Educational Perspectives on the Preservation of the Yang Jiao Zhong Chinese Bronze Instrument

Xiang Zhang[1], Arsenio Nicolas[1,*] & Awirut Thotham[1]

[1]College of Music, Mahasarakham University, Thailand

*Correspondence: College of Music, Mahasarakham University, Thailand. E-mail: 66012061022.msu@gmail.com

Received: November 1, 2025 Accepted: November 26, 2025 Online Published: December 8, 2025

doi:10.5430/wje.v15n4p62 URL: https://doi.org/10.5430/wje.v15n4p62

Abstract

The Yang Jiao Zhong, an ancient Chinese bronze instrument embodying both musical and ritual significance. The research aims to investigate the educational perspectives on the preservation of the Yang Jiao Zhong, a Chinese bronze instrument. Conducted at the Guangxi Zhuang Nationality Museum in Nanning, Guangxi, China, the study employed a qualitative descriptive method integrating field observation, semi-structured expert interviews, and documentary review. Five key informant experts in folk music, bronze instruments, digital audio technology, sound education, and spatial aesthetics provided insights into the instrument's historical value, sound preservation, and pedagogical applications. Data were analyzed thematically to interpret educational implications within cultural, technological, and pedagogical dimensions. The results revealed that the Yang Jiao Zhong serves as an interdisciplinary learning tool that connects history, music, and digital technology. Digital sound modelling and virtual exhibitions enhance accessibility, while museum-based workshops foster experiential learning and cultural empathy. The study concludes that integrating digital heritage tools and museum-based learning into curricula transforms ancient artefacts into dynamic educational resources. It recommends collaborative partnerships among museums, universities, and technology centers to promote sustainable preservation and curriculum innovation. This research underscores how education not only safeguards tangible heritage but also revitalizes cultural identity through creative engagement and cross-disciplinary learning.

Keywords: Yang Jiao Zhong, cultural heritage education, digital preservation, museum-based learning, interdisciplinary pedagogy

1. Introduction

The Yang Jiao Zhong is one of China's distinctive ancient museum masterpieces that ancient civilization originated and shaped. This study tackles the historical artefact and its adaptive preservation from an educational standpoint where cultural learning, heritage studies, and interdisciplinary teaching come into play. The preservation of such instruments today is rather the construction of an educational paradigm or the integration of civic education, discourse, and digital preservation that promotes the educational use of instruments.

1.1 Introduce the Problem

The preservation of ancient musical instruments such as the Yang Jiao Zhong poses complex challenges in a rapidly globalized and technologically advanced world. Moving from traditional instruments to digital and performance-based modern music education has contributed to the erasure of traditional instruments from the pedagogy. The Yang Jiao Zhong, once instrumental in ceremonial music and symbolic communication, is now known only to a handful of archaeologists, ethnomusicologists, and specialists in cultural heritage (Acquilino & Scavone, 2022; Du & Liang, 2024; Ma, 2024). Its physical fragility, and limited access to the public, makes direct engagement even more difficult. Museums and research institutions, in their attempts to conservation and education, face the paradox of ancient artefacts needing protection even as they need to be made available for the public to learn. Without robust educational outreach, the Yang Jiao Zhong will, and is, remaining an isolated relic, rather than a tool of cultural understanding and engagement (Good et al., 2019; Liu & Nicolas, 2024; Pellew & Goldman, 2018; Wang et al., 2025). The issue lies in the pedagogical systems surrounding the interpretation, study, and transmission to future generations, rather than just the physical preservation of the instrument.

1.2 The Importance of the Problem

The significance of the Yang Jiao Zhong goes beyond the conservation of a material artefact; it is a process of protecting those intangible values this instrument stands for. The Yang Jiao Zhong captures the essence of artistic creation, spiritual philosophy and the 'we' of the Chinese community identity. It illustrates how, at one time, the musical sound bridged the relationship of the human, natural, and supernatural realms. Including it in the teaching curriculum helps students to appreciate the unity of sound, material, and symbolism in the art of different cultures (Howard, 2022; Yang et al., 2024; Zhang, 2024). Today, digital modelling and museum-based learning make it possible for the instrument to be a centre of cross-cultural conversation for globalized audiences. In music education, such engagement promotes historical creativity, prompting students to view ancient instruments as artefacts of innovation and creativity rather than as items of mere historical importance (An et al., 2025; Norton & Matsumoto, 2018; Sawada & Andres, 2024). Thus, the Yang Jiao Zhong is a bridge to China's past and pulsing cultural present, and education The helps to reinforce this as the active, transformative element.

