



# Research on the Application of Gamified Learning of Traditional Bamboo Papermaking Skills in the Dissemination of Intangible Cultural Heritage

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**Abstract.** This study aims to explore how gamification for learning design can facilitate the inheritance and application of Tang'ao's intangible heritage of traditional bamboo papermaking. Through literature review and field investigation, we have gained a comprehensive understanding of the history, process, and current status of Tang'ao's traditional papermaking. A gamified learning program for the traditional bamboo papermaking craft was designed, integrating elements of gamified learning into informal education models. This is an advantageous way to promote the inheritance and innovation of traditional crafts.

**Keywords:** Bamboo paper, Gamification for learning, Gamification in education, Intangible cultural heritage.

## 1 Introduction

Gamification for learning plays a crucial role in the preservation and inheritance of intangible cultural heritage (ICH). By introducing interactivity and fun, gamified learning can stimulate learners' interest in ICH content. This approach is particularly effective for the younger generation, who are accustomed to learning through interactive and game-based methods. Incorporating ICH content into games can help information spread more quickly and widely. Challenges and achievements within the game can motivate learners to delve deeper into ICH culture.

Gamification for learning can be used for various educational purposes, environments, learning levels, and domains, with most studies reporting positive impacts and its potential to address educational challenges [1]. While gamification is an effective teaching method, some factors contributing to its success, especially for cognitive learning outcomes, remain unresolved [2]. In recent years, gamified learning has been increasingly applied to ICH education. ICH education games can effectively promote learning and training, receiving positive feedback [3]. The application of Augmented Reality (AR) technology in ICH lantern exhibitions can enhance visitors'

awareness and satisfaction. Applying AR in the making process of Chinese lanterns can better convey knowledge and increase learning interest [4]. Utilizing AR in ICH helps the public gain more information about ICH culture, and popular digital technology as part of ICH education can enhance young people's cultural awareness and learning motivation [5]. AR technology has been applied to ICH lanterns for educating children on religious diversity [6], and studies on users' acceptance of digital technology in ICH education through AR systems [7, 8]. Mixed reality, gamified presentation and storytelling used in virtual museum displays [9]. Disseminating Intangible Cultural Heritage Through Gamified Learning Experiences and Service Design [10]. Gamification for learning is not merely a replication of traditional culture; it creatively combines modern elements to present intangible cultural heritage (ICH) in a novel way, thereby attracting more attention. Games often have an international appeal, engaging individuals from various cultural backgrounds. This enables ICH not only to be inherited within its own country but also to cross borders and be understood and appreciated by people around the world.

The research on gamification for learning, especially in the context of intangible cultural heritage (ICH) education, has shown promising results and potential. However, there are several research gaps and challenges that need to be addressed to fully leverage gamification in ICH learning and preservation: While gamification has been identified as an effective teaching method, the specific factors contributing to its success, particularly regarding cognitive learning outcomes in the context of ICH, are still not fully understood. Research on how to integrate these technologies with traditional crafts in a way that respects and preserves the essence of the craft while making it accessible and appealing to modern audiences is still developing.

## **2 Development Overview of Intangible Cultural Heritage Traditional Bamboo Papermaking**

Tang'ao Village, anciently known as Tangxi, is a thousand-year-old village located at the northern foot of Dalei Mountain in Fenghua District, Zhejiang Province, China. The abundant forest resources surrounding Tang'ao Village, including lush bamboo forests, entwined vines, and plentiful streams, have been key elements in driving the development of Tang'ao's papermaking industry. These natural resources provide a rich supply of raw materials for traditional papermaking, with bamboo and mulberry bark widely used in paper production. The bamboo forests in the mountains have become the soul of Tang'ao's paper industry, as bamboo is the main raw material, and the paper made from bamboo is of excellent quality, durable and tough.

The history of papermaking in Tang'ao Village can be traced back to over a thousand years ago, to the ninth year of the Zhengde Emperor of the Ming Dynasty, when Tang'ao Village began to use bamboo to make paper, replacing the traditional method of making paper from vines. Over time, the traditional papermaking skills of Tang'ao evolved and improved, reaching their peak in the 1930s. During this period, Tang'ao had over 300 paper troughs, attracting thousands of workers and forming a massive paper production industry. Handmade papermaking became the main occupation for

local villagers, injecting vitality into the village's economic prosperity and cultural traditions. However, by the end of the 20th century, with the rise of machine-made paper and modern papermaking techniques, the traditional handmade paper industry gradually declined. Most of the handmade paper workshops closed down, with only Yuan Hengtong continuing to uphold this ancient skill, protecting and inheriting Tang'ao's papermaking tradition.

### 3 Tang'ao Bamboo Papermaking Technique

Tang'ao bamboo paper is renowned for its exceptional quality, characterized by its toughness, bright color, good folding endurance, fade resistance, non-yellowing, and reusability. These features make Tang'ao paper highly favored in fields such as ancient book restoration, calligraphy, painting, and cultural heritage.

