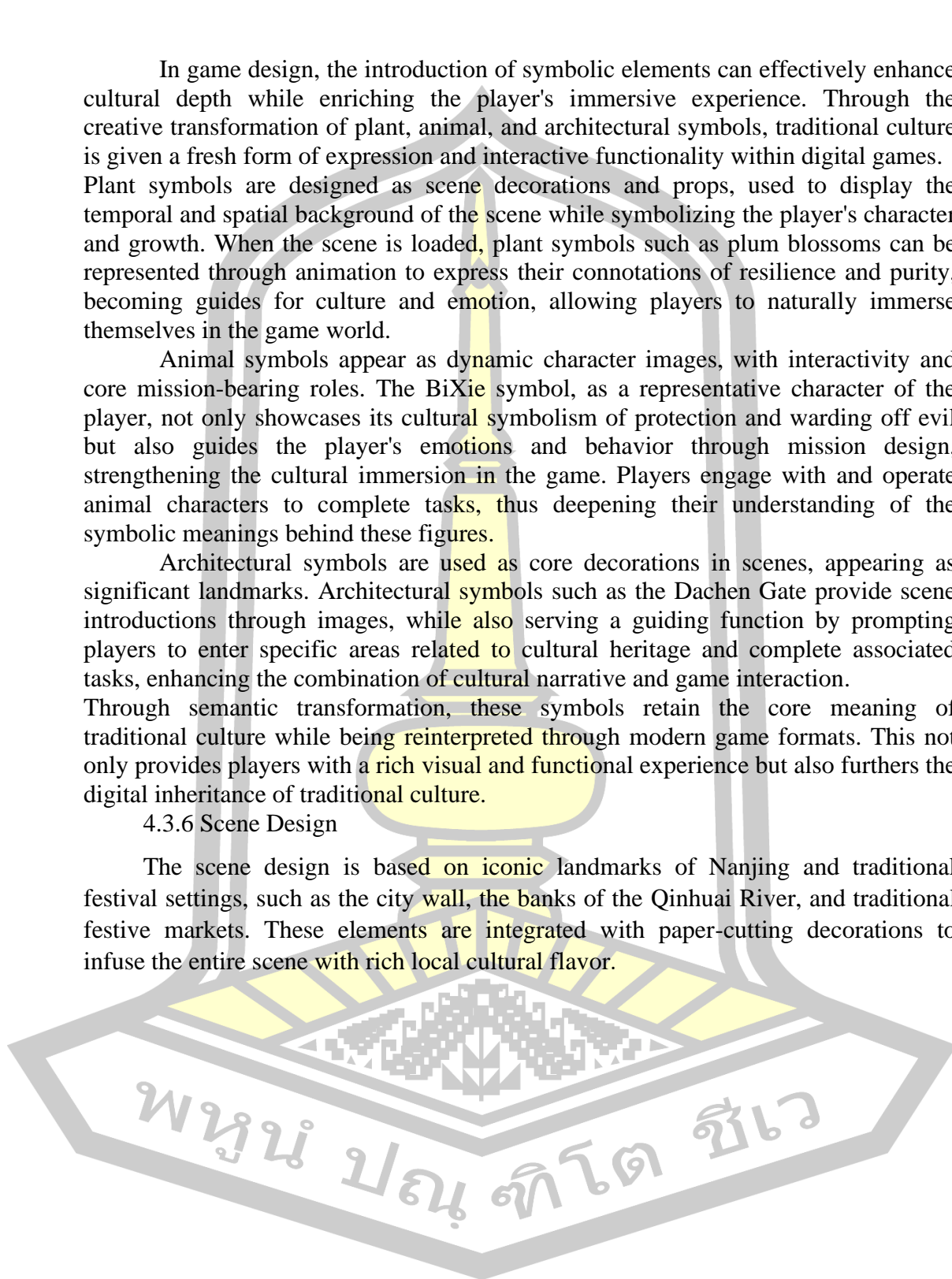


Table 12 Game scene design of *Nanjing Paper-Cutting Show*

Scene Number	Scene Name	Scene Description	Interactive Gameplay	Paper-cutting Elements	Sound Effects	Functional Goal
1	BiXie Paper cutting	Use BiXie elements to simulate the paper-cutting process	Players click the scissors to continue simulating paper-cutting, cutting out the BiXie pattern.	BiXie before being cut out, BiXie after being cut out	Paper-cutting, button, traditional background music	Emphasize the value of cultural symbols
2	Glowing Treasure Box	The mysterious treasure box glows, three characters appear, and the box is surrounded by light, guiding players to the next scene	Players unlock the characters that appear in the treasure box to understand their functions and continue	Treasure box, light, BiXie, dragon, tiger	Light, button	Stimulate exploration interest
33	History Unlocking at Zhongshan Gate	The Zhongshan Gate tower stands tall, plum blossoms fall, and the gray bricks of the city wall tell the history	Players need to watch the history of Nanjing Paper-Cutting presented in this scene to unlock the historical story	Contour of the city tower, leaves, and other paper-cut decorations reflecting a sense of history	Button	Cultural education
44	Lantern Riddle Challenge on Lantern Festival	The bustling market of the Lantern Festival, lanterns decorate the night sky, and lanterns hang with interesting riddles.	Players drag and drop pictures onto the corresponding riddle cards to unlock the riddles, choose the correct answer	Examples of Nanjing Paper-Cutting types, plum blossoms, riddle cards, lantern	Riddle card flipping, button	Lantern Riddle Challenge on Lantern Festival

Scene Number	Scene Name	Scene Description	Interactive Gameplay	Paper-cutting Elements	Sound Effects	Functional Goal
55	Introduction to the inheritance	A register containing photos of Nanjing Paper-Cutting heritage figures with text introductions	according to the prompts, and the riddle cards have special effects when answered correctly. Players press the mouse or wipe with their fingers to simulate the action of wiping glass, and the photos and introductions of the representative characters are displayed.	decorations create a festive atmosphere. Photos of heritage figures cutting paper	Button	Cultural education
6	Representative Works of Confucius Temple	The Confucius Temple is covered with lanterns and swallows fly by. In the middle of the Confucius Temple, Nanjing Paper-Cutting masterpieces are displayed	Players can click on the left and right buttons of the masterpiece album in Confucius Temple to like the works they like	Lanterns, Confucius Temple, and flying swallows enhance the cultural atmosphere	like button	Cultural education
7	Paper-cutting workshop	A paper-cutting material library, players can choose from four sections: outline patterns,	Players click to select materials from the four panels and assemble them into paper-cut	Paper-cut outline patterns, protagonists, theme text, and decorative	Library of different types of buttons	Motivate users to continue participating

Scene Numb	Scene Name	Scene Description	Interactive Gameplay	Paper-cutting Elements	Sound Effects	Functional Goal
		protagonists, theme text, and decorative	greeting cards. They can enter	elements		

The Nanjing Paper-Cutting interactive experience project integrates this traditional art form with modern interactive gameplay, allowing players to immerse themselves in the unique cultural charm of paper-cutting. Through beautifully designed scenes and detailed interactive elements, players can not only appreciate the essence of paper-cutting but also engage in hands-on participation, experiencing the joy of creating paper-cuts and gaining a deeper understanding of the cultural connotations and significance of Nanjing Paper-Cutting.

The first scene begins with the mysterious introduction of the BiXie paper-cutting. Starting with the creation of the BiXie paper-cut, players simulate the real process of paper-cutting by clicking scissors to gradually unveil the mystery of the BiXie pattern. This process perfectly combines the meticulous craftsmanship of traditional paper-cutting with the cultural symbolism of BiXie, sparking players' interest in the art of paper-cutting and laying a rich cultural foundation for subsequent scenes.

Scenes two and three explore the cultural narratives of the glowing treasure box and Zhongshan Gate. The glowing treasure box scene, with its mysterious light and role-unlocking mechanism, leads players into the next chapter of the story, further exploring the cultural significance of Nanjing Paper-Cutting. The Zhongshan Gate scene, themed around history, features outlines of city towers, gray brick walls, and falling leaves, creating a profound sense of history. Players unlock cultural clues by watching historical stories of paper-cutting, deepening their understanding of the close relationship between paper-cutting art and Nanjing's long history.

Scene four portrays the festive atmosphere of the Lantern Festival riddles. Filled with the joyful colors of the Lantern Festival, players find themselves amidst brightly lit marketplaces, solving fun riddles hanging beneath lanterns to trigger special effects like lighting up colorful lanterns. Elements like plum blossoms in Nanjing Paper-Cutting are used to enhance the festive ambiance, showcasing the charm of traditional festival culture while allowing players to learn and enjoy in a playful context.

Scene five introduces the Nanjing Paper-Cutting Inheritor Directory through an interactive glass-wiping simulation. Players visually and tactilely interact with the directory to gradually reveal photographs and textual introductions of inheritors, gaining an in-depth understanding of the history and culture of Nanjing Paper-Cutting. The design emphasizes the combination of education and entertainment, with content including cover design, inheritor photographs, text introductions, and interaction prompts. This interactive experience aims to spark players' interest and respect for Nanjing Paper-Cutting while injecting new vitality into traditional culture.

Scene six features the display of representative paper-cutting works at Confucius Temple. This scene showcases representative works of paper-cutting art, with hanging lanterns and flying swallows creating a rich cultural atmosphere. Players can browse these works by clicking left or right buttons and express their appreciation

for their favorite pieces, experiencing the diversity and exquisite craftsmanship of Nanjing Paper-Cutting and fostering a deeper connection with traditional art.

Scene seven is a hands-on paper-cutting workshop. The workshop offers players a platform for personalized creation, with a material library covering outline patterns, main character motifs, thematic texts, and decorative elements. Players can freely combine these to create unique paper-cut greeting cards. They can also input blessing texts and save or share their works, blending the art of Nanjing Paper-Cutting with modern social practices to inject new vitality into traditional culture.

4.3.7 Implementation of Interactive Modules

In *Nanjing Paper-Cutting Show*, the interactive mechanism is a core component of the game experience, aiming to enhance user engagement and immersion. Through carefully designed interactions, players not only learn about the history and art of Nanjing Paper-Cutting but also experience the creation process themselves, fully engaging their initiative and creativity.

The gameplay design aims to allow players to enjoy entertainment while deeply exploring the cultural characteristics and artistic charm of Nanjing Paper-Cutting. Through well-crafted levels and interactive elements, the game combines traditional art with modern technology to promote cultural dissemination and education while ensuring a high level of fun and playability.

The main interactive modules include:

BiXie Paper-Cutting Simulation Module.

Players use virtual scissors to simulate the real process of paper-cutting, gradually cutting out the BiXie pattern, which becomes the main character in the game. Through intuitive paper-cutting operations, accompanied by the “snip” sound effect, players experience the fun and challenges of paper-cutting craftsmanship. Before the paper-cutting is completed, the game showcases the evolution process of the BiXie pattern, adding educational value in both culture and art. (See the figure below.)



Figure 92 Interactive Process of Pi Xie Paper-Cutting

Source: Author. Nov. 19th, 2024

Glowing Treasure Box Unlocking Module.

Players unlock glowing treasure boxes to acquire various characters and tools. These characters and tools assist players in unlocking more content and challenges in subsequent scenes. Each character has unique functions, and players must use these

functions strategically to progress the storyline, enhancing the game's interactivity and sense of exploration.

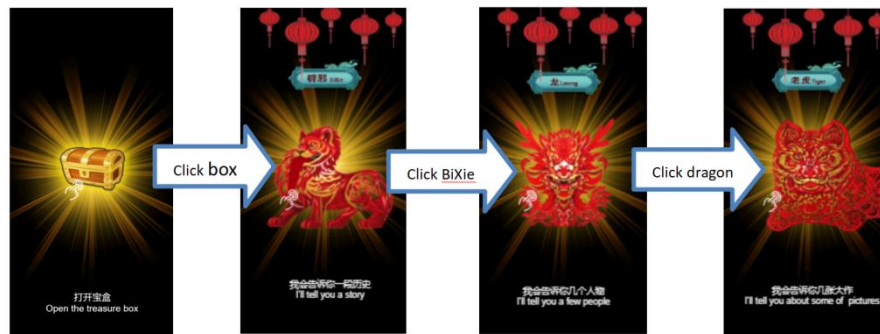


Figure 93 Players open the treasure box interactive process

Source: Author. Nov. 19th, 2024

Lantern Riddle Drag-and-Drop Matching.

In the Lantern Festival scene, players solve riddles by dragging and dropping images onto riddle cards. Each correct answer triggers special effects on the riddle card and unlocks new clues or rewards. This interactive method not only enhances the festive atmosphere of the game but also stimulates players' thinking and curiosity, increasing their sense of engagement and participation, as illustrated below:

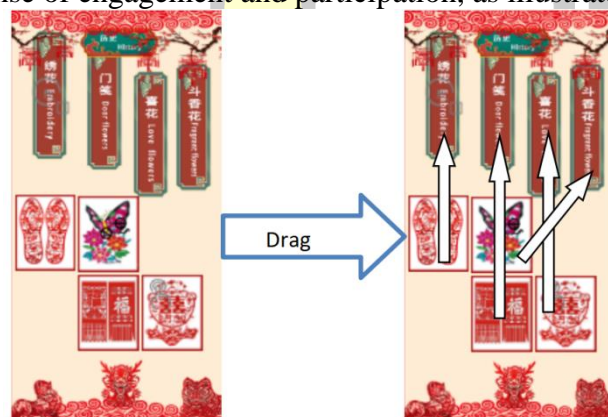


Figure 94 Lantern Riddle Drag-and-Drop Matching Interaction Process

Source: Author. Nov. 19th, 2024

The Nanjing Paper-Cutting Heritage Figures Directory uses a glass-wiping simulation for interaction, allowing players to gradually reveal photos of the heritage figures along with synchronously appearing textual descriptions by clicking with a mouse or swiping with a finger. This design enhances visual appeal and interactivity, enabling players to experience the charm of Nanjing Paper-Cutting through exploration while learning about the art's history and cultural significance, as illustrated below:



Figure 95 Glass-Wiping Interaction Process in the Heritage Figures Directory

Source: Author. Nov. 19th, 2024

Confucius Temple Masterpieces Appreciation Module.

In the Confucius Temple scene, players can browse a collection of paper-cutting masterpieces by clicking left or right navigation buttons and like their favorite pieces. This feature stimulates players' aesthetic and artistic appreciation abilities while enhancing interaction with cultural works, as illustrated below:

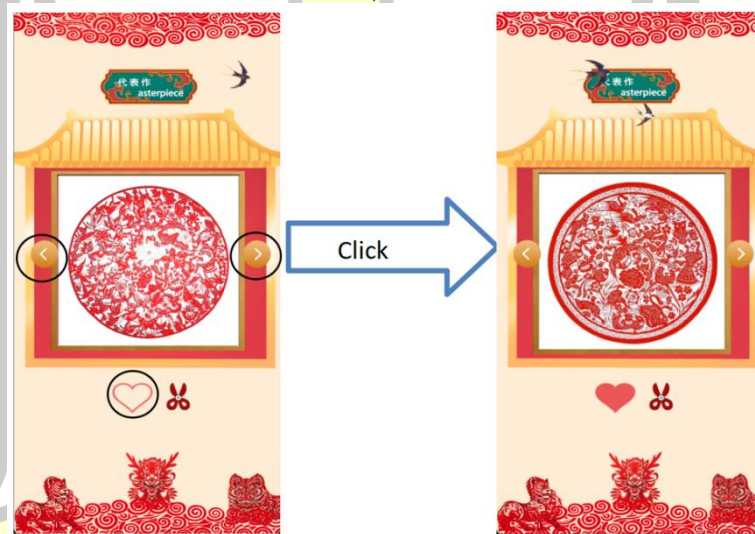


Figure 96 Interaction Process for Browsing and Liking Masterpieces in the Confucius Temple Scene

Source: Author. Nov. 19th, 2024

The Paper-Cutting Workshop Module.