1.3 Relevant Scholarship

Research on the Yang Jiao Zhong has been focused on its archaeological discovery, its acoustic features, and symbolic ornamentation. There has been scholarship that examines the type, distribution, and ritual association with the Chu–Yue culture of southern China and northern Vietnam. Although these studies provide important frameworks regarding the historical and aesthetic appreciation, they do not fully address the educational value of the instrument (Feng et al., 2023; Hao, 2023; Ulvik, 2020). In recent years, however, there has been a surfeit of interest from other disciplines, particularly regarding the integration of contemporary learning with the revival of ancient musical instruments through digital technologies, museum displays, and sound design. Museums and schools use digital sound archives, virtual exhibits, and 3D modeling to contemporary students facilitate interactive engagement with heritage artefacts. This approach represents a shift toward active participation and multisensory exploration of ancient instruments for students. Such integrated approaches demonstrate the relationship between ethnomusicology, archaeology, and pedagogy (Lewy, 2021; Ong, 2025; Xing & Chen, 2024). This is the educational aim of the current study.

1.4 Hypotheses

This study hypothesizes that engaging students with ancient musical instruments, especially the Yang Jiao Zhong, will improve both the understanding and the practice of preserving intangible cultural heritage. Teaching 'archaeological' history alongside creatively designed digital sound reconstructions and other innovative pedagogy not only protects the historical content but also revitalizes cultural artifacts as active learning tools. The study also hypothesizes that students will acquire a higher cultural literacy and appreciation of art if the Yang Jiao Zhong is integrated into educational practices, such as through museums, digital archives, and interactive curriculums. This model of educational engagement for students facilitates the practice of preservation, while heritage becomes a dynamic resource for learning. The hypothesis, therefore, is formulated to align with the study's primary research objective and question by predicting how educational innovation and digital tools may enable the preservation and transmission of the Yang Jiao Zhong as an instrument of cultural and musical heritage.

1.5 Research Objective

To investigate the educational perspectives on the preservation of the Yang Jiao Zhong, a Chinese bronze instrument.

1.6 Research Question

How can educational frameworks and digital innovation contribute to the effective preservation and transmission of the Yang Jiao Zhong as a cultural and musical heritage instrument?

2. Method

This study employed a qualitative descriptive research design to explore educational perspectives on the preservation of the Yang Jiao Zhong, a Chinese bronze instrument of historical and cultural significance. The qualitative approach allowed for an in-depth examination of the instrument's educational value through observation, expert interviews, and documentary analysis (Cai et al., 2025; Fu & Choatchamrat, 2024; Meng & Chuangprakhon, 2024). The research site was the Guangxi Zhuang Nationality Museum in Nanning, Guangxi, which houses the only complete replica of the Yang Jiao Zhong. This site was chosen for its authenticity, accessibility, and active role in cultural education and heritage exhibition. The qualitative process was guided by the objective of understanding how cultural heritage, digital innovation, and education intersect in preserving the Yang Jiao Zhong.

2.1 Research Design and Approach

The research design followed a descriptive-interpretive model, emphasizing observation and expert insight rather than numerical measurement. This design enabled the researcher to interpret the meanings, values, and educational applications associated with the Yang Jiao Zhong. The process consisted of three primary data collection methods:

2.1.1 Field Observation: Direct observation of the Yang Jiao Zhong replica and related exhibits to document its form, design, and acoustic potential.

2.1.2 Semi-Structured Interviews: Dialogues with five key informants possessing expertise in folk music, digital sound technology, and educational design.

2.1.3 Documentary Review: Examination of museum records, heritage archives, and research documents related to the Yang Jiao Zhong's preservation and digital documentation efforts.

The integration of these methods provided a holistic understanding of both the tangible and intangible dimensions of the instrument's preservation and its educational significance.

