Clareus Scientific Science and Engineering
Volume 3 Issue 3 May 2026
ISSN: 3065-1182

Clareus Scientific

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Citation: Narantsatsral Delgerkhuu., et al. "Research on Innovation of Dynamic Inheritance Mode of Yingge Dance in Colleges and Universities Driven by Big Data: Teaching, Learning, Transmission and Creation". Clareus Scientific Science and Engineering 3.3 (2026): 28-34.

Article Type: Research Article

Received: March 16, 2026

Published: May 29, 2026

Zhi Cheng Yi[1] and Narantsatsral Delgerkhuu[2]*

[1]Institute of Open Education, Mongolian University of Science and Technology, Guangdong Baiyun University, Guangzhou, 510000, China

[2]Department of History, culture and Tourism, School of Social Science and Humanities, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia

***Corresponding Author:** Narantsatsral Delgerkhuu, Department of History, culture and Tourism, School of Social Science and Humanities, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia.

Abstract

This study explores innovative pathways for developing a dynamic inheritance model of Yingge dance (a traditional Chinese folk art) through "teaching-learning-transmitting-innovation" in higher education institutions, driven by big data technology. By establishing a closed-loop system for data collection, analysis, and application, the research achieves personalized teaching pathway design, intelligent dissemination network construction, and optimized collaborative innovation mechanisms, thereby reshaping the inheritance ecosystem of traditional skills. The findings indicate that technology-driven empowerment can significantly enhance inheritance efficiency and cultural identity, while requiring ethical boundaries to balance data privacy protection and cultural authenticity preservation. Furthermore, multi-stakeholder collaboration mechanisms are proposed to overcome resource integration barriers.

Keywords: Big Data-Driven; Yingge Dance; Living Inheritance; Digital Innovation; Collaborative Mechanism

Introduction

Amid the convergence of intangible cultural heritage preservation and digital transformation, Yingge Dance-a quintessential form of traditional dance art-faces practical challenges in its living inheritance, including limited teaching methodologies, restricted dissemination scope, and insufficient innovation momentum. The integration of big data technology provides new methodological support for preserving Yingge Dance in higher education institutions. Through data-driven precision teaching, dynamic feedback mechanisms, and innovation incubation, this approach aims to reconstruct an integrated inheritance ecosystem encompassing "teaching-learning-inheritance-creation". Focusing on the deep integration of big data technology with Yingge Dance education, this study explores how to optimize traditional inheritance models through data mining, behavioral analysis, and intelligent recommendation systems.

The Theoretical Logic of Yingge Dance Inheritance in Colleges and Universities Driven by Big Data

The connotation of living inheritance and the need for technical empowerment

As a highly dynamic intangible cultural heritage, Yingge Dance demonstrates three core characteristics of living inheritance: the practicality of "artistic continuity through human practice". intergenerational transmission dynamics, and adaptability to cultural contexts. Unlike static artifact preservation, living inheritance requires skills to maintain vitality through ongoing practice-remaining faithful to traditional forms while addressing contemporary aesthetic and educational needs [1, pp. 165-168]. This dual challenge poses difficulties for traditional oral-instruction models: individualized teaching struggles with scalability, limiting transmission efficiency; meanwhile, lack of systematic documentation risks losing tacit knowledge like movement details and emotional expressions during intergenerational transfer. The integration of big data technology offers a new solution. Through motion capture and behavioral trajectory analysis, core elements of Yingge Dance-such as body language and rhythmic patterns-can be digitally deconstructed and dynamically modeled, transforming the traditionally subjective inheritance process into quantifiable, traceable data streams. The essence of technological empowerment lies in creating a closed-loop system (Figure 1: "data-knowledge-practice") that preserves authentic traditions while optimizing teaching methods and innovation pathways through data feedback, ultimately achieving a transition from "experience-based inheritance" to "data-driven transmission". [2, pp. 58-61].