As the core interactive segment, the Paper-Cutting Workshop offers a rich library of materials, including paper-cut outlines, main character designs, thematic text, and decorative elements. Players can freely combine these elements to create their own paper-cut artworks. Players are not only able to customize greeting cards and input personalized messages, but they can also save and share their creations. This feature allows players to fully unleash their creativity, enhancing the game's engagement and social aspects, as shown in the image below:

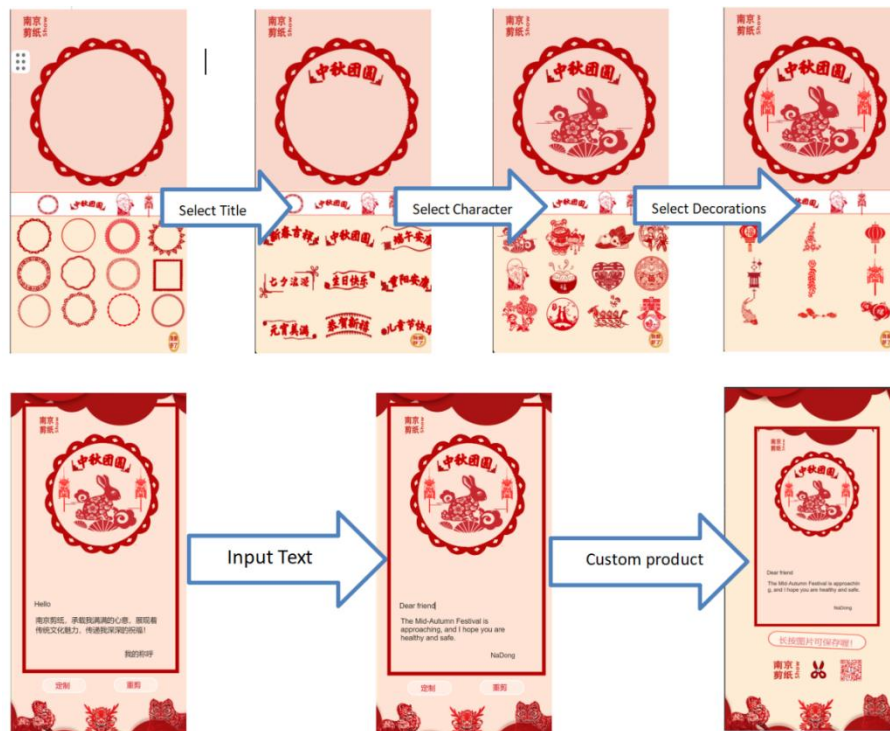


Figure 97 Interactive pages in the decoupage greeting card module

Source: Author. Nov. 25th, 2024

The design principles of the functional modules include:

Usability: All interactive features focus on simplicity and clarity, ensuring that users can quickly get started, reduce complex operational steps, and enhance the smoothness of the game experience.

Guidance: Each scene is equipped with guidance tips to help players complete tasks and unlock new content, while preventing players from losing interest due to confusion or lack of direction.

Reward Mechanism: After completing an interactive segment or unlocking new content, players are rewarded (such as points, items, achievements, etc.), motivating them to continue exploring and participating.

Balance of Education and Entertainment: The interactive design not only emphasizes entertainment but also integrates elements of Nanjing Paper-Cutting's culture and history, allowing players to acquire knowledge and foster a sense of cultural identity through interaction.

The interactive mechanisms and gameplay design of *Nanjing Paper-Cutting Show* combine artistry and entertainment. Through diverse interactive forms and engaging gameplay, the game attracts players to deeply experience paper-cutting art while ensuring they gain cultural knowledge and creative enjoyment. The carefully designed interactive segments and reward systems enhance player participation, satisfaction, and a sense of achievement, thus increasing the game's appeal and user retention.

4.3.8 Technical Architecture

Nanjing Paper-Cutting Show adopts a front-end and back-end separated architecture to ensure system flexibility and scalability. The system architecture is divided into the front-end presentation layer, back-end logic layer, and data storage layer, with data interaction achieved via API interfaces.

Front-End Presentation Layer: The front-end utilizes standard HTML5 and JavaScript technologies, integrated with development tools provided by the Mu Ge Da platform, ensuring compatibility across different devices (e.g., PCs, smartphones, tablets). Responsive design and optimization ensure a smooth user experience on various devices.

Back-End Logic Layer: The back-end uses development interfaces from the Mu Ge Da platform to handle user requests, manage game logic, and provide data processing functionalities. The back-end system ensures efficiency and accuracy in game operations and data interactions.

Data Storage Layer: Data, including user progress and task records, is stored in the Mu Ge Da platform's cloud database. A real-time synchronization mechanism ensures instant updates between user devices and the cloud.

4.4 Pre-Testing and Improvement Measures

4.4.1 Interface Testing

This study systematically evaluated the interface design of the *Nanjing Paper-Cutting Show* game to ensure the rationality and visual appeal of design elements such as layout, color schemes, fonts, and icons. Through a combination of expert reviews and user feedback, the strengths and weaknesses of the current design were analyzed, providing scientific guidance for subsequent interface optimization and improvement. **Rationality of Interface Layout.**

The rationality of the interface layout is fundamental to user experience, centered on ensuring intuitive operation paths and logical interface elements. This test focused on analyzing whether the interface layout aligns with user operation habits and provides a clear navigation experience.

Test results indicate that the main module distribution of the current interface is relatively reasonable, but some details still need further optimization. For instance, the layout of certain functional buttons deviates from users' visual focus area, affecting operational efficiency. Additionally, the hierarchical logic of the navigation bar appears overly complex in specific scenarios, posing obstacles for first-time users to get started quickly.

Consistency of Colors and Themes.

As a vital component of interface design, reasonable color schemes directly influence users' visual experience and reflect the cultural themes of Nanjing Paper-Cutting. This test focused on whether the color scheme aligns with the artistic style and cultural imagery of Nanjing Paper-Cutting and whether it possesses sufficient visual appeal.

Test results indicate that the overall interface employs red as the primary color, complemented by beige, aligning with the traditional color palette of Nanjing Paper-Cutting and successfully conveying the unique charm of the cultural theme. However, in some scenes, excessive use of neutral colors resulted in insufficient

layering. Moreover, low contrast in certain areas (e.g., text on buttons against the background) negatively affected content visibility.

Readability of Fonts and Icons.

The readability of font and icon design is crucial to user operation efficiency and overall experience. This test assessed font size, style, and icon recognizability to determine whether they meet the needs of the target user group.

The test results show that the interface primarily uses a clean and straightforward sans-serif font, which offers good readability overall. However, in certain modules (such as "Task Challenges"), the font size is too small, which impacts content visibility. Additionally, some icons' design style deviates from the theme of Nanjing Paper-Cutting and does not fully align with the visual language of traditional art. Some animated icons also experience delays in their animations, which affects users' intuitive perception and the smoothness of interactions.

Expert Feedback Summary.

asked on the test results, experts have provided the following optimization suggestions:

Interface Layout: Adjust the position of functional buttons to ensure that key operations are concentrated within the user's visual focus area. Additionally, optimize the logical structure of the navigation bar, simplify operational steps, and improve user convenience in navigation.

Colors and Theme: Enhance the interface's sense of layering and further emphasize the artistic elements of Nanjing Paper-Cutting. Optimize color contrast, such as adding green, to improve content visibility and visual impact.

Fonts and Icons: Adjust the font size and icon design style to ensure consistency with the theme of Nanjing Paper-Cutting, and optimize the responsiveness of dynamic icons to enhance smoothness in user operations and interaction experience.

4.4.2 Interface Testing Improvement Measures

Based on the results of the interface test and expert recommendations, the following improvement measures are proposed for this study:

Interface Layout Optimization: Adjust the arrangement of the main interface functional modules, placing important operations in the center or focal point of the screen. Simplify the navigation bar's hierarchical structure, reduce the number of subpages, and improve the interface's intuitiveness and operational efficiency.

Color and Theme Optimization: Enhance the sense of layering in the color scheme. While maintaining the traditional red and gold as the primary color tones, introduce supplementary colors to enrich the visual effect. Increase the contrast between text and background colors to ensure the readability of button text and other interface elements.

Font and Icon Improvements: Increase the font size for smaller text, especially on key task pages, to ensure that the text is clearly visible.

Icon Design Optimization: Unify and optimize the icon designs to better align with the artistic style of Nanjing Paper-Cutting. Reduce unnecessary dynamic effects to ensure smooth operations.

These improvements are expected to effectively enhance the ease of use, visual appeal, and overall user experience of the interface, thereby better supporting the

educational and cultural dissemination goals of the Nanjing Paper-Cutting Show game.

4.4.3 Functionality Testing

This section focuses on the comprehensive evaluation of the functional modules of the *Nanjing Paper-Cutting Show* game to verify the completeness of its operation, the smoothness of its interactive logic, and whether it can achieve the core objectives as designed. Based on the results of the functionality test and expert opinions, optimization plans will be proposed to provide theoretical support for further refining the game's functions.

Completeness of Functional Modules.

The completeness of functional modules is critical to the achievement of the game design goals. This test primarily evaluates whether the core modules of the game operate normally and the coverage of their functions.

The test results indicate that the core functional modules of the game can start normally and achieve the intended functions. For example, the "Paper-Cutting Greeting Card" module includes a variety of traditional patterns for display and selection, effectively serving the educational purpose. The greeting card sharing function supports custom text input, offering strong interactivity. However, the test also revealed the following issue: users were unable to immediately perceive that the text on the greeting card could be customized.

Smoothness of Interactive Logic. The smoothness of interactive logic is an important factor affecting user experience. This test evaluates the ease with which users can switch between different modules and the system's response speed, focusing on potential lag or abnormal logical transitions. The test results show that most of the game modules switch smoothly, with response times under 2 seconds, meeting expectations. However, the following interaction issues need attention: The transition logic between the "Masterpiece Appreciation" module and the "Paper-Cutting Greeting Card" module is not intuitive, with some users reporting confusion during testing.

Expert Feedback Summary.

Based on the test results, the expert group provided the following suggestions from the perspectives of functional design completeness and user interaction experience:

Functional Module Optimization: Improve the prompts for customizing text on the "Paper-Cutting Greeting Card."

Interaction Logic Improvement: Optimize the loading logic of each module to reduce switching time between modules, and enhance the intuitiveness of page transitions by incorporating guiding hints (e.g., gesture instructions).

4.4.4 Functional Testing Improvement Measures

Based on the results of functional testing and expert feedback, this study plans to optimize the following aspects:

Functional Module Enhancement: Fix the issue of customizing text in the "Paper-Cutting Greeting Card" module, ensuring that users are promptly reminded of the option to customize text when the task is presented.

Interaction Logic Optimization.

Improve the switching speed between modules by using preloading technology to reduce page load time. Add navigation buttons between the "Masterpiece Appreciation" and "Paper-Cutting Greeting Card" modules to ensure clear operation paths.

User Experience Enhancement.

Introduce more interactive feedback mechanisms, such as gesture guides for various operations, to reduce user confusion. Add shortcut keys for transitioning to tutorial modules, allowing users to quickly switch to the target module.

Through these improvements, it is expected that the functionality stability and user interaction fluidity of the *Nanjing Paper-Cutting Show* game will be significantly enhanced, further improving the educational dissemination and cultural experience value of the game.

4.4.5 User Experience Testing

User experience testing aims to assess the overall feel and user satisfaction with the *Nanjing Paper-Cutting Show* game in practical use, identifying potential problems and providing directions for optimization. This test combines the User Experience Map to analyze the user's operation path and emotional changes during the game, while also referencing expert opinions for improvement.

4.4.5.1 User Experience Map

The User Experience Map is an essential tool for analyzing emotional and behavioral changes during user interaction. In this test, the key experience nodes (such as starting the game, task challenges, free creation, and artwork display) were recorded through actual operation. The emotional responses were then analyzed, as shown in the image.

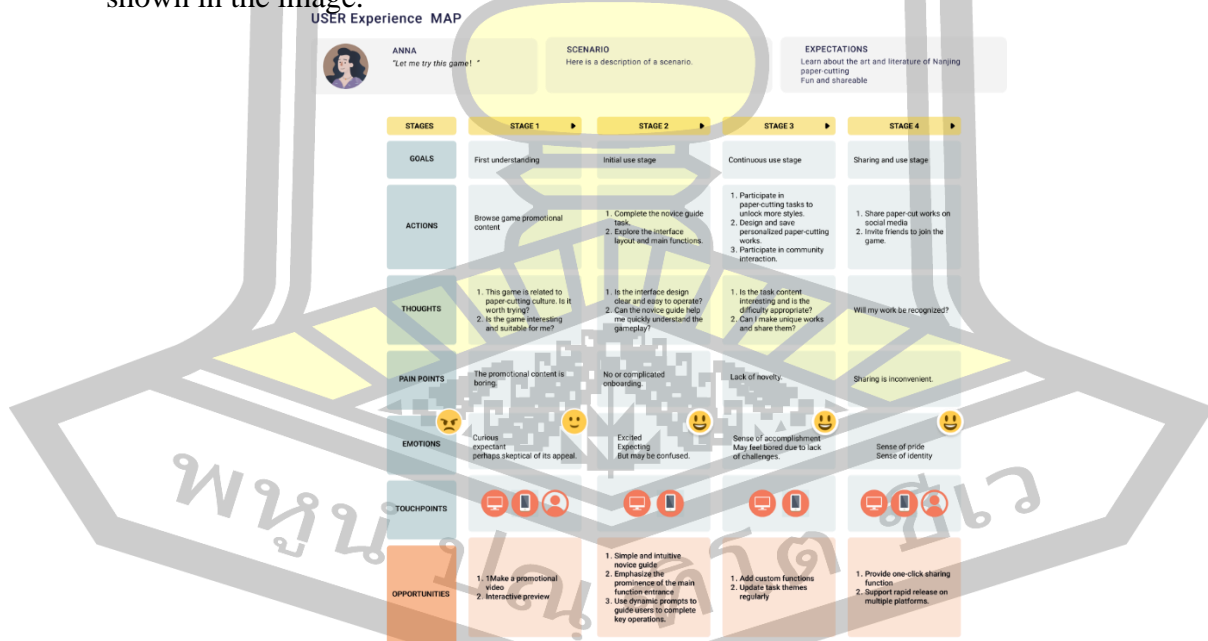


Figure 98 User Experience Map of *Nanjing Paper-Cutting Show*
Source: Author. Oct. 20th, 2024

From the User Experience Map, it can be seen that the user experience of the *Nanjing Paper-Cutting Show* game is divided into four stages: cognition, first use, continuous use, and sharing. The goals, behaviors, emotions, and pain points of users in each stage present different characteristics.

In the cognition stage, the goal is to stimulate users' interest, but the lack of appeal in promotional content and channels becomes the main obstacle to users' willingness to download the game. By enhancing the cultural features of the promotion and optimizing the app store page description, the game can more effectively attract the target users.

In the first use stage, users expect to quickly get started and experience the fun of the game. However, the overly complicated beginner guide, lack of intuitive interface operation, and cumbersome registration process increase the entry barriers to the first experience. Optimizing the beginner guide, simplifying the registration process, and improving the intuitiveness of the navigation logic will help improve users' satisfaction with their initial experience.

In the continuous use stage, users hope to maintain interest in the game through rich content and attractive rewards. However, the monotony of existing content and the lack of an appealing reward system cause users to feel fatigued. By increasing the diversity of game tasks, adding personalized features, and introducing innovative gameplay, user engagement and participation can be significantly improved.

In the sharing stage, the main goal for users is to gain recognition by showcasing their work and interacting with others, but the current sharing function is inconvenient, lacks feedback mechanisms, and has low social interaction. Optimizing the design of the sharing function, providing feedback response mechanisms, and strengthening the community interaction platform will help users gain more sense of achievement and social connection.

Through optimization in promotion appeal, ease of use, content innovation, and interactive mechanisms, the overall game experience can be significantly enhanced. This not only meets users' needs at each stage but also better spreads the cultural value of Nanjing Paper-Cutting.