2.2 Research Site

The study was conducted at Jiaoyu Road, Qingxiu District, Nanning, Guangxi, China, where the Guangxi Zhuang Nationality Museum is located. The museum plays a vital role in promoting Zhuang and Chinese folk heritage through exhibitions, performances, and educational programs. The Yang Jiao Zhong replica displayed at the museum is a detailed reconstruction based on archaeological findings from Guangxi and Yunnan. The setting provided a rich context for field research, combining traditional artefacts, multimedia educational displays, and public engagement programs that reflect China's ongoing efforts in heritage-based education.

2.3 Key Informants

The study involved five key informants, all of whom were selected based on their expertise and professional engagement with Chinese folk music, sound design, or educational research. Each informant represented a specialized domain essential to the study's interdisciplinary nature, as shown in Table 1.

Table 1. Key Informants

No	Field of Expertise	Professional Role
1	Folk Music and Cultural Heritage	Museum Director and Folk Music Specialist
2	Bronze Instrument Research	Cultural Researcher and Performer
3	Digital Audio Technology	Recording and Mixing Engineer
4	Sound and Educational Design	Academic in Sound Engineering Education
5	Spatial Aesthetics and Psychology	Researcher in Art, Design, and Learning Psychology

The informants were interviewed separately to obtain independent and authentic perspectives. Each interview lasted between 60 and 90 minutes, conducted either at the museum or in professional studio settings.

2.4 Research Tools

To ensure the systematic collection of data, research tools were employed. These tools ensured the consistency and reliability of the data collection process across all research stages, as shown in Table 2.

Table 2. Research Tools

Tools	Purpose
Observation form	To record field notes on the instrument's design, texture, and spatial presentation
Interview form	To structure questions focusing on historical, technological, and educational themes
Documentation form	To organize supplementary materials such as museum catalogues and heritage reports

2.5 Data Collection Procedures

Data collection proceeded in three sequential phases:

2.5.1 Preliminary Survey: The researcher conducted an initial site visit to the Guangxi Zhuang Nationality Museum to identify relevant exhibits and gather contextual information on the Yang Jiao Zhong.

2.5.2 Field Observation and Documentation: Observations were conducted over multiple visits to study the physical form, sound structure, and display methods of the replica. Notes and photographs were used to record visual and acoustic details.

2.5.3 Expert Interviews: Semi-structured interviews were guided by three key themes:

- Historical and symbolic understanding of the Yang Jiao Zhong;
- Digital reconstruction and sound preservation methods;
- Educational integration in cultural heritage learning environments.

Each interview provided a unique perspective, enriching the interpretation of the Yang Jiao Zhong's role in education and preservation, as shown in Figure 1.

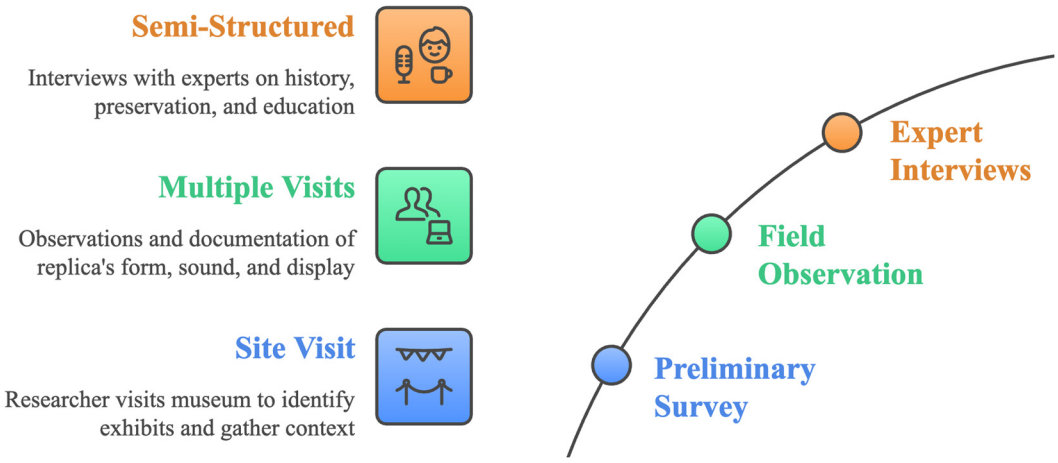

Figure 1. Data Collection Procedures

2.6 Data Analysis

After collecting data, the researcher used thematic content analysis to find patterns and relationships. The process involved transcribing and verifying interviews, coding data into categories related to cultural, digital, and educational dimensions, and synthesizing results into key findings. This facilitated understanding the intersection of digital innovation and educational frameworks in preserving ancient musical heritage, ultimately informing the interpretation of the Yang Jiao Zhong as both a cultural artefact and a pedagogical tool.