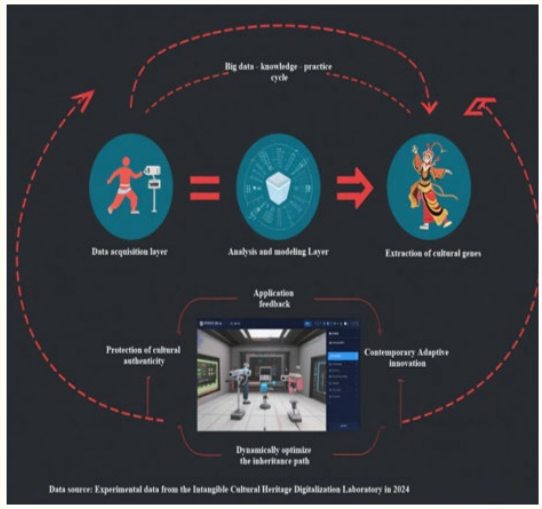

Figure 1: The closed-loop model of Yingge dance inheritance enabled by big data technology.

Coupling mechanism between big data technology and cultural inheritance

The integration mechanism between big data technology and cultural heritage preservation fundamentally represents the deep convergence of technological logic and cultural logic, with its core mission being to reconstruct the "teaching-learning-transmission-creation" value chain of Yingge Dance through data flow. At the data collection level, multi-dimensional sensing technology achieves comprehensive digital mapping of Yingge Dance's intrinsic characteristics and inheritance processes, transforming intangible knowledge such as body rhythm and emotional expression-elements challenging to quantify in traditional teaching-into structured data assets [3, pp. 65-69]. This digitization not only transcends temporal and spatial constraints, enabling traceable teaching processes, but more importantly establishes a digital archive of cultural genes, laying the foundation for subsequent analysis and application. In data analysis, machine learning algorithms identify critical milestones and bottlenecks in inheritance through mining correlation features like movement standardization, learning curves, and trending topics. For instance, they pinpoint error-prone movements in specific dance segments or misinterpretations of cultural connotations, providing objective evidence for instructional strategy adjustments. At the

data application level, intelligent recommendation systems match teaching resources based on personalized learning profiles, while virtual reality technology creates immersive cultural experiences to enhance identity recognition. Generative artificial intelligence assists creators in modernizing traditional vocabulary through experimental expressions. This closed-loop optimization mechanism of "collection-analysis-application" transforms Yingge Dance inheritance from an experience-driven process into a data-driven precision system, maintaining cultural DNA stability while offering controlled trial-and-error space for innovation [4, p. 132].

The reconstruction of the role of colleges and universities in inheritance

In the digital age, universities are undergoing a profound transformation from traditional educational institutions to dual-function entities serving as "technology application hubs" and "cultural heritage centers" for the dynamic inheritance of Yingge dance, as illustrated in the model shown in Figure 2. This restructuring primarily manifests through enhanced technological application capabilities. While historically universities primarily focused on skill transmission, their technological integration capacity has become crucial in the big data-driven era-- By establishing digital laboratories, developing intelligent teaching systems, and creating cultural heritage databases, universities deeply embed technological innovation into heritage preservation practices [5, pp. 63-65.]. This enables standardized documentation of dance movements, quantitative assessment of learning outcomes, and optimized design of inheritance pathways. The establishment of this technological autonomy not only improves preservation efficiency but also reshapes pedagogical paradigms, positioning universities as core hubs for digital protection and development of Yingge dance. Within regional cultural ecosystems, universities leverage their academic resources, talent pools, and interdisciplinary advantages to effectively connect government cultural departments, folk art troupes, technology enterprises, and young audiences, forming a multi-stakeholder collaborative network. Through digital performances, interdisciplinary workshops, and university-local cooperation bases, universities facilitate both academic documentation of traditional skills and their creative adaptation in contemporary contexts. This pivotal role allows universities to balance technical rationality with cultural values-- While adopting data analysis methods, they maintain humanistic warmth in preservation processes; while exploring innovative expressions, they preserve the authenticity of cultural genes [6, pp. 118-122.]. The coordinated development of these dual functions indicates that colleges and universities are transforming from passive cultural inheritors to active designers of inheritance mode. The reconstruction of their roles is not only related to the survival of a single art form, but also has exemplary significance for the overall protection and innovative development of China's intangible cultural heritage [7, pp. 52-54.].