4.4.5.2 Summary of Expert Opinions

Based on the analysis of user experience for the *Nanjing Paper-Cutting Show* game, the following optimization suggestions were provided by experts:

Optimize Promotion and Channel Strategy.

During the awareness phase, the game's visibility and attractiveness should be enhanced through integrated multi-channel marketing. The promotional content should emphasize the cultural depth, highlighting the traditional artistic value of Nanjing Paper-Cutting, and design more interactive and visually striking promotional materials. For example, using short videos, cultural explanations, and user-generated content can increase user participation and engagement, thereby broadening the promotional reach.

Simplify First-Time Use Flow and Guidance Design.

In the initial usage phase, simplifying the onboarding and registration process is crucial. It is recommended to shorten the tutorial to a few key steps, avoid lengthy

textual explanations, and incorporate visually appealing prompts with images and text. At the same time, optimize the interface layout to ensure that key function buttons align with user habits. A/B testing can be used to validate different guidance flows, ensuring new users can complete tasks quickly and immerse themselves in the game.

Enrich Game Content and Personalization Features.

In the continuous use phase, users have high expectations for content. Therefore, it is necessary to continuously expand the depth and breadth of the game by adding more tasks, creative gameplay, and personalization options. This will increase user participation and the long-tail effect of the game. By analyzing data, task difficulty can be optimized to balance challenge and enjoyment, enhancing user retention.

Enhance Sharing and Social Interaction Features.

Sharing and social interaction are key to increasing user engagement. The sharing feature should be optimized to ensure seamless sharing of works on social platforms, displaying users' achievements and creative processes. In addition, a user interaction community should be established to encourage users to evaluate, discuss, and collaborate on works. This will enhance the social experience while increasing users' sense of belonging and participation. A timely feedback mechanism can also be introduced to improve user interaction with the platform and increase loyalty.

Regularly Collect User Feedback and Conduct Data Analysis.

User feedback should be regularly collected, and the product should be continuously optimized based on data analysis. By analyzing user behavior data, it is possible to identify which features are most popular and which areas have issues, allowing for timely adjustments and improvements. Methods such as surveys and user interviews should be used to understand user needs and pain points, and based on data and feedback, the game design should be iteratively updated to ensure it continues to meet user expectations and optimize the gaming experience.

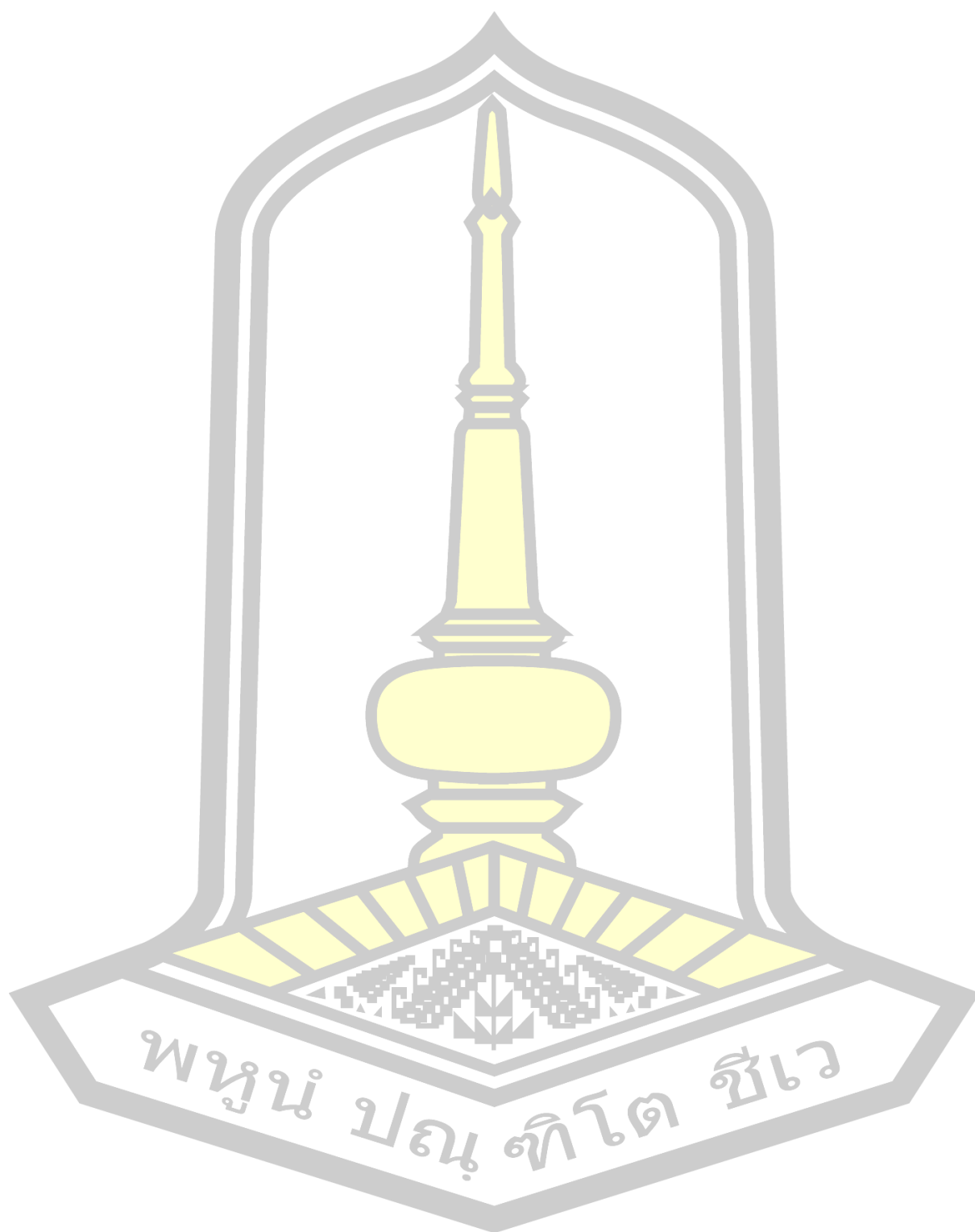
These suggestions can improve the game's user experience from multiple aspects, enhancing user engagement and further promoting cultural transmission and innovation.

4.4.6 User Experience Improvement Measures

To continuously optimize the user experience of the *Nanjing Paper-Cutting Show* game, based on the current test results and expert feedback, the following improvement measures are proposed. These measures aim to enhance the overall user experience through multi-dimensional optimization, ensuring the game's usability, cultural appeal, and interactivity.

Optimize Promotion Channels and Information Delivery.

In the awareness phase, to address the issue of insufficient promotional coverage, it is recommended to strengthen the game's multi-channel promotion strategy. This can be achieved through social media, short video platforms, collaborative promotions, and partnerships with cultural bloggers to increase the game's exposure. Additionally, optimize the game's presentation in app stores by highlighting its cultural features and artistic value, using more visually attractive promotional materials, adding cultural interpretation, and introducing key highlights of the game to spark potential users' interest and attract more downloads and engagement.



Simplify the First-time Use Process.

In the initial use phase, simplifying the tutorial and operation process is crucial. It is recommended to reduce unnecessary text explanations and adopt a more intuitive, illustrated guidance approach, combining dynamic guidance and interactive tutorials. This ensures users can quickly get started and understand the core gameplay within a short time.

Enhance Content Diversity and Game Depth.

In the sustained usage phase, user interest and engagement rely on the richness and innovation of game content. More creative gameplay should be introduced, such as holiday events, personalized creation tasks, and challenge missions, to maintain the novelty and continuous appeal of the game. By offering personalized customization features, players can create unique paper-cutting works based on their preferences, increasing user retention. Additionally, it is recommended to optimize the task difficulty curve through data analysis to ensure a balance between challenge and playability, avoiding monotonous tasks that may cause user attrition.

Strengthen Sharing Functions and Social Interaction.

In the sharing usage phase, the convenience of sharing functions and the enhancement of social interactions are crucial for improving user retention. The sharing process should be optimized to ensure that users can quickly and easily share their creations on major social platforms and display the creation process and achievements. Establish an in-game community and interaction platform that allows users to like others' works, thus enhancing the social experience. Through timely feedback and interaction, users should be encouraged to participate and continue creating, increasing their social interaction and sense of accomplishment, further boosting user loyalty.

Enhance Data Analysis and User Feedback Mechanism.

The key to continuously optimizing user experience lies in accurately understanding user needs. Regularly collect user feedback and combine it with user behavior data analysis to evaluate whether the game's features and designs meet expectations. Various methods such as online surveys and user interviews should be used to understand users' true experiences and suggestions regarding the game's content, features, and operations. Through data analysis, identify problem areas, such as inconvenient operation zones, and respond quickly to iterate and optimize features, ensuring the game can continuously meet user needs at all stages.

By implementing the above improvement measures, the user experience of the *Nanjing Paper-Cutting Show* game can be effectively enhanced, increasing its cultural and interactive appeal, maintaining user retention and long-term engagement, and driving the game's success and cultural dissemination in the market.

4.5 Deployment and Release

The deployment plan is the core step to ensure that the *Nanjing Paper-Cutting Show* game can be successfully launched and run. This mainly includes platform configuration, server environment setup, and security assurance. Based on the characteristics of the Mu Ge Da platform, the deployment plan first needs to configure an appropriate release domain and server environment, ensuring the game can run stably in the WeChat mini-program or H5 web format and achieve efficient loading.

The release plan outlines the game's steps from pre-launch preparations to post-launch promotional strategies. Before launch, comprehensive functionality and performance testing should be conducted, especially compatibility tests across devices and operating systems, to ensure that all features work as expected. After completing regression testing, optimization should be performed based on the issues found to guarantee smooth gameplay and user experience. In terms of release channels, it is recommended to prioritize the WeChat mini-program launch, while also combining the HTML5 web release to expand the game's coverage. By launching through these two methods, *Nanjing Paper-Cutting Show* can attract a broader user base. Additionally, an effective user feedback channel should be established before launch, including an in-game feedback system and social platform interactions, to collect player opinions and suggestions.

After the game is launched, a long-term maintenance and update strategy should be developed to continuously optimize the user experience. Issues and suggestions collected through user feedback channels can drive iterative updates to game features. Additionally, for potential compatibility issues or performance bottlenecks, the team should arrange for ongoing optimization and development.

4.6 Key Technological Breakthroughs and Innovations

In the development of the *Nanjing Paper-Cutting Show* game, significant innovations and breakthroughs were made across multiple technical fields. These efforts aim to enhance user experience, ensure the game's cultural and interactive aspects, and facilitate the digital inheritance of traditional art while fostering the deep integration of technology and culture. The following are key technological breakthroughs and innovations in the game development:

4.6.1 Digital Reconstruction Technology of Paper-Cutting Art

The game achieved significant breakthroughs in the digital reconstruction technology of paper-cutting art. By converting traditional Nanjing Paper-Cutting art into digital elements, the game transcended the static nature of traditional paper-cutting, bringing it to life with dynamic and interactive features. Utilizing AIGC (Artificial Intelligence Generated Content), image processing, and animation technologies, the game digitally converts paper-cutting patterns with high precision, preserving the traditional aesthetic of the art while enhancing interactivity and operability. This reconstruction technology not only improves the display effects of paper-cutting art but also provides users with a more diverse creative space, expanding the expressive forms of traditional art.

Vectorization of Images and Animation Technology: By transforming the flat patterns of traditional paper-cutting into digital art forms and incorporating animation technology, the game enables the patterns to change dynamically according to the user's creations. This method of reconstruction allows paper-cutting to evolve from a static art form into a controllable element for players, greatly enhancing interactivity.

Detail and Precision Preservation: Through high-precision image processing technology, the game faithfully reproduces the fine details of Nanjing Paper-Cutting, ensuring that no traditional visual effect or cultural meaning is lost during digital transformation. Special attention is given to color application and texture rendering, preserving the unique artistic style of the craft.

User-Customized Creation: The digital reconstruction technology allows players not only to admire paper-cutting artworks but also to create their own paper-cutting designs. The game simplifies the creation process, reducing entry barriers and enabling more users to participate in the artistic creation experience.

Enhanced Interactive Experience: Building on traditional paper-cutting, the game includes various interactive features that allow players to create and modify paper-cutting works. Through touch screens and gestures, users can interact naturally with the art. Digital technologies make these interactions more intuitive and livelier, heightening player immersion and engagement.

4.6.2 Deep Integration of Cultural Symbols and Interactive Experience

The *Nanjing Paper-Cutting Show* game innovates by integrating Nanjing Paper-Cutting's cultural symbols with modern interactive technologies, breaking the traditional one-way display of cultural symbols. The game uses advanced image recognition and dynamic interaction technologies to present the traditional symbols, patterns, and symbolic meanings of Nanjing Paper-Cutting in a virtual environment. User interactions trigger dynamic changes in the cultural symbols, enabling players to understand and experience the cultural connotations during the creative process.

Deep Integration of Cultural Symbols and Game Interaction: The game converts the symbols in Nanjing Paper-Cutting into digital formats, and through interactive design, players can directly manipulate these symbols. Users not only visually appreciate the beauty of paper-cutting but also understand the historical and cultural significance of each symbol through the interaction, experiencing the cultural stories behind the art.

Symbols and Dynamic Feedback Mechanisms: When players select certain paper-cutting symbols, the system provides immediate feedback based on their actions. The symbols are dynamically transformed, illustrating their cultural meaning and enhancing their expressiveness and educational value. This feature increases the cultural depth and interactivity of the game.

4.6.3 Multidimensional Design Combining Education and Entertainment

The *Nanjing Paper-Cutting Show* game achieves a multidimensional design by integrating education and entertainment. The tasks and challenges in the game are not only entertaining but also incorporate educational elements related to Nanjing Paper-Cutting art. Through carefully designed task systems, players can enjoy the fun of the game while learning and mastering paper-cutting techniques and understanding its cultural background. This design breaks through traditional education models by using interactive gameplay, allowing players to acquire knowledge in a fun and engaging way.

Seamless Integration of Education and Entertainment: The game integrates learning content on paper-cutting art with the game narrative, allowing players to enjoy the fun of creating art while gradually mastering paper-cutting skills and cultural knowledge. This achieves both educational and entertainment goals.

Interactive Learning Mode: In the process of completing tasks, players do not simply receive knowledge; they actively learn through creation and exploration. Feedback mechanisms encourage players to keep engaging and mastering more paper-cutting techniques and cultural knowledge.

4.6.4 Integration of Social Interaction and Virtual Cultural Spaces

The *Nanjing Paper-Cutting Show* game deepens the integration of social interaction and community platforms, transcending the limitations of traditional, singular game experiences. The game not only focuses on user participation in art creation but also enhances social features and online community platforms, allowing for real-time interaction, sharing of artworks, and creative competitions among players. By leveraging virtual cultural spaces and online community technologies, the game fosters communication and emotional connections between players, transcending geographical boundaries.

Combining Creation and Sharing in Social Features: As players create paper-cutting artworks, they can immediately share their creations on social platforms or in the game's community. This feature allows users to showcase their personal works, while also drawing inspiration from others' creations. It cultivates a healthy environment for interaction and exchange, enhancing the game's social dimension and player engagement.

Community Platform: Through the community platform, players not only display their works but can also exchange their creations, further enhancing the social connection and fostering a sense of belonging within the community.

These breakthroughs and innovations contribute to the overall success of the *Nanjing Paper-Cutting Show* game by combining cultural heritage with cutting-edge technology and interactivity.

4.7 Chapter Summary

4.7.1 Review of the Chapter

This chapter provides a comprehensive review of the design and development process of the digital interactive game *Nanjing Paper-Cutting Show*, delving into the inheritance and innovation of Nanjing Paper-Cutting art in the digital context. It first establishes the cultural value of Nanjing Paper-Cutting as an ICH and highlights the urgency and necessity of its digital dissemination in modern society. Subsequently, the chapter analyzes the core objectives and significance of the game design, aiming to leverage digital technology to offer new approaches to the preservation and dissemination of traditional culture.