2.7 Ethical Considerations

Everyone who took part in the study knew what it was for and gave their full consent before doing so. Their identities were kept secret, and transcripts and publications made sure that the data were not linked to any one person. The study followed ethical research guidelines to make sure that people were treated with respect, their privacy was protected, and their culture was taken into account.

3. Results

The findings are presented under three major dimensions: 1) Cultural-Historical Understanding, 2) Digital Sound Heritage Application, and 3) Educational Integration and Pedagogical Value. These dimensions collectively reflect how traditional knowledge systems, technological innovation, and educational methodologies intersect in preserving and revitalizing the Yang Jiao Zhong. They also illustrate how learning environments, whether formal or informal, can serve as living platforms for sustaining intangible heritage.

The results are derived from comprehensive qualitative analyses, combining field observations, expert interviews, and documentation review. The researcher conducted fieldwork at the Guangxi Zhuang Nationality Museum in

Nanning, where the only complete replica of the Yang Jiao Zhong is preserved (Figure 2). The data gathered were systematically analyzed through thematic interpretation to identify educational implications in cultural heritage transmission.

Figure 2. Replica of the Yang Jiao Zhong at the Guangxi Ethnic Music Museum

Source: Photo by the researcher, 2024

3.1 Cultural-Historical Interpretation

The first of major outcomes is an investigation of the cultural and historical value of the Yang Jiao Zhong. While garnering expert testimony and recording observations in the field, I learned that this instrument is more than a simple memorial and is not just an object to be sounded. It contains a rich and profound cultural history of social stratification, distinctive worldview order, and regional belonging. One of the informants with whom I shared this research testimony identified the object as an indicator of cultural cross-fertilization of the Central Plains and southern peoples, and a historical integration of Chu–Yue ceremonial traditions with local bronze artistry. It means that, in value and significance, the Yang Jiao Zhong is an aspect of artistic and ideological integration and synthesis that reveals a basic understanding in advanced early China of sound, divinity, metal, and the interrelationships among all three.

Figure 3. Yang Jiao Zhong in the Huashan Rock Paintings, Guangxi

Source: Guizhou Department of Culture, Tourism, Radio, and Television

Interviews have identified Figure 3 (Huashan Rock Paintings, Guangxi) as an example, illustrating the extent to which the Yang Jiao Zhong was incorporated in ancient ritual performances. Among the dancers and painted

shamans was a representation of a bell-like instrument attesting to the claim that music served a dual function as a social and sacred medium of communication to and from the spirit realms. The fertility and strength ram horns made along the Yang Jiao Zhong were complemented as auspicious in the observational data from the museum replicas. Experts have pointed out that the totemic southern tribal beliefs associated with the ram horn motifs as spiritually and materially balancing.

One informant observed that within an educational context the Yang Jiao Zhong is studied as a means of illustrating the intersection of culture and form. Physical features of the replica, including the dual horns, and decorative engravings with patterns, reveal the craftsmanship and the ritualistic purpose which ancient instruments served. Other experts noted that the instrument's museum placement as well as its use in lesson presentations is an example of inquiry-based learning, as students start to formulate questions. The integration of social values, music, ritual, and metallurgical skills prompts even richer questions. This is a remarkable example of a cultural-historical approach to preservation, as it involves active cultural literacy rather than passive storage.

Additionally, the Yang Jiao Zhong demonstrates the internal diversity of ancient music systems in China. Unlike the northern bianzhong chime bells that adhered to courtly scales, the southern bells were more flexible tonally, indicating their participation in local folk rituals. This sort of flexibility is an excellent way to start discussions on cultural pluralism, showing students that multiple, sometimes radically different, traditions can coexist in China. This is certainly a feature of the civilization.

To facilitate this sort of learning, museums can create interpretive panels or classroom educational modules focused on geography, anthropology, and the impact of an artefact like the Yang Jiao Zhong on musical craftsmanship. This study thus demonstrates that the cultural-historical dimension of the Yang Jiao Zhong serves as a basis for heritage-based curriculum development, where artefacts are the focal point of developing a study on musical traditions and creative expression.