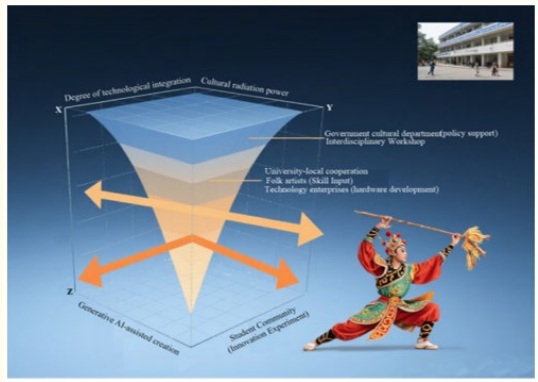

Figure 2: Three-dimensional model of the reconstructed role of universities in the inheritance of Yingge dance.

Construction of Big Data-Driven 'Teaching-Learning-Transmitting-Creating' Mode

Data-based teaching: personalized learning path design

The deep integration of big data technology is revolutionizing traditional pedagogical models in Yingge dance education at universities. As depicted in Figure 3, the personalized learning pathway achieves paradigm shift from "one-size-fits-all" instruction to "tailored education" through systematic collection and analysis of learner behavioral data. In practice, digital teaching manifests through multidimensional learning profiling--: motion capture systems track key metrics including physical coordination, rhythmic precision, and expressive capacity, while eye-tracking and practice duration data form a comprehensive learner model encompassing physiological characteristics, cognitive patterns, and emotional tendencies. This evidence-based data collection transcends the subjective limitations of traditional teaching experience, enabling instructors to accurately identify individual strengths and weaknesses across "hand-eye-body-method-step" dimensions. Leveraging association rule mining and cluster analysis, intelligent algorithms automatically identify typical learning patterns and common pitfalls-such as correlating "unstable horse stance" with insufficient core muscle strength or establishing causal links between "stiff facial expressions" and cultural comprehension gaps. These insights directly inform dynamic teaching strategy adjustments: automatically reinforcing drum rhythm training for learners with weak rhythmic sense, while providing cultural awareness materials for those with limited understanding, ultimately achieving closed-loop optimization through "assessment-diagnosis-intervention". Personalized path design is not a simple accumulation of fragmented resources, but a hierarchical progression logic based on "standardization of basic movements-personalization of advanced performance". Through data feedback, teaching objectives are continuously calibrated to ensure the standard inheritance of traditional programs and respect the individual differences of learners [8, pp. 121-124.].

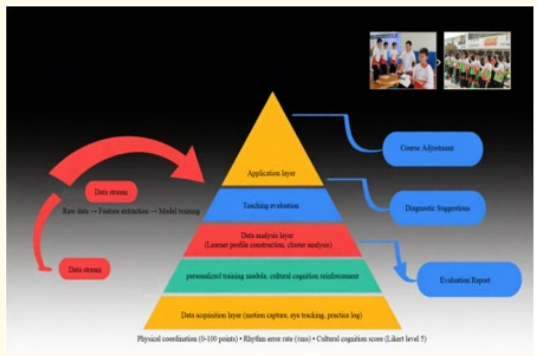

Figure 3: Big data driven personalized learning path design of Yingge Dance.