Through user research and needs analysis, this chapter constructs a design framework based on task-oriented learning models and interactive experiences. It elaborates on key aspects, including functional requirements, user interaction design, character creation, and scene construction. Furthermore, the chapter introduces an innovative semantic transformation of paper-cutting symbols within the game design, reinterpreting and revitalizing traditional artistic elements in a virtual cultural space. This approach broadens and deepens the scope of cultural dissemination. Through these efforts, *Nanjing Paper-Cutting Show* not only achieves the digital inheritance of traditional art but also provides robust support for its global dissemination.

4.7.2 Research Findings of This Chapter

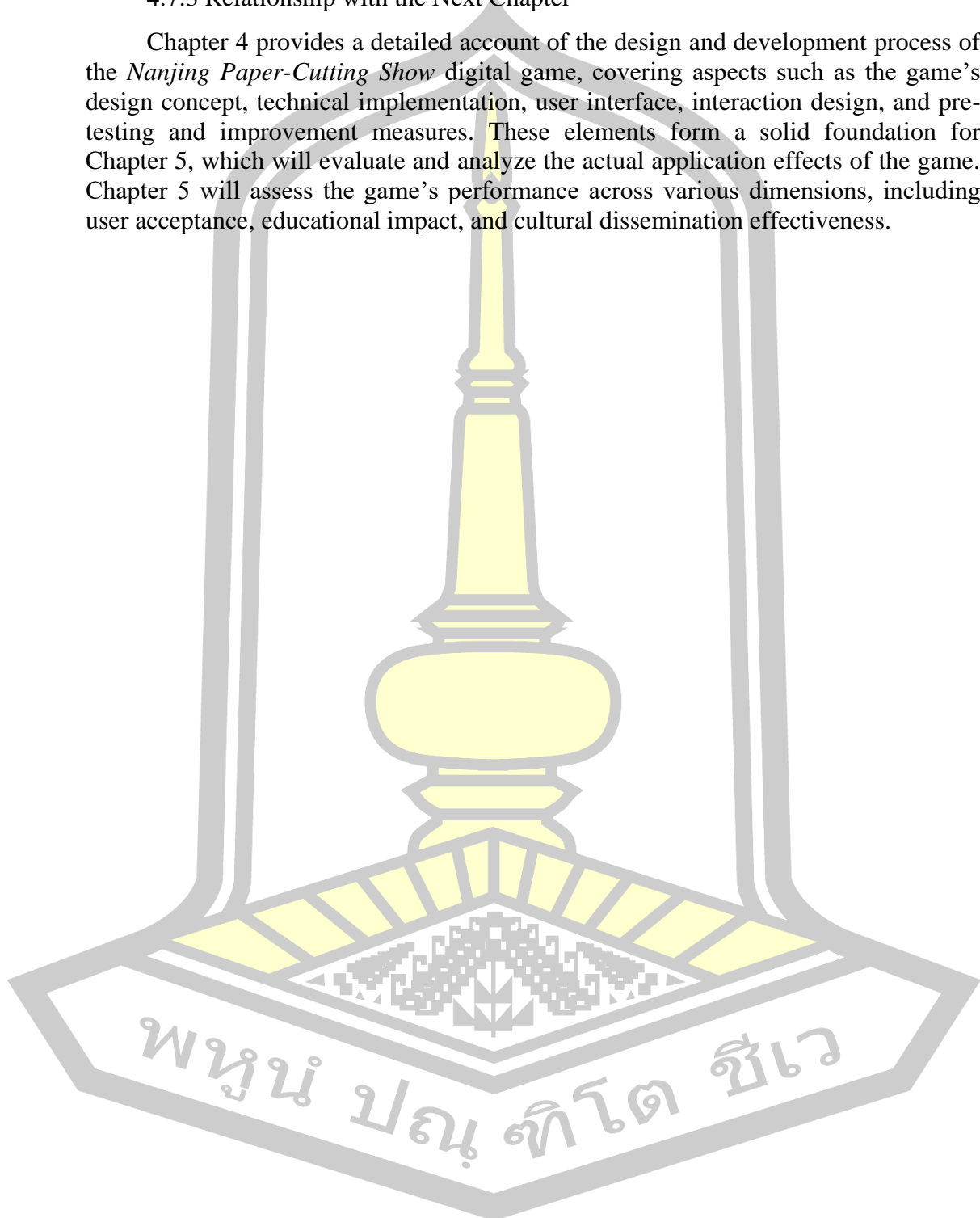
Table 13 Chapter 4 Research Results

Serial Number	Achievement Name	Specific Content
1	User research	Target user portraits cover analysis of age groups, demand expectations, etc.; functional requirements focus on paper-cut art learning, cultural awareness and inheritance, immersive experience, etc.; non-functional requirements involve system performance, user ease of use, etc
2	Game Design	The overall design of the game takes user experience as the core, including user interface design, interaction design, scene setting, character design and digital semantic conversion of cultural symbols, highlighting the cultural inheritance and innovative expression of paper-cut symbols
3	Functional module division and technical implementation	Realize paper-cutting art and skill learning, cultural cognition and interactive motivation functional modules; the technical architecture ensures system performance and user experience; the interactive module enhances the fun and dissemination of cultural content through game mechanisms
4	Pre-testing and improvement measures	Including interface testing, functional testing and user experience testing, game design is optimized through expert opinions and user feedback, and improvement measures are formulated to improve user satisfaction and cultural communication effects.
5	Deployment and release.	Determine the game launch strategy, pay attention to user experience and cultural communication goals during the deployment process, and conduct promotion and maintenance based on actual application scenarios
6	Key technological breakthroughs and innovation points	Key technological innovations include the digital reconstruction of paper-cut art, the integration of cultural symbols and interactive experience, the diversified design that combines education and entertainment, and the new model of integrating social interaction and virtual cultural space

Source: Author. Oct.8, 2024

4.7.3 Relationship with the Next Chapter

Chapter 4 provides a detailed account of the design and development process of the *Nanjing Paper-Cutting Show* digital game, covering aspects such as the game's design concept, technical implementation, user interface, interaction design, and pre-testing and improvement measures. These elements form a solid foundation for Chapter 5, which will evaluate and analyze the actual application effects of the game. Chapter 5 will assess the game's performance across various dimensions, including user acceptance, educational impact, and cultural dissemination effectiveness.



Chapter V

Application and Evaluation of the *Nanjing Paper-Cutting Show* digital interactive game

5.1 Introduction

5.1.1 Research Background

With the rapid development of digital technology, the dissemination methods of traditional culture are undergoing profound changes. As an important ICH of China, paper-cutting art faces the dual challenges of inheritance and innovation. Youth, as a key audience for the transmission of traditional culture, generally prefer engaging with it through digital and highly interactive methods. This creates new opportunities for the application of digital games in the field of cultural dissemination.

Nanjing Paper-Cutting Show is a digital game designed based on Nanjing Paper-Cutting art, aiming to integrate traditional art with modern digital technology through innovative interactive forms. By taking paper-cutting art symbols as its core, the game seeks to inspire young people's interest in and recognition of Nanjing Paper-Cutting culture through an educational and entertaining approach. However, how to evaluate its effectiveness in cultural dissemination and user acceptance remains an issue requiring further exploration. Therefore, this study systematically applies and evaluates *Nanjing Paper-Cutting Show* from multiple dimensions, combining the UTAUT2 model and qualitative analysis by experts. It aims to explore the practical value of digital methods in the preservation and dissemination of traditional culture.

5.1.2 Research Objectives and Significance

This study systematically analyzes and evaluates the design and application outcomes of *Nanjing Paper-Cutting Show*, exploring the mechanisms by which digital games contribute to the inheritance of traditional culture. It aims to provide theoretical support and practical guidance for the development and promotion of similar projects. As a digital game centered on Nanjing Paper-Cutting art, *Nanjing Paper-Cutting Show* integrates modern digital technology with traditional cultural elements to showcase the core values and cultural connotations of paper-cutting art through innovative interactive formats.

The research adopts a mixed-methods approach, combining the UTAUT2 model to analyze user behavior and usage intentions with expert evaluation to validate the game's performance in cultural transmission. Experts provide professional insights into aspects such as cultural expression, user experience, and educational significance, deepening the understanding of the game's role in promoting cultural identity and enhancing youth cultural awareness and emotional connection. Based on the multidimensional evaluation results, the study also proposes optimization suggestions, exploring broader pathways for the digital innovation of Nanjing Paper-Cutting art and offering practical guidance for integrating traditional culture into digital media. Specifically, this chapter includes the following three core objectives:

- (1) **Application Scenarios:** Analyze the contexts and use cases where the game can be effectively applied.
- (2) **User Acceptance Factors:** Evaluate the critical elements that influence users' willingness to adopt and engage with the game.
- (3) **Optimization Suggestions:** Provide actionable recommendations for improvement based on expert evaluations.

5.1.3 Chapter Structure

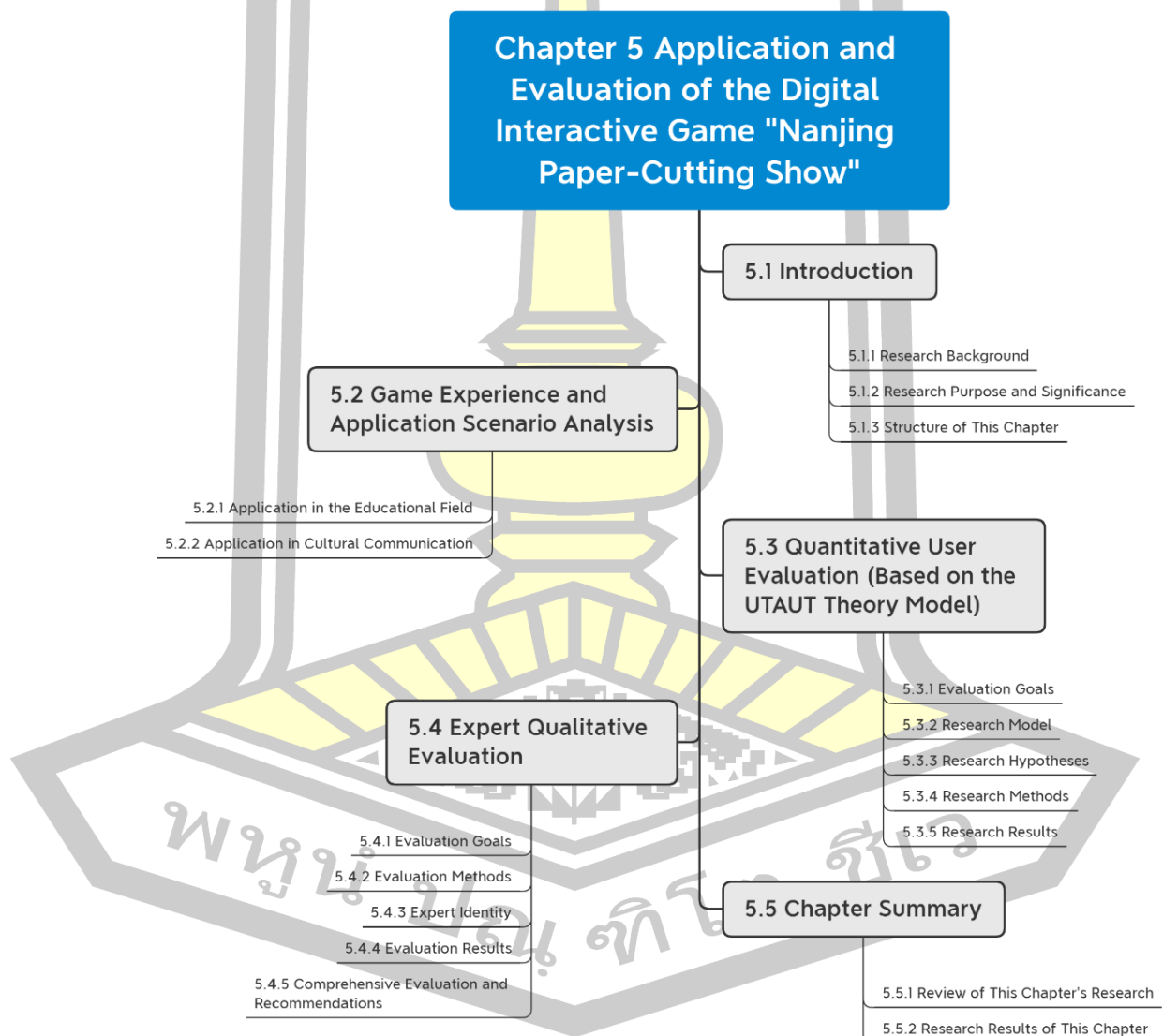


Figure 99 Chapter 5 Logical Structure Diagram

Source: Author. Nov. 25th, 2024

5.2 Analysis of Game Experience and Application Scenarios

Nanjing Paper-Cutting Show, as an innovative game integrating cultural art and digital technology, aims to spark users' interest in Nanjing Paper-Cutting culture through its entertaining and interactive features while enhancing cultural awareness and aesthetic appreciation. Its application scenarios are primarily concentrated in the fields of education and cultural dissemination, demonstrating multi-dimensional social value.

5.2.1 Applications in Education

In the educational field, *Nanjing Paper-Cutting Show* highlights the potential for deep integration between traditional culture and modern teaching methods. Through gamified learning, the product provides diverse cultural learning resources for school education, social training, and family education.

The game can serve as an auxiliary tool for traditional cultural education in primary, secondary, and higher education art classes. By completing paper-cutting tasks or exploring the cultural connotations behind the artworks, students can deepen their understanding of ICH while improving their hands-on skills and creativity. For instance, teachers can guide students through tasks in the game to create innovative paper-cutting pieces, helping them learn about the aesthetics of paper-cutting, traditional folklore, and the unique cultural features of Nanjing.

Compared with traditional teaching methods, modified learning offers a more engaging and interactive experience. *Nanjing Paper-Cutting Show* employs task and reward mechanisms to stimulate students' enthusiasm for participation. Rewards obtained in the game can also be shared with classmates and parents via the sharing feature, further encouraging continued learning.

The game is also suitable for family settings, where parents and children can collaborate on paper-cutting projects. This enhances parent-child interaction while laying a foundation for children's cultural enlightenment. Through storytelling and hands-on activities in the game, parents can help children understand cultural values and acquire knowledge in a relaxed and enjoyable environment.

5.2.2 Applications in Cultural Dissemination

As a digital dissemination tool, *Nanjing Paper-Cutting Show* overcomes the temporal and spatial limitations of traditional cultural transmission, providing a novel channel for the preservation and promotion of Nanjing Paper-Cutting culture.

The modified dissemination format aligns better with young users' preferences. Through its engaging and interactive features, *Nanjing Paper-Cutting Show* attracts young people to actively engage with Nanjing Paper-Cutting culture, enhancing their sense of identification with traditional culture. For example, the game's social sharing feature allows players to upload their paper-cutting works to social media, fostering interaction with friends and creating a dissemination effect among young users.

With the globalization of digital games, *Nanjing Paper-Cutting Show* also holds the potential for cultural export. By incorporating multilingual support and internationalized design, the game could serve as an important platform for foreign users to learn about Nanjing Paper-Cutting and China's ICH.

The game can also be integrated with offline cultural activities, becoming a key carrier for digital exhibitions. For instance, museums, ICH exhibition centers, or cultural tourism destinations could use *Nanjing Paper-Cutting Show* to enhance visitor interaction. Paper-cutting works completed in the virtual game could be developed into cultural souvenirs or personalized products, forming a "digital + cultural creation" model.

With its unique characters, storylines, and paper-cutting elements, *Nanjing Paper-Cutting Show* showcases rich cultural appeal and IP development potential. Combining this traditional culture with modern sports products could lead to a series of sports gear featuring Nanjing Paper-Cutting characteristics, as illustrated in the figure below.