3.2 Digital Sound Heritage Application

The second key result highlights the transformative role of digital innovation in preserving and disseminating the Yang Jiao Zhong's sound heritage. All five informants agreed that digital reconstruction represents one of the most powerful educational tools for cultural preservation. Because most ancient bronze bells, including the Yang Jiao Zhong, are too fragile to play, physical performance is often impossible. Digital sound modelling and virtual acoustics provide a sustainable alternative that maintains both the authenticity and accessibility of the artefact's sound profile.

During the research, the Yang Jiao Zhong replica at the Guangxi Zhuang Nationality Museum (Figure 2) was recorded using professional audio equipment. The recordings were processed using specialized software to capture and analyze tonal frequencies, resonant harmonics, and decay patterns. The data were then transformed into a digital sound library, allowing users to explore the instrument's acoustic characteristics interactively. Experts reported that this database enables educators to simulate musical performances and compare tonal qualities between instruments of different periods or regions.

The informants further noted that digital reconstruction not only preserves the sonic identity of the instrument but also revitalizes learning. One sound engineer explained that when students can manipulate the digital model adjusting tone, resonance, and playback they gain a hands-on understanding of acoustic physics and historical musicology simultaneously. Through this process, the Yang Jiao Zhong becomes a bridge between science and art, as shown in Table 3.

The digital reproduction process also demonstrated that technology could restore aspects of the instrument's "living soundscape." Experts shared that acoustic modelling revealed resonant frequencies between 200–500 Hz, corresponding to human vocal registers used in ritual chanting. This correlation strengthens the hypothesis that Yang Jiao Zhong performances were intended to mimic human vocal patterns, emphasizing the sacred unity of sound and speech. Such findings, when incorporated into educational programs, offer rich opportunities for connecting ancient music with modern sound design theory.

However, several challenges emerged during digital preservation. Interviewees mentioned the difficulty of reproducing the instrument's precise material resonance due to variations in bronze composition and environmental conditions. Despite these technical constraints, the digital model achieved high educational value by allowing learners to experience the instrument's tonal diversity. Through augmented and virtual reality applications, students can now explore the Yang Jiao Zhong's acoustic structure, interact with its sound, and even "play" it in simulated performances.

Table 3. The Educational Applications Identified Through Digital Preservation Activities

Application Area	Digital Method	Educational Value
Acoustic Reconstruction	3D sound modelling using digital signal processing software	Enables interactive listening sessions and tone analysis in music technology classes
Virtual Museum Exhibition	360° visual displays with synchronized sound playback	Creates immersive learning environments linking visual art and audio heritage
Sound Archive Development	Creation of digital databases for heritage instruments	Provides long-term preservation and accessibility for researchers and students
Cross-disciplinary Learning Modules	Integration of sound data into art, physics, and cultural studies curricula	Encourages interdisciplinary collaboration and inquiry-based learning
Performance Simulation	Real-time sound reproduction via digital instruments	Allows learners to perform ancient music without endangering original artefacts

Digital innovation thus plays a critical role in transforming the Yang Jiao Zhong into a pedagogical instrument of cultural continuity. Museums and universities can collaborate to create open-access sound archives, integrating heritage artefacts into music, history, and technology education. This process not only democratizes access to cultural heritage but also strengthens interdisciplinary learning across artistic and scientific domains.

3.3 Educational Integration and Pedagogical Value

The third result emphasizes the Yang Jiao Zhong's role as a teaching tool and educational model for integrating cultural heritage into contemporary curricula. Interview data revealed that incorporating such ancient artefacts into learning contexts enhances cultural awareness, creativity, and critical thinking. Informants agreed that education must move beyond preservation as a static display toward participatory learning experiences that connect heritage to the modern learner.

Museum-based workshops, as observed at the Guangxi Zhuang Nationality Museum, provide an effective platform for experiential learning. These workshops encourage students to engage with ancient instruments through observation, digital playback, and guided discussion. Educators reported that students exhibited higher curiosity and emotional engagement when learning about the Yang Jiao Zhong through interactive media compared to traditional lectures. This aligns with modern pedagogical theories emphasizing multisensory learning where visual, auditory, and tactile experiences combine to strengthen understanding and retention, as shown in Table 4.