Intelligent communication: construction of a cross-temporal inheritance network

Big data technology is reshaping the communication ecosystem of Yingge Dance, with its core value lying in building a three-dimensional inheritance network that transcends time and space through social data mining and intelligent algorithmic recommendations. In terms of dissemination scope, user profiling-based precision recommendation algorithms can effectively identify potential interest groups -- By analyzing social media behavior data, content consumption preferences, and geographical information, the system automatically identifies users with latent interest in folk art, intangible cultural heritage, or dance performances, achieving an "culture finds people" intelligent push model. This data-driven audience expansion mechanism significantly enhances Yingge Dance's exposure and reach efficiency among young demographics, enabling traditional art forms previously limited to specific regions and age groups to gain broader social recognition. At the depth of interaction level, intelligent communication breaks through the limitations of traditional one-way output by establishing a two-way interactive inheritance mechanism through real-time feedback from user behaviors. For instance, implicit feedback data such as audience dwell time and replay frequency for specific dance segments can optimize con-

tent production strategies in reverse; while sentiment analysis in comment sections helps identify audiences' cultural knowledge gaps, providing basis for subsequent content supplementation. The integration of virtual reality and augmented reality technologies allows remote learners to acquire physical memory akin to on-site training through immersive experiences, while blockchain technology introduces technical safeguards for copyright protection of original choreographic works, encouraging more innovative practices. This intelligent communication network has not only expanded the audience base for Yingge Dance, but also achieved continuous optimization of dissemination effects through a closed-loop data system, breathing new life into traditional culture in the digital realm. With the advancement of metaverse technology, Yingge Dance dissemination is poised to create immersive cultural experiences that blend virtual and physical dimensions. This evolution will transform passive "viewing" into active "participation", ultimately establishing a sustainable digital heritage ecosystem [9, pp. 77-83.].

Collaborative innovation: two-way drive of creation and research

Big data technology has established a "practice-research-feedback" collaborative mechanism for the innovative development of Yingge Dance in universities, as illustrated in Figure 4. The core lies in stimulating co-creation vitality between teachers and students through bidirectional data flow circulation. At the creative level, the integration of movement databases and generative algorithms enables digital deconstruction and recombination of traditional dance vocabulary--. Teachers and students can not only extract typical movement paradigms through cluster analysis of historical performance data, but also attempt modern expressions of traditional vocabulary via style transfer algorithms. This "innovative preservation" approach maintains cultural genetic stability while expanding artistic boundaries. In the research dimension, user feedback data, performance effectiveness metrics, and social response data form a closed loop, providing empirical foundations for theoretical studies and transforming subjective artistic evaluations into quantifiable innovation assessments. Notably, the collaborative innovation mechanism breaks through the traditional one-way "master-apprentice inheritance" model, establishing a spiral upward path of "skill practice-data analysis-theoretical refinement-reinvention". Through data interaction, teachers and students form an equal research partnership. This innovative model not only generates works blending traditional charm with modern aesthetics but also gradually establishes a theoretical system and methodology for Yingge Dance innovation through continuous data accumulation and knowledge mining. It provides replicable and verifiable practical paradigms for contemporary transformation of intangible cultural heritage [10, pp. 51-54.].

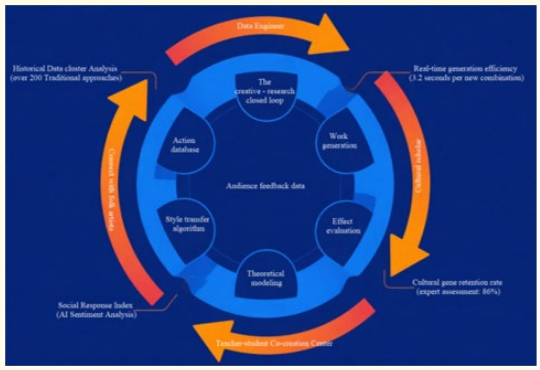

Figure 4: Two-way driving mechanism of Yingge dance collaborative innovation.