Figure 100 Sports products BiXie image -Basketball
Source: Author. Nov. 25th, 2024



Figure 101 Sports products BiXie image - Boxing glove
Source: Author. Nov. 25th, 2024



Figure 102 Sports products BiXie image – Sports wear
Source: Author. Nov. 25th, 2024



Figure 103 Sports products BiXie image – Sneaker

Source: Author. Nov. 25th, 2024

Through these designs, the IP of *Nanjing Paper-Cutting Show* can seamlessly integrate with sports products, not only expanding the influence of Nanjing Paper-Cutting culture but also adding unique cultural value and artistic charm to sports merchandise.

Nanjing Paper-Cutting Show demonstrates profound application value in both educational and cultural dissemination domains. It broadens the channels for traditional cultural transmission and achieves the integration of culture and technology through innovative approaches, providing a modern solution for the preservation of Nanjing Paper-Cutting culture.

5.3 Research and analysis of user acceptance factors for games(Based on the UTAUT2 Theoretical Model)

This study utilizes the UTAUT2 technology acceptance model to quantitatively evaluate the key factors influencing young users' behavioral intentions to engage with *Nanjing Paper-Cutting Show*, a digital paper-cutting game.

5.3.1 Evaluation Objectives

The study examines the role of seven core constructs: performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, habit, and cultural identity. It seeks to comprehensively reveal how these factors influence young users' acceptance and usage intentions toward the digital game. The specific research objectives are as follows:

- Analyze the acceptance level of digital paper-cutting games among young users.
- Identify the key factors influencing young users' behavioral intentions.
- Examine the impact of cultural identity on behavioral intentions.

5.3.2 Research Model

This study aims to identify the key factors influencing young users' behavioral intentions toward digital paper-cutting games. It investigates six factors from the UTAUT2 model: performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), hedonic motivation (HM), and habit (HT), as well as an additional variable, cultural identity (CI).

As highlighted in the literature, adapting technology acceptance models to specific contexts enhances their explanatory and predictive power for user acceptance. Incorporating cultural identity as a factor reveals how cultural influences affect user

interactions with the game, thereby improving the effectiveness of its design and implementation. Figure 106 illustrates the proposed research model:

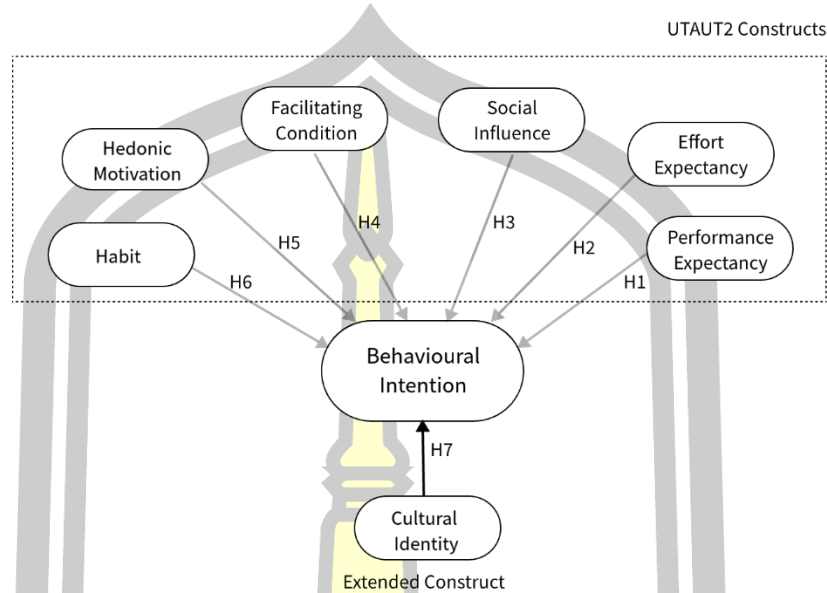


Figure 104 UTAUT2 Research Model

Source: Author. Nov. 30th, 2024

5.3.3 Research Hypotheses

This study aims to identify and validate the key factors influencing young users' behavioral intention (BI) to engage with digital paper-cutting games. These hypotheses were formulated to explore the impact of various factors and support the preservation and promotion of cultural heritage through digital means. Performance Expectancy (PE)

Performance expectancy refers to the belief that using a technology can enhance individual performance in personal or professional contexts. In this study, PE is defined as the belief among young users that digital paper-cutting games can improve their cultural knowledge, artistic appreciation, and entertainment experience. For youths engaged in cultural heritage and art education, such games may appear beneficial for both learning and entertainment, thereby increasing their intention to use this technology.

Hypothesis 1 (H1): PE has a positive impact on young users' BI toward digital paper-cutting games.
Effort Expectancy (EE)

Effort expectancy represents the perceived ease of use of a technology, directly influencing the intention to accept and use it. This includes perceived challenges like learning costs, operational complexity, and usability. In this study, EE is defined as the perceived ease of use of digital paper-cutting games. If the game is perceived as easy to learn and operate, users are more likely to adopt it, making EE critical in determining initial attractiveness and continued use.

Hypothesis 2 (H2): EE has a positive impact on young users' BI toward digital paper-cutting games.
Social Influence (SI)

Social influence reflects the expectations and opinions from family, friends, colleagues, and others regarding technology use. In this study, SI is defined as the perceived support and recommendations from peers regarding the use of digital paper-cutting games. In the Chinese cultural context, the opinions of social networks play a significant role in decision-making.

Hypothesis 3 (H3): SI has a positive impact on young users' BI toward digital paper-cutting games.

Facilitating Conditions (FC)

Facilitating conditions refer to the belief that the necessary resources and support for using a technology are available. This includes technical support, resources, and environmental factors that help overcome adoption barriers. In this study, FC is defined as the resources and support, such as devices, internet access, and technical assistance, available to young users of digital paper-cutting games.

Hypothesis 4 (H4): FC has a positive impact on young users' BI toward digital paper-cutting games.

Hedonic Motivation (HM)

Hedonic motivation is the enjoyment and positive emotions experienced while using a technology, directly influencing behavioral intention. In this study, HM reflects the enjoyment young users feel when playing digital paper-cutting games. Well-designed cultural digital products enhance user satisfaction, increasing acceptance and engagement.

Hypothesis 5 (H5): HM has a positive impact on young users' BI toward digital paper-cutting games.

Habit (HT)

Habit refers to the automatic behavior of using a technology over time, shaped by user inertia and dependence. In this study, HT is defined as the usage patterns and dependency young users form while playing digital paper-cutting games. Habit significantly influences the sustained engagement of users in cultural applications.

Hypothesis 6 (H6): HT has a positive impact on young users' BI toward digital paper-cutting games.

Cultural Identity (CI)

Cultural identity represents an individual's sense of belonging to their culture, playing a crucial role in technology acceptance. In this study, CI is defined as the cultural connection and identity experienced by young users while playing digital paper-cutting games. In the context of China's emphasis on traditional culture, CI reflects not only an affinity for tradition but also the rediscovery and experience of traditional culture in digital environments.

Hypothesis 7 (H7): CI has a positive impact on young users' BI toward digital paper-cutting games.

5.3.4 Research Methods

This study employs structural equation modeling (SEM) to test hypotheses and analyze relationships among variables. SEM is a robust statistical tool that effectively addresses measurement errors and improves result accuracy. Additionally, SEM provides various fit indices to evaluate the model's overall validity and goodness of fit.

Data were collected through a questionnaire survey and analyzed using IBM SPSS Statistics 27 for data preprocessing, suitability tests, and reliability evaluation. Path analysis was conducted using IBM SPSS Amos 27 to validate hypothesized relationships and assess model fit through multiple indices. Hypothesis validity was confirmed through significance tests of path coefficients at a 0.05 significance level.

The results section focuses on explaining the direct effects of variables on BI. Path coefficients and significance levels were used to evaluate the influence of different factors on young users' behavioral intention toward digital paper-cutting games. Practical applications and implications of the findings are also discussed.

5.3.4.1 Sample and Data Collection

To achieve the research objectives, a questionnaire with 40 items was developed and administered to a youth sample. A total of 346 valid responses were collected. Descriptive statistics of the sample are presented in Table 14:

Table 14 Participants' demographic profile.

Characteristics	Values	Frequency	Percent (%)
Age	18 to 45	346	100.0%
Gender	Male	132	38.2%
	Female	214	61.8%
Education	Junior college or below	9	2.6%
	College	132	38.2%
	Undergraduate	190	54.9%
	Postgraduate	15	4.3%
Location	Township	51	14.7%
	City	295	85.3%

Source: Author. Nov. 30th, 2024

The age distribution of the sample reflects the typical age range of Chinese youth in society. Among the participants, 38.2% were male and 61.8% were female. Educationally, 54.9% were undergraduate students, 38.2% were diploma-level students, 4.3% were postgraduate students, and only 2.6% were below diploma level, indicating a relatively high level of education among the participants with substantial experience in using digital products. Additionally, 85.3% of respondents resided in urban areas, while 14.7% lived in towns or rural regions, demonstrating that most respondents came from economically developed areas with well-established communication network infrastructure.

5.3.4.2 Questionnaire Design

The questionnaire is divided into two parts. The first part collects demographic information, while the second part evaluates the factors influencing young people's behavioral intention towards paper-cutting digital games. These factors are based on the validated UTAUT2 model variables and are measured using a five-point Likert scale (Appendix B).

5.3.4.3 Suitability Tests

The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were conducted to evaluate the adequacy of data for factor analysis. If the KMO value exceeds 0.6 and Bartlett's test result is statistically significant ($p < 0.05$), the data are considered suitable for factor analysis.

In this study, the KMO value was 0.94, and Bartlett's test yielded a p-value of 0, as shown in Table 15, indicating that the data were highly suitable for factor

analysis. This result demonstrates strong correlations among variables, supporting further factor extraction and analysis.

Table 15 KMO and Bartlett's Test Results

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.94
Bartlett's Test of Sphericity	Approx. Chi-Square	7473.10
	df	630.00
	Sig.	.00

Source: Author. Nov. 30th, 2024

5.3.4.4 Reliability and Validity Testing

Reliability testing is used to verify the reliability and stability of the questionnaire results, while validity testing evaluates whether the questionnaire accurately measures the defined variables. The reliability of the questionnaire is typically measured using the Cronbach's alpha coefficient, which ranges from 0 to 1. A higher value indicates stronger reliability. Generally, a Cronbach's alpha value of 0.8 or higher indicates high reliability. Additionally, composite reliability (CR) is used to evaluate the consistency of items within each latent variable. A CR value of 0.7 or higher signifies strong internal consistency within the latent variables.

The Cronbach's alpha values for all measurement dimensions exceeded 0.8, indicating high reliability and internal consistency for the questionnaire. CR values also exceeded 0.8, further supporting strong internal consistency among the latent variables.

According to Fornell and Larcker's criteria, convergent validity requires the average variance extracted (AVE) of a latent variable—representing the average variance explained by the latent variable for its observed variables—to be greater than or equal to 0.5. Discriminant validity requires the correlation coefficient between any two latent variables to be less than the square root of their AVE.

As shown in the results from Table 16, the AVE of all latent constructs exceeded 0.5, indicating strong convergent validity. Additionally, Table 17 shows that the square root of each latent variable's AVE was higher than the correlation coefficients between latent variables, demonstrating good discriminant validity among the latent variables.

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Table 16 Construct Reliability and Convergent Validity

Construct	Item Code	Estimate	AVE	CR	Cronbach's Alpha
PE	PE1	0.773	0.620	0.867	0.865
	PE2	0.799			
	PE3	0.797			
	PE4	0.780			
EE	EE1	0.755	0.605	0.885	0.883
	EE2	0.787			
	EE3	0.771			
	EE4	0.786			
	EE5	0.790			
SI	SI1	0.792	0.616	0.865	0.864
	SI2	0.770			
	SI3	0.775			
	SI4	0.802			
FC	FC1	0.828	0.635	0.874	0.873
	FC2	0.774			
	FC3	0.770			
	FC4	0.813			
HM	HM1	0.769	0.612	0.887	0.887
	HM2	0.777			
	HM3	0.808			
	HM4	0.793			
	HM5	0.762			
HT	HT1	0.766	0.607	0.885	0.884
	HT2	0.809			
	HT3	0.735			
	HT4	0.775			
	HT5	0.809			
CI	CI1	0.779	0.608	0.886	0.886
	CI2	0.757			
	CI3	0.773			
	CI4	0.802			
	CI5	0.788			
BI	BI1	0.768	0.615	0.865	0.863
	BI2	0.806			
	BI3	0.788			
	BI4	0.775			

Source: Author. Nov. 30th, 2024

Table 17 Discriminant validity: Fornell–Larcker criteria

Construct	PE	EE	SI	FC	HM	HT	CI	BI
PE	0.620							
EE	0.517	0.605						
SI	0.449	0.491	0.616					
FC	0.456	0.451	0.479	0.635				
HM	0.453	0.536	0.563	0.474	0.612			
HT	0.432	0.458	0.469	0.475	0.428	0.607		
CI	0.522	0.551	0.622	0.577	0.547	0.496	0.608	
BI	0.515	0.58	0.637	0.656	0.67	0.528	0.699	0.615
\sqrt{AVE}	0.787	0.778	0.785	0.797	0.782	0.779	0.780	0.784

Source: Author. Nov. 30th, 2024

5.3.4.5 Model Fit Evaluation

After preprocessing and verifying the data to ensure its reliability and validity, the structural equation model's fit was evaluated. Table 18 presents the model fit measures:

Table 18 Model Fit Measures

	CMIN/DF= χ^2/df	RMSEA	GFI	TLI	SRMR	CFI
Recommended	1 < χ^2/df < 3	< 0.08	> 0.90	> 0.90	< 0.08	> 0.90
Values	1.137	0.02	0.909	0.988	0.0351	0.989

Source: Author. Nov. 30th, 2024

The overall fit of the model is good, with all fit indices falling within the recommended range: Chi-square/degrees of freedom (χ^2/df) = 1.137, Root Mean Square Error of Approximation (RMSEA) = 0.02, Goodness of Fit Index (GFI) = 0.909, Tucker-Lewis Index (TLI) = 0.988, Standardized Root Mean Square Residual (SRMR) = 0.0351, Comparative Fit Index (CFI) = 0.989. These results indicate that the model fit indices meet the standards, and the model is suitable for subsequent path analysis.

5.3.4.6 Hypothesis Testing Results During the validation of the SEM, we tested the model paths proposed by the research hypotheses. The path coefficients and their significance levels are shown in Table 19, which clearly defines the relationships between the structures.

Table 19 Structural Equation Model Validation Results

Hypothesis	Estimate(β)	S.E.	C.R.	P	Decision	
H1	BI<---PE	0.025	0.053	0.461	0.645	Rejected
H2	BI<---EE	0.089	0.058	1.547	0.122	Rejected
H3	BI<---SI	0.144	0.06	2.32	0.02	Supported
H4	BI<---FC	0.25	0.053	4.31	***	Supported
H5	BI<---HM	0.257	0.061	4.306	***	Supported
H6	BI<---HT	0.067	0.053	1.274	0.203	Rejected
H7	BI<---CI	0.23	0.069	3.403	***	Supported

Source: Author. Nov. 30th, 2024

Significance of Correlations:
 $p < 0.100^*$ $p < 0.050^{**}$ $p < 0.010^{***}$ $p < 0.001$

The results indicate that Performance Expectancy (PE) does not have a significant impact on Behavioral Intention (BI) towards paper-cutting digital games ($\beta = 0.025$, $p > 0.05$), so Hypothesis H1 is not supported. Similarly, Effort Expectancy (EE) does not significantly affect Behavioral Intention (BI) towards paper-cutting digital games ($\beta = 0.089$, $p > 0.05$), so Hypothesis H2 is also not supported. However, Social Influence (SI) has a significant positive effect on Behavioral Intention (BI) towards paper-cutting digital games ($\beta = 0.144$, $p < 0.05$), supporting Hypothesis H3. In addition, Facilitating Conditions (FC) significantly positively influence Behavioral Intention (BI) towards paper-cutting digital games ($\beta = 0.250$, $p < 0.05$), confirming Hypothesis H4. Hedonic Motivation (HM) also shows a significant positive effect on Behavioral Intention (BI) towards paper-cutting digital games ($\beta = 0.257$, $p < 0.05$), supporting Hypothesis H5. Meanwhile, Habit (HT) does not significantly affect Behavioral Intention (BI) towards paper-cutting digital games ($\beta = 0.067$, $p > 0.05$), meaning Hypothesis H6 is not supported. Cultural Identity (CI) has a significant positive effect on Behavioral Intention (BI) towards paper-cutting digital games ($\beta = 0.230$, $p < 0.05$), supporting Hypothesis H7.