Table 4. The Research Identified Three Primary Models of Educational Integration

Model Type	Description	Learning Outcome
Museum-Based Learning	Involves direct engagement with replicas, multimedia exhibitions, and curator-led activities	Enhances observation, inquiry skills, and historical empathy
Digital Classroom Integration	Incorporates 3D models, sound libraries, and virtual tours into lesson plans	Promotes interactive learning and technological literacy
Creative Practice-Based Learning	Encourages students to use digital reconstructions in artistic compositions or performances	Fosters creativity, collaboration, and cultural reinterpretation

Several educators highlighted the Yang Jiao Zhong as an ideal case study for interdisciplinary curriculum design. It connects history, music, design, physics, and anthropology, making it suitable for programs that encourage STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning. For example, a digital sound engineering student might analyze the bell's acoustic properties, while an art history student interprets its symbolic design, and a cultural studies student explores its role in ritual society. Such integrated learning mirrors the holistic thinking of ancient craftsmen who saw no boundary between art and science.

Interview results also revealed that learners who participated in heritage-based workshops developed a deeper sense of identity and appreciation for traditional culture. The act of digitally recreating or "performing" the Yang Jiao

Zhong allowed them to connect emotionally with their cultural past, bridging temporal and generational gaps. One informant observed that when students heard the bell's reconstructed sound, they described it as "a voice from history." This emotional resonance illustrates the potential of heritage education to nurture empathy and cultural continuity.

Another significant finding was the pedagogical adaptability of the Yang Jiao Zhong. Educators found that it could be incorporated into diverse teaching contexts from museum exhibitions and university lectures to online learning platforms. Digital models of the bell can be embedded in interactive textbooks or online heritage courses, allowing global access to Chinese cultural heritage. This adaptability demonstrates how digital innovation can transform a local artefact into a global learning resource.

Moreover, the study uncovered that combining traditional heritage education with creative digital storytelling amplifies student engagement. By inviting learners to reconstruct the history of the Yang Jiao Zhong through digital animation, sound mixing, or virtual exhibition design, educators create immersive learning experiences that blend creativity with critical inquiry. This method transforms heritage learning into a process of co-creation rather than mere observation, allowing students to become active participants in cultural preservation.

The interviews also identified the challenges in integrating ancient artefacts into modern education. Limited funding, inadequate teacher training, and lack of interdisciplinary collaboration were cited as key barriers. Nevertheless, experts agreed that strategic partnerships between museums, universities, and technology centers could overcome these obstacles. Developing joint programs, such as a "Digital Sound Heritage Curriculum," could provide models for global heritage education.

4. Discussion

This study highlights that to preserve Yang Jiao Zhong, education, technology, and management of cultural heritage should be integrated. The findings reflect Howard (2022), who states musical instruments are tangible and intangible cultural heritage. The findings are that educational interaction brings artefacts from static transformation into dynamic cultural tools. The transformation is exemplified in the museum-based learning at the Guangxi Zhuang Nationality Museum, in which Lewy's (2021) applied ethnomusicology is practiced through the sound narratives and interactive learning which connects historical artefacts to contemporary audience.

The findings are aligned to heritage education theories focused on experiential and constructivist learning (Ulvik, 2020; Ong, 2025). Rather than reiterating the general value of digital heritage tools, the analysis emphasizes how digital sound modelling functions as a pedagogical mechanism that deepens learners' interpretation of cultural artefacts by linking sonic characteristics to historical meaning. Similar to the virtual museum approaches in Singapore (Ong, 2025), this study found that students' interaction with the Yang Jiao Zhong's reconstructed sounds enhanced curiosity, engagement, and comprehension. Acquilino and Scavone (2022) reinforce this study, stating that digital tools enhance instrumental pedagogy through interactive explorations of acoustic properties and cultural contexts.

The results of this research align well with the theory on digital heritage education literature, yet also indicates challenges which remain relatively unexplored. Compared to the comprehensive infrastructure available in the European and Japanese models of cultural education (Xing & Chen, 2024; Sawada & Andres, 2024), barriers such as lack of deeper interdisciplinary synergies and inadequate funding remain in Chinese heritage institutions. This is why the results, to some extent, still diverge from the expectations of inclusive ethnomuseology as proposed by Lewy (2021), and reinforce the need for a more coherent fusion of educational technology with policies on heritage management. This suggests that while technological tools are promising, their educational impact depends on institutional support and the strategic alignment of heritage policy with curriculum development.