These characteristics render the Tang'ao bamboo papermaking craft a unique and valuable intangible cultural heritage, worthy of protection and inheritance. It represents not only the excellence of traditional craftsmanship but also embodies profound cultural significance, offering an eco-friendly, healthy, and sustainable papermaking option for contemporary society. Moreover, the high quality of Tang'ao paper and the transmission of traditional skills grant it a special status in the realms of art and culture, making significant contributions to cultural inheritance and exchange.

The production of Tang'ao bamboo paper involves more than 70 steps, from raw material preparation, fermentation, steaming, fermenting, squeezing dry, pounding, bleaching, pulping, filtering, papermaking, pressing, to drying (see Figure 1).



**Fig. 1.** The main process of traditional bamboo papermaking technique

It is precisely this method that makes Tang'ao bamboo paper more durable in color retention, tougher, and less prone to tearing, making it suitable for ancient book

restoration. Interviews and investigations have revealed that in the past, Tang'ao paper workshops primarily produced black gold paper, windproof paper, and calligraphy and painting paper. Now, the main uses of Tang'ao paper are in ancient book restoration, reprinting of old texts, and as writing paper.

## 4 Prototype Design

Gamification for learning design merges traditional handmade papermaking crafts with modern technology, aiming to promote the inheritance and innovation of ancient papermaking techniques through enhanced participation and experience. We have developed a specialized bamboo paper-making game learning program that allows users to simulate the papermaking process on their smartphones or tablets. This application delves into the art of ancient papermaking through detailed text, images, and video tutorials, enabling users to gain a deep understanding of the craft.

The traditional craft of bamboo papermaking involves creating an interactive, educational experience that simulates the ancient process of making bamboo paper. The game would guide players through the traditional steps of bamboo paper production, including fermentation, steaming, pounding, pulping, paper forming, pressing, and drying. The papermaking game process is illustrated in Figure 2.



**Fig. 2.** Bamboo Papermaking Technique Process Game Design (Designer: Kangping He, Yiping Wang, Xu Wang, Leyi Fan, Wenqian Xue, Yuhan Fang, Yiyang Ying and Xiaorui Lin.)

Throughout the game, players learn about the historical and cultural significance of bamboo papermaking. Tips and facts about traditional papermaking techniques are provided at each stage. This gamified approach not only educates players about the ancient craft of bamboo papermaking but also immerses them in the cultural and historical context of this traditional art form.

Furthermore, we designed an interactive animation that showcases the important processes and tools in bamboo paper production. The animation guides visitors through the papermaking flow, from bamboo processing to the completion of the paper, deepening the understanding of the importance of each step. With comprehensive narrations and introductions to the cultural background, the animation informs viewers about the history, cultural value of bamboo paper, and its connection to Tang'ao Village, enhancing awareness of the intangible heritage of handmade papermaking.

To meet the needs of visitors, we established a feedback system, encouraging the audience to share opinions and suggestions to continuously optimize the interactive display design. The animation focuses on presenting historical information about papermaking techniques and, through vivid content, transports viewers through time to ancient paper workshops, allowing them to experience the craftsmanship and art of traditional papermaking. Our goal is to vividly convey the artistic features, manufacturing skills, and cultural essence of "Tang'ao Paper" through interactive animations, enabling the audience to deeply appreciate the unique charm of this intangible heritage skill.

## 5 Results

This project invited three human-computer interaction experts with over five years of experience to test and review the system. All three experts agreed that the system is easy to use and can be quickly learned, and that the gamification of traditional bamboo papermaking education effectively enhances learners' interest in and understanding of the bamboo papermaking process. Expert 1 mentioned that it offers an engaging interactive learning experience, attracting the younger generation accustomed to interactive and game-based learning methods. The other two experts also agreed that the beautiful design and interesting colors make the learning process more enjoyable and engaging, and that an intriguing storyline is definitely a way to attract learners' attention and keep them engaged. Integrating this approach into informal education models shows promise for enhancing the protection and dissemination of intangible cultural heritage. Through the interactive gaming experience, audiences can participate in the papermaking process, personally experiencing each production step, including the selection of raw materials, the preparation of pulp, the making of paper, and the drying process. This hands-on participation not only enhances the audience's interactive experience but also sparks their interest in and awareness of protecting intangible cultural heritage.

## 6 Conclusions

Gamified learning can incorporate fun, motivating, and exciting game elements, integrating them with the learning curriculum to enhance its effectiveness. Through this study, we gained a deeper understanding of the history, craftsmanship process, and current status of Tang'ao's ancient papermaking, as well as how to combine gamified learning with digital heritage preservation to promote the inheritance and innovation of

this traditional craft. Gamified teaching is a significant method that can facilitate the transmission and innovation of Tang'ao's ancient papermaking.

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