The detailed results of the Structural Equation Model can be seen in Figure 107. These findings provide valuable insights into the factors influencing the Behavioral Intention of users towards paper-cutting digital games and offer guidance for future research and practical applications.

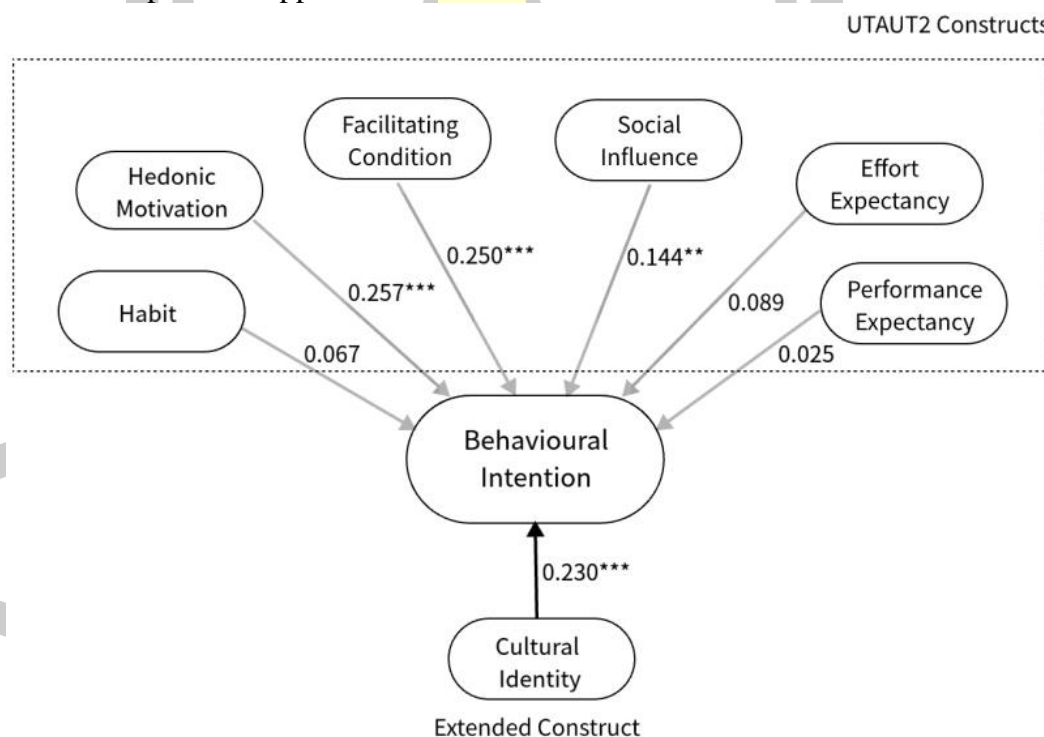


Figure 105 Structural Equation Model Results
 Source: Author. Nov. 30th, 2024

5.3.5 Research Results

This study, based on the UTAUT2 model, explored the factors influencing youth behavioral intention toward paper-cutting digital games. Seven hypotheses were tested, with four hypotheses (H3, H4, H5, H7) showing significant effects, while three hypotheses (H1, H2, H6) were not supported. The findings indicate the following:

Social Influence (SI) is significantly positively correlated with Behavioral Intention (BI), suggesting that peers, family, and societal opinions strongly influence youth's acceptance of digital games. This finding is consistent with previous studies based on the UTAUT2 model, highlighting the importance of the social environment in technology acceptance.

Facilitating Conditions (FC) significantly and positively affect Behavioral Intention (BI). Users are more likely to exhibit higher behavioral intention when they believe adequate resources and support are available to use the paper-cutting digital game. This includes aspects such as technical support, device availability, and ease of access to game-related information, consistent with relevant research.

Hedonic Motivation (HM) shows a positive correlation with Behavioral Intention (BI), emphasizing the role of entertainment and enjoyment in driving youth acceptance of paper-cutting digital games. If users find the game enjoyable, they are more likely to continue using and recommend it. This finding aligns with research on mobile applications and digital product acceptance.

Cultural Identity (CI) is positively correlated with Behavioral Intention (BI). Specifically, whether young users enjoy the paper-cutting digital game depends on how well the game aligns with their cultural identity. This highlights the key role of cultural identity in technology acceptance. Cultural identity encompasses users' sense of belonging and connection to their culture. When digital games reflect and express users' cultural backgrounds, they are more likely to accept and engage with them. Therefore, paper-cutting, as a traditional art form, showcases its unique aesthetic and cultural significance within digital games, allowing users to connect with their cultural heritage while enjoying the game.

The results also show that Performance Expectancy (PE) does not significantly affect Behavioral Intention (BI), indicating that the younger generation may not view paper-cutting digital games as effective tools for enhancing skills or acquiring knowledge. This could be due to the fact that the functions of paper-cutting digital games do not offer direct utility or work-related relevance. Similarly, Effort Expectancy (EE) does not significantly impact Behavioral Intention (BI), suggesting that users may find paper-cutting digital games relatively easy to use, requiring little learning effort. Lastly, Habit (HT) does not have a significant positive effect on Behavioral Intention (BI), possibly because the frequency of use and personal habits associated with paper-cutting digital games have not yet formed a consistent pattern, indicating that these games have not yet integrated into users' daily lives.

5.4 Expert Qualitative Evaluation

Nanjing Paper-Cutting Show innovatively transmits Nanjing Paper-Cutting, an ICH, through a game format, aiming to enhance public awareness and interest in traditional culture through interactive experiences. To further improve the game's performance in cultural communication and user experience, experts in relevant fields were invited for in-depth qualitative evaluation.

5.4.1 Evaluation Objectives

The evaluation focused on three areas: game design, cultural content, and user experience, aiming to analyze whether the game effectively achieves the core goals of ICH transmission. By combining the expert's professional knowledge and practical experience, the evaluation not only identified existing strengths and weaknesses but also proposed targeted optimization suggestions, providing scientific references for the game's iterative upgrades and the innovative inheritance of cultural heritage. The evaluation covered:

- A. Creativity
- B. Technicality
- C. Educational value
- D. Interactivity
- E. Cultural transmission
- F. Artistic quality
- G. Playability
- H. Performance optimization
- I. Cross-platform compatibility
- J. Social impact
- K. Overall evaluation

The evaluation was based on the following three objectives:

- (1) Examining the game's interaction design
- (2) Evaluating the game's cultural transmission quality
- (3) Assessing the user experience


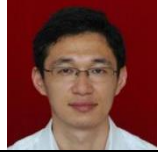

5.4.2 Evaluation Method

The evaluation used expert assessment forms (attached), with input from Nanjing Paper-Cutting inheritors, software development experts, and educational game design experts.

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5.4.3 Expert Profiles

Table 20 Evaluate the basic situation of experts

Name	Title/Position	Affiliated Institution	Professional Field	Industry Certification	Public Photos
Zhang Ying	Nanjing Paper-Cutting inheritor	Zhang Fanglin Art Studio	Traditional art	Chinese arts and crafts artist	
Chen Ping	Professor	Ma'anshan Teacher'College	Software engineering, artificial intelligence	Software designer	
Suchat Saenpich	Lecturer in the School of Liberal Arts	Sukhothai hammathirat Open University	AR, VR, Game for Education, Educational Technology	Professional Ph.D.	

Source: Author. Nov. 30th, 2024

5.4.4 Evaluation Results

Zhang Ying's Evaluation Results (Appendix C)

Zhang Ying, the fifth-generation inheritor of Nanjing Paper-Cutting and a Chinese craft artist, gave an overall positive evaluation of the *Nanjing Paper-Cutting Show* interactive game, especially praising its creativity and educational value. She highlighted that the game's innovative theme and unique perspective effectively capture players' interest, while playing a significant role in conveying the cultural background of Nanjing Paper-Cutting and helping players learn about this art form. In terms of cultural inheritance, artistry, and social impact, the game was highly recognized, as it respects and accurately conveys traditional elements of Nanjing Paper-Cutting and contributes positively to the inheritance and promotion of traditional culture.

Regarding technicality, the game's use of HTML5 technology was mature, but there was still room for improvement in the fluidity of the interactive design. The visual and auditory effects, art design, and rule clarity received positive feedback, showing the game's excellent performance in artistic expression and player experience.

Suggestions for Improvement: Zhang Ying suggested improving the portrayal of cultural elements, particularly the design of evil-warding figures, by consulting more sources to ensure their accurate representation. She also proposed adding three-dimensional effects to enhance the game's visual impact and artistic expression. These suggestions aim to increase the game's educational value and cultural transmission effectiveness, making it more appealing and influential worldwide.

Chen Ping's Evaluation Results (Appendix D)

Professor Chen Ping, from Ma'anshan Normal College, specializing in software engineering and AI (Computer Vision), provided a thorough expert

assessment of the *Nanjing Paper-Cutting Show* HTML5 interactive game. He evaluated the game from multiple dimensions, including creativity, technicality, and educational value, offering an overall "Good" rating. Chen Ping commended the game for its educational performance, particularly its ability to help players understand and learn about paper-cutting art, awarding it a "Very Good" rating in this area. Regarding creativity, Chen Ping rated the game's thematic creativity, artistic charm, and expressiveness as "Good." The technical application of HTML5 also earned a "Good" rating, though the interactivity design was rated as "Average." The game was highly recognized for its cultural heritage, respecting and accurately conveying the traditional elements of Nanjing Paper-Cutting, contributing to the promotion of traditional culture. Artistry and playability were also rated positively. **Suggestions for Improvement:** Chen Ping suggested that the development team consider creating a multilingual adaptive version of the game, enabling automatic language switching based on the user's browser or operating system settings. This would enhance the game's cultural transmission and international promotion.

Suchat Saenpich's Evaluation Results (Appendix E)

Dr. Suchat Saenpich, Assistant Professor at Sukhothai Thammathirat Open University, specializing in AR, VR, educational games, and educational technology, provided a professional evaluation of the *Nanjing Paper-Cutting Show* interactive game. He evaluated the game across several dimensions, including creativity, technicality, educational value, and more, providing valuable feedback to the development team. Dr. Saenpich gave the game a "Good" rating across multiple areas, indicating that it performs well in creativity, technical application, educational value, interactivity, cultural transmission, artistry, playability, performance optimization, and cross-platform compatibility. Notably, the artistic expression and showcasing of the charm of Nanjing Paper-Cutting art were rated "Excellent," reflecting the game's exceptional performance in these areas. **Suggestions for Improvement:** Although the game received a "Good" overall evaluation, Dr. Saenpich proposed specific improvements to further enhance the game experience. He suggested providing gameplay instructions before the game starts, adding voiceovers or narration to enhance the experience, and introducing a scoring system to increase interactivity and challenge. These recommendations aim to improve player engagement and the educational value of the game.

5.4.5 Comprehensive Evaluation and Suggestions

The *Nanjing Paper-Cutting Show* is an HTML5 interactive game centered on Nanjing Paper-Cutting art. The three experts unanimously gave high marks for its creativity, educational value, and cultural transmission. The game successfully attracts player interest with its novel theme, unique artistic presentation, and innovative interactivity, while effectively promoting the cultural background and techniques of Nanjing Paper-Cutting. It injects new vitality into the promotion and education of traditional culture.

Despite its overall excellence, several areas still need optimization. Experts suggested conducting in-depth research into the design of evil-warding figures to ensure the accuracy of cultural symbols. Additionally, the incorporation of three-dimensional effects could further enhance the game's artistic impact and visual appeal. Improvements to the interactivity design, adding a scoring system, and introducing achievement rewards could significantly boost the game's fun factor and

player engagement. Furthermore, adding multilingual support and narration would increase the game's global appeal and cultural transmission potential.

By incorporating the experts' valuable suggestions, the *Nanjing Paper-Cutting Show* is poised to become an even more attractive and educational cultural transmission tool. Enhanced visual effects, richer interactive designs, and multilingual adaptation will further extend its global influence. By deeply integrating technological innovation and cultural content, the game not only showcases the unique charm of Nanjing Paper-Cutting but also opens up new possibilities for the modern dissemination of traditional art.

5.5 Summary of This Chapter

5.5.1 Review of This Chapter's Research

This chapter focuses on the application and evaluation of "*Nanjing Paper-Cutting Show*," examining the game from three aspects: game scenarios, user behavior analysis, and expert feedback. In the application scenario analysis, the game was shown to have significant value in the fields of education and cultural dissemination. Its task-based learning and interactive design sparked players' interest in Nanjing Paper-Cutting art and, through digital means, broke the spatial and temporal limitations of traditional cultural transmission. The integration of IP image creation also provided a new channel for the inheritance and international promotion of ICH. The user behavior analysis used the UTAUT2 model, emphasizing the impact of factors such as performance expectancy and cultural identity on game acceptance intentions. The results showed that cultural identity, hedonic motivation, and social influence were key driving factors, while effort expectancy and habit had relatively weaker effects. Additionally, expert evaluations comprehensively assessed the game's performance from the perspectives of creativity, technicality, and cultural transmission, highly recognizing its innovation and educational value, while suggesting improvements in areas such as interaction design and multilingual support. This chapter systematically reveals the potential of digital games in promoting cultural awareness and inheritance.



5.5.2 Research Findings of This Chapter

Table 21 Chapter 5 Research Results

Serial Number	Achievement Name	Specific Content
1	Analysis of game experience and application scenarios	In the field of education, games help users learn paper-cutting art and cultural knowledge; in cultural communication, interactive design and digital technology are used to enhance the communication effect and promote the modern expression and international exchange of traditional culture
2	Quantitative user evaluation (based on UTAUT2 model)	Construct a research framework through the UTAUT2 model, set evaluation goals and research hypotheses; use questionnaire surveys and data analysis methods to complete sample data collection, reliability and validity testing, model fitting and hypothesis testing, and draw Factors influencing user behavioral intentions
3	Quantitative research results	The results show that factors such as performance expectations and social influence significantly affect user intentions; cultural identity plays an important role in promoting game acceptance, verifying the value of paper-cutting games in cultural inheritance and user participation
4	Expert qualitative evaluation	By inviting experts in the fields of culture, education and game design to conduct evaluations and analyze the educational, cultural and entertainment qualities of the game; experts' comprehensive suggestions include optimizing user interface design, enhancing cultural interactive functions, and improving communication effects
5	Comprehensive evaluation and improvement suggestions	Comprehensive quantitative and qualitative research results, it is proposed to optimize the cultural expression of paper-cutting games, strengthen the educational function and user participation, while expanding application scenarios to achieve an organic combination of cultural inheritance and innovation

Source: Author. Nov. 30th, 2024

Chapter VI

Conclusions, Discussion, and Recommendations

6.1 Conclusions

This study focuses on the development and application of digital interactive games for Nanjing Paper-Cutting art in virtual cultural spaces. By integrating theoretical analysis, user research, game design, functional implementation, and both quantitative and qualitative evaluations, it addresses the primary research questions and draws the following conclusions:

6.1.1 The historical, cultural and artistic value of Nanjing Paper-Cutting

Nanjing Paper-Cutting Carries Profound Historical and Cultural Connotations.