Furthermore, this research moves the discourse on Yang Jiao Zhong beyond the ethics of educational cultural transmission by incorporating pedagogy that focuses on the preservation of the Yang Jiao Zhong. The findings indicate that digitized sound heritage supports posthumanist and interdisciplinary learning (An et al., 2025). The analytical synthesis shows that digital reconstruction becomes most effective when embedded within broader interpretive learning activities that connect students to cultural identity, heritage values, and creative inquiry, rather than being treated merely as a technological enhancement. The virtual ability to "play" the reconstructed instrument offers innovative pedagogy that bridges the creative fusion of the arts and sciences, and resonates with the principle of music heritage as a living system of knowledge (Norton & Matsumoto, 2018). Therefore, the findings align with and build upon existing theoretical frameworks by confirming the educational value of the ancient artefacts, while

calling for more digital and interdisciplinary opportunities in the theory.

5. Conclusion

This study concludes that educational innovation that combines traditional culture with contemporary digital technology will define the future preservation strategies of the Yang Jiao Zhong. Our findings confirm the value of balance curricula, cloud-based museum tours, and digital audio echo reconstruction as educational layering techniques that will make the Yang Jiao Zhong a teachable resource. These techniques preserve historical soundscapes and promote the cultural creativity, compassion, and empathy of students as artefacts of history continue to foster cultural identification. The results clearly demonstrate that educational frameworks rooted in experiential, inquiry-based, and interdisciplinary learning provide the conceptual structure needed for students to interpret the instrument's cultural significance, while digital innovations such as sound modelling, virtual exhibitions, and interactive archives offer practical tools that ensure its sustainable transmission. Together, these approaches directly answer the research question by showing how pedagogy and technology jointly facilitate the preservation and revitalization of the Yang Jiao Zhong.

This study suggests that enduring preservation will depend on collaborative strategies between museums, universities, and software builders. Limited teacher training and a lack of resource allocation will continue to pose challenges for educational institutions. A systematic review of the findings indicates three core discoveries: 1) the Yang Jiao Zhong embodies rich ritual, artistic, and historical meanings that are effectively communicated through heritage-based learning; 2) digital reconstruction enables safe access to the bell's acoustic identity and significantly enhances student engagement; and 3) integrating the instrument into museum programs and classroom instruction strengthens cultural literacy and interdisciplinary creativity. Future projects should include border comparative case studies on museum-embedded learning between China and other countries and the digital heritage learning value of students, focusing on quantitative measurement. Moreover, the use of artificial intelligence and augmented reality in heritage pedagogy to simulate ancient soundscapes and promote cross-border collaboration in cultural preservation should be prioritized.

This study furthers the scholarship that combines ethnomusicology with educational innovation and the digital humanities. The Yang Jiao Zhong, which was an ancient ceremonial instrument, is now a teaching bridge to the past and the present, a reminder to us that education is the preserver and transformer of cultural heritage. By establishing how educational design and digital tools work in tandem, the study affirms that preservation is no longer limited to conservation practices alone but extends into learning environments where cultural memory can be actively reinterpreted, experienced, and sustained for future generations.

References

Acquilino, A., & Scavone, G. (2022). Current state and future directions of technologies for music instrument pedagogy. *Frontiers in Psychology, 13*, 835609. https://doi.org/10.3389/fpsyg.2022.835609

An, N., Chuangprakhon, S., Seekhunlio, W., & Liu, Q. (2025). Guqin Transmission in the Digital Age: A Posthumanist Perspective on Music Education. *Journal of Posthumanism, 5*(2), 771-783. https://doi.org/10.63332/joph.v5i2.453

Cai, R., Karin, K., & Thotham, A. (2025). Educational Strategies for the Transmission of Tibetan Folk Songs in Multicultural China. *World Journal of Education, 15*(2), 111-120. https://doi.org/10.5430/wje.v15n2p111

Du, B., & Liang, Y. (2024). The Development and Evolution of Ancient Chinese Musical Instruments. *Material science, 6*(7), 46-51. https://doi.org/10.25236/FAR.2024.060708

Feng, T., Ma, Z., & Ding, Y. (2023). Cultural Division. In *The Changjiang River Civilization: Nature and Culture of the Changjiang River from a Global Perspective* (pp. 127-174). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-4552-6_4