Challenges and Countermeasures of Model Innovation

Risks and ethical boundaries of technology application

The application of big data technology in the dynamic inheritance of Yingge Dance faces dual ethical dilemmas. On one hand, privacy concerns during data collection through motion capture and behavioral tracking technologies have become increasingly prominent,

particularly when involving biometric data. Balancing research needs with learner privacy protection has emerged as a critical issue. Excessive digitization risks eroding humanistic care in teaching processes, transforming the emotionally rich tradition of skill transmission into cold data analysis. On the other hand, algorithmic intervention in creative processes raises cultural authenticity controversies that warrant vigilance. When machine-generated movement combinations or performance styles are incorporated into inheritance systems, how do we define the boundaries between innovation and variation? The erosion of cultural subjectivity by technical rationality may cause Yingge Dance to gradually lose its inherent cultural genes and spiritual essence. At their core, these issues reflect the tension between technological tools and cultural values. To address this, mechanisms like the "Technical Ethics Review Committee" (Figure 5) should be established to regulate data usage, formulate industry standards for cultural heritage digitization, and embed cultural preservation values into algorithm design. This ensures technological applications always serve rather than dominate cultural inheritance.

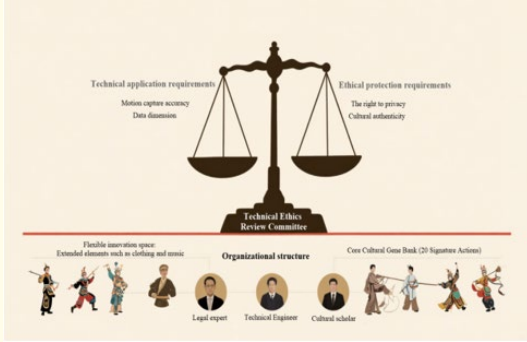

Figure 5: Ethics risk prevention and control system for digital inheritance of Yingge Dance.

Mechanism barriers of multi-agent collaboration

The core challenge in the digital preservation of Yingge dance stems from conflicting objectives and resource barriers among stakeholders: universities prioritize academic innovation, communities value authentic traditional practices, and tech firms focus on commercial viability. These divergent values create challenges in collaboration, including responsibility shirking and resource waste--. University-developed smart teaching systems risk cultural insufficiency by overlooking folk artists 'wisdom, while corporate platforms may over-entertain traditional elements for traffic. Meanwhile, communities' passive role in technology adoption hinders effective decision-making. To resolve this, we propose a "culture-led, technology-supported" collaborative governance framework: Establishing a tripartite coordination body, creating joint mechanisms for recognizing traditional skills and setting digital standards, designing shared intellectual property models, and clarifying distribution principles for university research outcomes, corporate commercial benefits, and community cultural rights. This will ultimately form a sustainable ecosystem with shared goals, complementary resources, and collective risk-sharing.

Top-level design of long-term development path

To achieve sustainable development in the dynamic inheritance of Yingge dance, systematic institutional innovation is essential. At the policy level, digital inheritance should be incorporated into specialized intangible cultural heritage protection plans, establishing a cross-departmental "Digital Development Fund for Intangible Cultural Heritage" to coordinate resource allocation across cultural preservation, educational innovation, and technological research. In disciplinary development, it is crucial to break down knowledge barriers between art studies, computer science, and anthropology by creating an interdisciplinary "Digital Humanities" program to cultivate versatile professionals proficient in both cultural heritage preservation and data technology. The evaluation system reform must transcend single-focused academic paper metrics, establishing comprehensive indicators that encompass cultural dissemination

effectiveness, technological innovation levels, and social impact, with particular emphasis on qualitative indicators like folk artists' participation and youth engagement. The core of these top-level designs lies in building a tripartite support system integrating culture, technology, and education. Through institutional innovation, we can unleash synergistic effects among various elements, ensuring big data technology truly serves as a catalyst for revitalizing traditional culture rather than a force distorting its authenticity.

Conclusions

Big data technology has unlocked new possibilities for the dynamic inheritance of Yingge dance in higher education institutions. Its core value lies in connecting the entire "teaching-learning-transmission-innovation" process through data chains, enabling precise preservation and innovative expression of cultural genes. However, the effectiveness of technological tools always depends on humanistic guidance, requiring a balance between efficiency and ethics while respecting traditional authenticity. Future research should further explore standardized frameworks for intelligent inheritance, driving the transition of intangible cultural heritage protection from experience-driven to data-driven paradigms. This will provide Chinese solutions for sustaining cultural diversity within a global context.

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