Nanjing Paper-Cutting, as an essential part of traditional Chinese folk art, embodies a deep historical background and rich cultural connotations. It reflects the history, customs, and beliefs of Nanjing and its surrounding regions, bearing local characteristics and cultural memory. Through the symbolic meanings and subject choices in its works, Nanjing Paper-Cutting showcases a unique regional identity and folk beliefs, making it a vital carrier of Nanjing's cultural heritage.

Distinctive Artistic Techniques and Forms of Expression.

Nanjing Paper-Cutting is characterized by unique techniques and expressive forms, demonstrating exquisite craftsmanship and creative artistry. Its diverse presentation includes intricate line work and simple pattern designs, highlighting the vivid and distinctive nature of folk art. The artistic value of Nanjing Paper-Cutting lies in its exceptional techniques and distinctive expression, establishing it as a significant art form in Chinese culture.

Multifaceted Cultural Significance and Modern Applications.

Beyond preserving traditional culture, Nanjing Paper-Cutting shows vast potential in modern society. As an ICH, it plays a significant role in education, promotion, and tourism. In contemporary cultural dissemination, Nanjing Paper-Cutting not only helps preserve local traditions but also expands its applications in modern cultural spaces through innovative displays.

Opportunities and Challenges in Virtual Cultural Spaces.

With the development of digital technology, Nanjing Paper-Cutting faces new opportunities and challenges in virtual cultural spaces. Digital displays and interactive platforms allow its artistic expressions and cultural meanings to transcend time and space, reaching broader audiences, particularly younger generations. However, maintaining the essence of traditional art while meeting the demands of modern communication remains a critical challenge.

6.1.2 Current situation of paper-cut art in virtual cultural space supported by digital technology

Digital Technology Overcomes Time and Space Limitations, Expanding Cultural Dissemination.

Digital technology provides new opportunities for the inheritance and innovation of Nanjing Paper-Cutting art. By leveraging digital methods, the art form transcends traditional dissemination limitations, overcoming geographical barriers and reaching wider audiences, especially the younger demographic. This technology

enables the art to be displayed and experienced anytime, anywhere, enhancing its audience reach and dissemination efficiency.

Interactivity and Diverse Displays Enhance the Appeal of Artistic Inheritance.

In virtual cultural spaces, the integration of multimedia forms and interactive experiences brings paper-cutting art to life. Digitized representations not only preserve its original cultural characteristics but also engage audiences through interactive elements, increasing the appeal and participation in cultural dissemination. This interactivity boosts its educational value, transforming it from a mere visual art display into an effective tool for knowledge transmission and cultural education.

Promoting International Dissemination and Innovation of Paper-Cutting Art.

Digital technology facilitates the international dissemination of Nanjing Paper-Cutting art. Virtual platforms enable the art to transcend language, geographic, and cultural differences, attracting global audiences. Digitalized displays and interactive features help domestic and international audiences better appreciate this traditional art, fostering cultural exchange and innovation on a global scale.

Attracting Younger Generations and Fostering Cultural Identity.

By integrating modern technology, Nanjing Paper-Cutting art captures the interest of younger audiences. Through gamification and virtual interaction, the art evolves from a static traditional form into a dynamic cultural experience. This innovation not only raises awareness among younger generations but also strengthens their cultural identity, motivating active participation in its inheritance and innovation.

6.1.3 Design and develop *Nanjing Paper-Cutting Show* digital interactive game

Task-Based Learning Enhances Player Engagement.

The game employs task-based learning, designing diverse levels and challenges to increase player engagement and interest. Players complete tasks related to creating or assembling Nanjing Paper-Cutting artworks, naturally learning basic techniques. This design enhances interactivity, allowing cultural learning through entertainment while deepening players' recognition and interest in Nanjing Paper-Cutting.

Semantic Transformation of Cultural Symbols in Virtual Cultural Spaces.

In digital games, the semantic transformation of Nanjing Paper-Cutting symbols bridges traditional cultural connotations and modern interactive forms. By digitally reconstructing and gamifying the symbols, the game effectively inherits traditional cultural elements while infusing them with new meanings. This transformation highlights the adaptability of Nanjing Paper-Cutting in the digital era and opens new paths for cultural innovation.

Inspiring Players' Interest and Recognition of Traditional Culture.

Through modern game design and digital technology, *Nanjing Paper-Cutting Show* conveys the artistic value of Nanjing Paper-Cutting and inspires players' interest and recognition of traditional culture. Players engage in creative activities while learning about the cultural and artistic contexts of paper-cutting. Interactive features foster cultural understanding and participation, enhancing the game's impact on cultural transmission and appreciation.

6.1.4 Application and evaluation of *Nanjing Paper-Cutting Show* digital interactive game

Combining Cultural Inheritance with Entertainment.

The game successfully integrates cultural inheritance with entertainment. Its task-based learning and interactive design allow players to explore and experience Nanjing Paper-Cutting art in a relaxed environment, enhancing both the fun and educational aspects of cultural engagement.

User Behavioral Analysis Based on the UTAUT2 Model.

The study reveals that performance expectancy, social influence, and cultural identity are key factors influencing user participation. Cultural identity significantly drives user behavior, highlighting the importance of embedding cultural elements in game design to strengthen emotional connections and promote the effective preservation of ICH.

Expert Evaluation and Game Effectiveness Verification.

Expert evaluations affirm the game's success in cultural, educational, and entertainment aspects, while recommending improvements in user experience and cultural interaction design. Suggestions include enhancing interaction design, visual effects, and user engagement to boost global dissemination potential.

Recommendations and Future Directions.

Based on evaluations, recommendations include improving interaction fluency, adding multilingual support, and enhancing visual effects to optimize global dissemination. These improvements provide a roadmap for the future development of the game, advancing the digital inheritance and worldwide application of Nanjing Paper-Cutting art.

In conclusion, this study systematically explores the historical, cultural, and artistic values of Nanjing Paper-Cutting, its integration into digital contexts, and the design, development, application, and evaluation of the *Nanjing Paper-Cutting Show* digital interactive game. By employing task-based learning and semantic transformation of cultural symbols, the game achieves profound interaction between traditional art and modern audiences. Analysis based on the UTAUT2 model underscores the significance of cultural identity in driving user participation. Expert evaluations highlight the game's contributions and areas for enhancement, offering valuable insights for the digital preservation and global dissemination of Nanjing Paper-Cutting as an ICH.

6.2 Discussion

6.2.1 Theoretical and Practical Significance

This study provides fresh insights and theoretical frameworks for digital transformation and cultural heritage preservation, with a particular emphasis on developing digital interactive games for Nanjing Paper-Cutting.

From a theoretical perspective:

Cultural Awareness and Identity Formation.

By combining traditional culture with modern digital technologies, the research enhances awareness of Nanjing Paper-Cutting among younger generations and fosters cultural identity and innovative expression of traditional art.

Semantic Transformation of Cultural Symbols.

By integrating digital and interactive design, the study introduces a theory of semantic transformation and innovation of cultural symbols in virtual cultural spaces, addressing the research gap on how traditional cultural symbols adapt and evolve in modern digital environments.

Game Design and Cultural Inheritance.

The findings highlight the potential of game design as a tool for cultural transmission, promoting the integration of cultural education and entertainment. From a practical perspective:

Application in Virtual Cultural Spaces.

The study facilitates the application of Nanjing Paper-Cutting in virtual cultural spaces and proposes feasible design strategies for digital interactive games in cultural heritage preservation and dissemination.

Integration with UTAUT2 and Cultural Identity.

The research combines the UTAUT2 model with cultural identity variables, providing theoretical support for understanding user behavioral intentions and expanding the scope of cultural heritage transmission studies.

Game Design and User Experience Optimization.

The study provides practical guidance on game functionality and user experience optimization, offering valuable insights for similar digital art projects.

In conclusion, this research contributes significantly to cultural heritage preservation, digital technology application, and innovative cultural dissemination models, providing robust support for the development of the cultural and education industries.

6.2.2 Comparison with International Research

This study delves into the inheritance and innovation of Nanjing Paper-Cutting art in digital interactive games, focusing on the transformation of cultural symbol meanings in virtual cultural spaces. Through digital technology, Nanjing Paper-Cutting symbols transition from traditional cultural connotations to modern interactive forms, offering new pathways for the preservation and transmission of ICH. This process emphasizes not only the digital reconstruction of symbols but also their integration into interactive experiences and educational functionalities, breathing new life and cultural significance into Nanjing Paper-Cutting in contemporary virtual cultural spaces.

Compared to existing international research, this study demonstrates distinct innovations:

Cultural Symbol Transformation.

While international studies often emphasize the application of virtual reality (VR) and augmented reality (AR) in cultural heritage preservation, they primarily focus on technological applications without delving deeply into the semantic analysis of specific cultural symbols. This research addresses that gap by reconstructing and gamifying the semantics of Nanjing Paper-Cutting symbols, advancing the digital representation of traditional cultural symbols.

Cultural Identity Analysis.

By incorporating cultural identity into user behavior analysis based on the UTAUT2 model, the study highlights the pivotal role of cultural values in digital

game design, showcasing the potential of digital interactive games as tools for cultural inheritance.

Comprehensive Validation.

Through qualitative and quantitative methods, the study validates the educational, cultural, and entertainment value of the interactive game, ensuring its effectiveness in cultural transmission and user engagement.

Despite its achievements, the study has limitations, such as a focus on Nanjing Paper-Cutting without addressing other regional paper-cutting arts or diverse traditional cultural forms. Future research could explore the application of this approach to other traditional arts or cultural heritage fields and conduct cross-cultural studies to analyze the global dissemination of Nanjing Paper-Cutting.

6.2.3 Limitations

The limitations of this research include:

Regional Bias.

The study's sample primarily focuses on the Nanjing region, potentially introducing geographic bias. Users from different cultural backgrounds may exhibit varying levels of understanding and acceptance of Nanjing Paper-Cutting art, limiting the generalization of the findings.

Technological Constraints.

The reliance on specific digital platforms and virtual cultural space technologies may affect the applicability and scalability of the findings. Differences in technical platforms, such as graphical representation and interactive experience, could influence user experiences. Moreover, as technology evolves, the methods used in this study may become outdated, affecting future applicability.

6.3 Recommendations

To address these limitations and enhance the study's impact, the following **recommendations are proposed:**

Exploring Advanced Technologies.

Future digital interactive games should leverage advanced platforms and tools, such as VR and AR, to improve compatibility, stability, and immersive experiences, thereby enhancing cultural transmission.

Expanding Sample Scope.

Broaden the sample population to include users from diverse cultural backgrounds, enabling cross-cultural studies to explore the global adaptability and dissemination of Nanjing Paper-Cutting symbols.

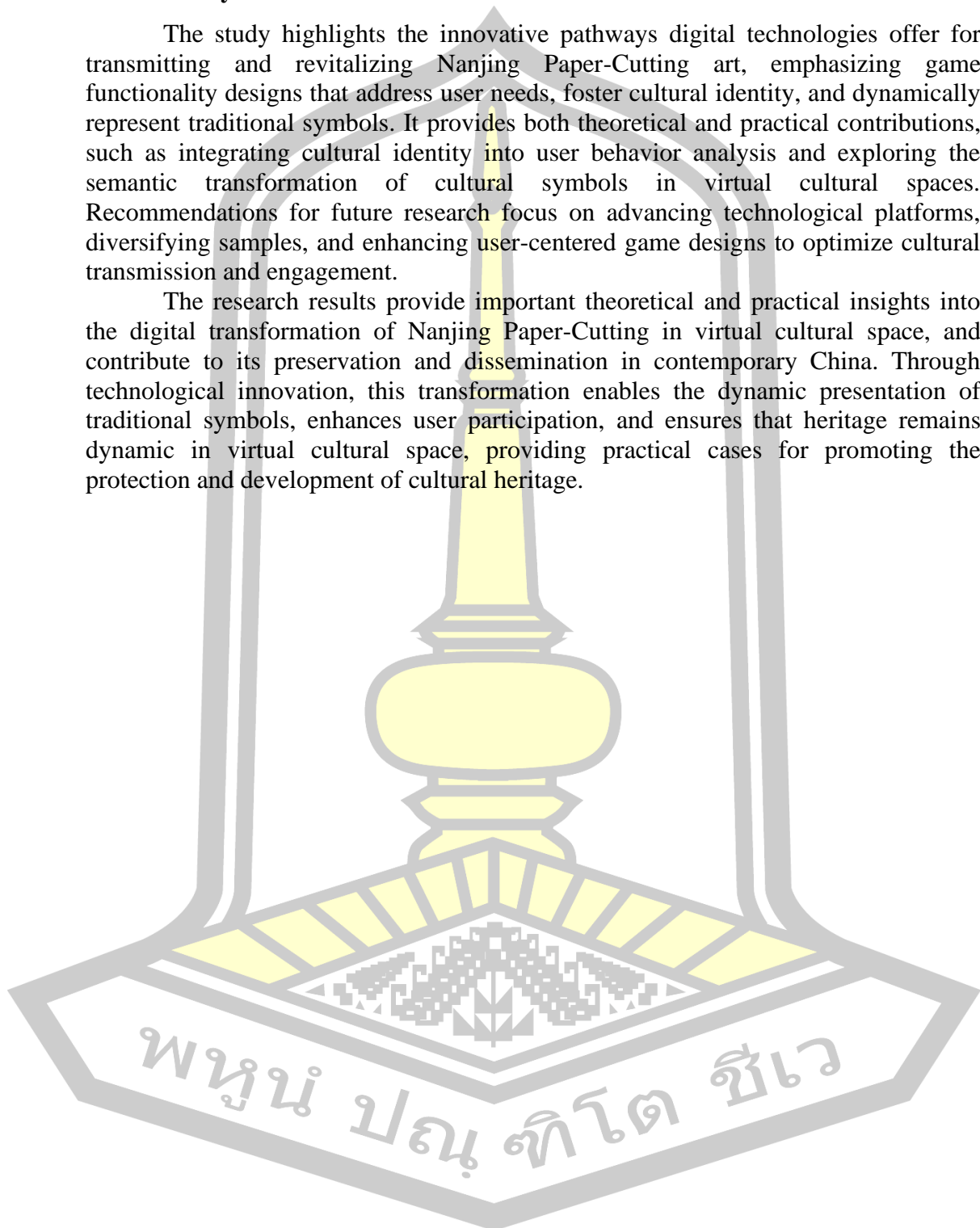
Innovative Cultural Expression.

Continue to explore representative paper-cutting symbols and cultural elements, combining them with contemporary values and lifestyles to endow them with new cultural significance. Encourage cross-disciplinary collaborations, such as integrating music, dance, and theater, to create diverse cultural experiences and promote ongoing innovation and dissemination of Nanjing Paper-Cutting art in virtual cultural spaces.