Fu, X., & Choatchamrat, S. (2024). The Contemporary Transmission Methods and Education of Chinese Jinghe Opera to Address Current Challenges in Hubei Province. *World Journal of Education, 14*(1), 96-105. https://doi.org/10.5430/wje.v14n1p96

Good, C., Tyrrell, P., Zhou, Z., & Macdonald, D. W. (2019). Elephants never forget, should art museums remember too? Historic ivory collections as ambassadors for conservation education. *Biodiversity and Conservation, 28*(6),

1331-1342. https://doi.org/10.1007/s10531-019-01735-6

Hao, H. (2023). Archaeological Excavations of Percussion Instruments in the Song Dynasty and their Implications for Modern Musical Instruments. *Mediterranean Archaeology and Archaeometry, 23*(3), 219-229.

Howard, K. (2022). Musical instruments as tangible cultural heritage and as/for intangible cultural heritage. *International Journal of Cultural Property, 29*(1), 23-44. https://doi.org/10.1017/S0940739121000436

Lewy, M. (2021). Applied Ethnomusicology in Museum Exhibitions: Critical Reflections on Sound Narratives as a Method for Knowledge Transfer. *Applied Ethnomusicology: Practices, Policies and Challenges*, 123-134. https://doi.org/10.2307/jj.13245879.13

Liu, J., & Nicolas, A. (2024). Educational and Literacy Perspectives about Bronze Drums in Southwest China for Contemporary Learning Resources. *International Journal of Education and Literacy Studies, 12*(1), 245-251. https://doi.org/10.7575/aiac.ijels.v.12n.1p.245

Ma, Y. (2024). Bibliometric study of 40 years of research in Chinese music archaeology. *SAGE Open, 14*(4), 21582440241308339. https://doi.org/10.1177/21582440241308339

Meng, G., & Chuangprakhon, S. (2024). Education and Learning Guidelines for the Preservation and Protection of Qinghai Mongolian Folk Songs in China. *Journal of Education and Learning, 13*(2), 75-84. https://doi.org/10.5539/jel.v13n2p75

Norton, B., & Matsumoto, N. (Eds.). (2018). *Music as heritage: Historical and ethnographic perspectives*. Routledge. https://doi.org/10.4324/9781315393865

Ong, C. S. L. (2025). The Use of Virtual Museums in the Teaching and Learning of History. In *Virtual Fieldwork in Humanities Education: Exploring Evolving Frontiers of Learning in Singapore* (pp. 67-86). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-96-4200-7_4

Pellew, J., & Goldman, L. (2018). *Dethroning historical reputations: universities, museums and the commemoration of benefactors (p. 166)*. University of London Press. https://doi.org/10.14296/718.9781909646834

Sawada, M., & Andres, F. (Eds.). (2024). *Impacts of museums on global communication*. IGI Global. https://doi.org/10.4018/979-8-3693-2129-4

Ulvik, M. (2020, April). Promoting aesthetical values to education. In *Frontiers in Education* (Vol. 5, p. 34). Frontiers Media SA. https://doi.org/10.3389/feduc.2020.00034

Wang, W., Nicolas, A., & Thotham, A. (2025). Preservation of the Literacy of Musical Instruments from the Shang Dynasty of the Central Plains in China. *International Journal of Education and Literacy Studies, 13*(1), 80-87. https://doi.org/10.7575/aiac.ijels.v.13n.1p.80

Xing, T., & Chen, N. (2024). Evolution of education models in European musical instrument manufacturing: From traditional apprenticeships to modern academic systems. *Arts Educa*, 39.

Yang, F., Chonpairot, J., You, L., & Li, J. (2024). Guqin: The physical structure and literary significance of Chinese traditional musical instruments. *International Journal of Education and Literacy Studies, 12*(2), 111-117. https://doi.org/10.7575/aiac.ijels.v.12n.2p.111

Zhang, Y. (2024). Exploring the Artistry and Archaeological Significance of Sound, Resonance, and Musical Expression in Instruments of the Spring-Autumn and Warring States Period. *Mediterranean Archaeology and Archaeometry, 24*(2), 114-130.

Acknowledgments

Not applicable.

Authors contributions

Not applicable.

Funding

Not applicable.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Sciedu Press.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.