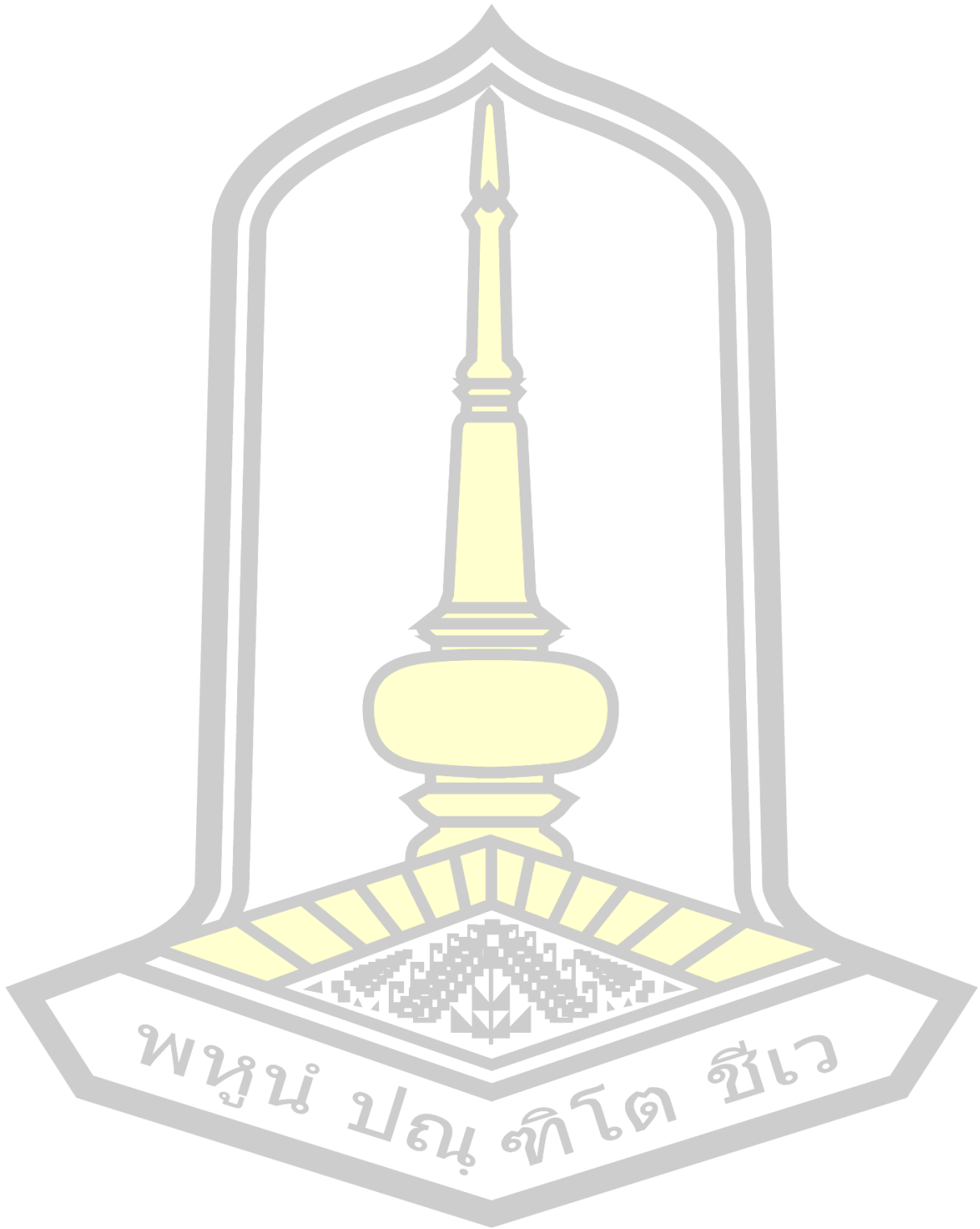
6.4 Summary

The study highlights the innovative pathways digital technologies offer for transmitting and revitalizing Nanjing Paper-Cutting art, emphasizing game functionality designs that address user needs, foster cultural identity, and dynamically represent traditional symbols. It provides both theoretical and practical contributions, such as integrating cultural identity into user behavior analysis and exploring the semantic transformation of cultural symbols in virtual cultural spaces. Recommendations for future research focus on advancing technological platforms, diversifying samples, and enhancing user-centered game designs to optimize cultural transmission and engagement.

The research results provide important theoretical and practical insights into the digital transformation of Nanjing Paper-Cutting in virtual cultural space, and contribute to its preservation and dissemination in contemporary China. Through technological innovation, this transformation enables the dynamic presentation of traditional symbols, enhances user participation, and ensures that heritage remains dynamic in virtual cultural space, providing practical cases for promoting the protection and development of cultural heritage.



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Appendix
Appendix A Nanjing Paper-Cutting Interactive Game User Expectation
Questionnaire

南京剪纸互动游戏 用户期望调查表

- 1. 年龄**
 - A. 18岁以下
 - B. 18岁-44岁
 - C. 45岁以上
- 2. 性别**
 - A. 男
 - B. 女
- 3. 受教育程度**
 - A. 专科以下
 - B. 大学专科
 - C. 大学本科
 - D. 研究生
- 4. 目前所在地区**
 - A. 乡镇
 - B. 城市
- 5. 与传统剪纸相比，我认为“剪纸数字游戏”能够更快地完成剪纸任务**
 - A. 非常不同意
 - B. 不同意
 - C. 中立
 - D. 同意
 - E. 非常同意
- 6. 我相信通过“剪纸数字游戏”，我能提升自己在剪纸艺术方面的技能**
 - A. 非常不同意
 - B. 不同意
 - C. 中立
 - D. 同意
 - E. 非常同意
- 7. 我觉得“剪纸数字游戏”有助于提高我对剪纸艺术的认知和理解**
 - A. 非常不同意
 - B. 不同意
 - C. 中立
 - D. 同意
 - E. 非常同意
- 8. 我期望通过“剪纸数字游戏”来学习和掌握剪纸文化及其相关知识**
 - A. 非常不同意
 - B. 不同意
 - C. 中立
 - D. 同意
 - E. 非常同意

Appendix B Scale items used to measure the model's variables (UTAUT2)

Construct	Code	Items	Source
Performance Expectancy (PE)	PE1	The Paper-cutting Digital Game is a great way to cut paper faster.	(Sewando no et al., 2023)
	PE2	I can improve my paper-cutting skills with the digital game.	
	PE3	The Paper-cutting Digital Game helped me learn about the art of paper-cutting.	
	PE4	I want to learn about paper-cutting and related topics through the Paper-cutting Digital Game.	
Effort Expectancy (EE)	EE1	The Paper-cutting Digital Game has an easy-to-use interface.	(Rahi et al., 2019)
	EE2	The Paper-cutting Digital Game is easy to learn.	
	EE3	The Paper-cutting Digital Game is simple.	
	EE4	I think the user support for Paper-cutting Digital Game will help me solve the problem.	
	EE5	I think the interactive elements in the Paper-cutting Digital Game are designed and easy to master.	
Social Influence (SI)	SI1	I was encouraged by my family to attempt the Paper-cutting Digital Game.	(Kalia et al., 2023)
	SI2	A friend recommended the Paper-cutting Digital Game.	
	SI3	Play the Paper-cutting Digital Game to boost your status in your social circle.	
	SI4	I preferred to try the Paper-cutting Digital Game. It was recommended or used by people in my social circle.	
Facilitating Conditions (FC)	FC1	I had easy access to the Paper-cutting Digital Game.	(Abbad, 2021)
	FC2	I can find quality learning resources to improve my paper-cutting skills.	
	FC3	I had enough time to learn and enjoy the Paper-cutting Digital Game.	
	FC4	I received effective help when I had technical problems with the Paper-cutting Digital Game.	
Hedonic Motivation (HM)	HM1	I had social fun interacting with others through the Paper-cutting Digital Game.	(Tyrväinen et al., 2020)
	HM2	I feel very accomplished with the tasks and challenges in the Paper-cutting Digital Game.	
	HM3	The Paper-cutting Digital Game is a great way for me to express myself and be creative.	
	HM4	I feel accomplished when I complete tasks in the Paper-	

		cutting Digital Game.	
	HM5	The visual and auditory effects of the Paper-cutting Digital Game give me a high level of pleasure.	
Habit (HT)	HT1	Normally I would open and use Paper-cutting Digital Game.	(Tamilmani et al., 2019)
	HT2	I use the Paper-cutting Digital Game a lot of times.	
	HT3	Although there are other games to choose from, I'm leaning towards the Paper-cutting Digital Game.	
	HT4	I would naturally use the Paper-cutting Digital Game.	
	HT5	I use the Paper-cutting Digital Game several times a week. It's almost a habit.	
Cultural Identity (CI)	CI1	I think the Paper-cutting Digital Game accurately reflects the core values of paper-cutting culture.	(Daly et al., 2021)
	CI2	By playing the Paper-cutting Digital Game, I feel that I am actively passing on and protecting the art of paper-cutting.	
	CI3	By playing the Paper-cutting Digital Game, I feel closer to the culture of paper-cutting and it also inspires my willingness to participate in related cultural activities.	
	CI4	Playing the Paper-cutting Digital Game has greatly enhanced my sense of pride and belonging to traditional culture.	
	CI5	After playing the Paper-cutting Digital Game, my sense of identification with the paper-cutting culture has increased significantly.	
Behavioral intention (BI)	BI1	I plan to use this Paper-cutting Digital Game in the future.	(Ho et al., 2020)
	BI2	I have a strong desire to experience the Paper-cutting Digital Game.	
	BI3	I would likely recommend the Paper-cutting Digital Game to a friend or family member.	
	BI4	I play the Paper-cutting Digital Game regularly.	


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Appendix D Chen Ping's Evaluation Results

《南京剪纸 Show》交互游戏专家鉴定

尊敬的专家：
您好！我们开发了一款以南京剪纸为主题的 HTML5 交互游戏，现需您的专业鉴定。请您根据以下标准，为我们的游戏提供宝贵的意见。感谢您的参与和支持！

基本信息
专家姓名：_____ 陈平 _____
职称/职位：_____ 教授 _____
所属机构：_____ 马鞍山师范高等专科学校 _____
专业领域：_____ 软件工程、人工智能 (CV) _____
联系方式：_____ +86 1894963056 _____
行业认证：_____ 软件设计师 _____
_____ 中国计算机学会高级会员 _____

签名：_____  _____

游戏基本信息
游戏名称：_____ 《南京剪纸 Show》 _____
开发团队：_____ 董娜 _____

鉴定内容

A. 创意性
1. 游戏的主题创意是否新颖，能否吸引玩家的兴趣？
非常好 好 一般 差 非常差

2. 游戏是否能够以独特的视角展现南京剪纸的艺术魅力？
非常好 好 一般 差 非常差

3. 游戏的艺术表现力如何？
非常好 好 一般 差 非常差

B. 技术性
4. 游戏的 HTML5 技术应用是否成熟？
非常好 好 一般 差 非常差

5. 游戏的交互设计是否流畅自然，是否能够提供良好的用户体验？
非常好 好 一般 差 非常差

C. 教育性
6. 游戏是否能够传达南京剪纸的文化背景和技艺？
非常好 好 一般 差 非常差

7. 游戏是否有助于玩家了解和學習剪纸艺术？
非常好 好 一般 差 非常差

D. 互动性
8. 游戏的互动设计是否能够有效吸引玩家参与？

非常好 好 一般 差 非常差

9. 游戏是否具有足够的挑战性和趣味性？
非常好 好 一般 差 非常差

E. 文化传承
10. 游戏是否尊重并准确地传达了南京剪纸的传统元素？
非常好 好 一般 差 非常差

11. 游戏是否有助于传统文化的传承和推广？
非常好 好 一般 差 非常差

F. 艺术性
12. 游戏的视觉和听觉效果是否具有艺术感？
非常好 好 一般 差 非常差

13. 游戏的美术设计是否能够与剪纸艺术的美学相匹配？
非常好 好 一般 差 非常差

G. 可玩性
14. 游戏的规则是否简单易懂？
非常好 好 一般 差 非常差

15. 游戏难度是否适中，是否具有可重复游玩的价值？
非常好 好 一般 差 非常差

H. 性能优化
16. 游戏在不同设备和浏览器上运行是否流畅？
非常好 好 一般 差 非常差

17. 游戏是否进行了合理的性能优化？
非常好 好 一般 差 非常差

I. 跨平台兼容性
18. 游戏是否能够在不同的操作系统和设备上正常运行？
非常好 好 一般 差 非常差

19. 开发团队是否进行了跨平台测试？
非常好 好 一般 差 非常差

J. 社会影响
20. 游戏是否能够产生积极的社会影响？
非常好 好 一般 差 非常差

21. 游戏是否能够促进文化理解、交流和传播？
非常好 好 一般 差 非常差

综合评价
22. 您对这款游戏的整体评价如何？
非常好 好 一般 差 非常差

23. 您有哪些建议可以帮助我们改进这款游戏？
作为一款文化传播类游戏，建议做成多语种自适应游戏（能根据用户浏览器或者操作系统的语言，自动切换显示相应语种）

感谢您的宝贵时间和专业意见，您的反馈对我们至关重要。

Appendix E Suchat Saenpich's Evaluation Results

Expert Evaluation Form for "Nanjing Paper-Cutting Show" Interactive Game

Dear Expert,

Greetings! We have developed an HTML5 interactive game themed around Nanjing paper-cutting and would appreciate your professional evaluation. Please provide your valuable feedback based on the criteria below. Thank you for your participation and support!

Basic Information

Expert's Name: ___Assistant Professor Dr. Suchart

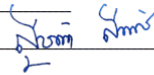
Title/Position: _Lecturer in the School of Liberal Arts

Affiliated Institution: _ Sukhothai Thammathirat Open University

Field of Expertise: __AR, VR, Game for Education , Educational Technology _____

Contact Information: ___ Sukhothai Thammathirat Open University 9/9 Mu 9, Chaengwattana Rd. Bangpoo, Pakkret Nonthaburi 11120

Industry Certification: _____

Signature (Electronic Signature) : 

Game Basic Information

Game Title: 'Nanjing Paper-Cutting Show'

Development Team: Na Dong



Evaluation Content(Tick the appropriate location ✓)

A. Creativity

Is the game's theme creative and capable of attracting player interest?
Excellent Good Average Poor Very Poor

Does the game uniquely showcase the artistic appeal of Nanjing paper-cutting?
Excellent Good Average Poor Very Poor

How is the game's artistic expression?
Excellent Good Average Poor Very Poor

B. Technicality

Is the HTML5 technology applied in the game mature?
Excellent Good Average Poor Very Poor

Is the interactive design smooth and does it offer a good user experience?
Excellent Good Average Poor Very Poor

C. Educational Value

Does the game convey the cultural background and techniques of Nanjing paper-cutting?
Excellent Good Average Poor Very Poor

Does the game help players understand and learn paper-cutting art?
Excellent Good Average Poor Very Poor

D. Interactivity

Does the interactive design attract player participation?
Excellent Good Average Poor Very Poor



Does the game offer sufficient challenge and fun?
 Excellent Good Average Poor Very Poor

E. Cultural Heritage

Does the game respect and accurately convey the traditional elements of Nanjing paper-cutting?
 Excellent Good Average Poor Very Poor

Does the game help in the inheritance and promotion of traditional culture?
 Excellent Good Average Poor Very Poor

F. Artistry

Do the visual and auditory effects of the game possess artistic quality?
 Excellent Good Average Poor Very Poor

Does the art design align with the aesthetics of paper-cutting?
 Excellent Good Average Poor Very Poor

G. Playability

Are the rules of the game simple and easy to understand?
 Excellent Good Average Poor Very Poor

Is the difficulty appropriate, with replay value?
 Excellent Good Average Poor Very Poor

H. Performance Optimization

Does the game run smoothly on different devices and browsers?
 Excellent Good Average Poor Very Poor

Has reasonable performance optimization been conducted?
 Excellent Good Average Poor Very Poor



I. Cross-Platform Compatibility

Can the game operate normally on different operating systems and devices?

Excellent Good Average Poor Very Poor

Has cross-platform testing been conducted by the development team?

Excellent Good Average Poor Very Poor

J. Social Impact

Can the game generate a positive social impact?

Excellent Good Average Poor Very Poor

Can the game promote cultural understanding, exchange, and dissemination?

Excellent Good Average Poor Very Poor

Overall Evaluation

What is your overall rating for this game?

Excellent Good Average Poor Very Poor

Do you have any suggestions to help us improve the game?

1. There should be an explanation of how to play the game on the game screen before starting each stage.
 2. There should be narration or voiceover at certain points, which could be short tips or using sound to reinforce the experience, such as cheering sounds.
 3. It would be great to have a scoring system for each section of the game.
-

Thank you for your valuable time and professional opinions. Your feedback is crucial to us.



BIOGRAPHY

NAME Na Dong

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Ma'anshan City, Anhui Province, China

POSITION Teacher

PLACE OF WORK MAANSHAN TEACHER'S COLLEGE

EDUCATION 2015 Graduated from Anhui University of Technology
with a Master of Engineering in Computer Application
2023 - 2025 Currently studying at Mahasarakham
University of Fine and Applied Art Research and Creation
with Ph.D.

