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Research Article

A Feasibility Study on the Two-way Empowerment of Art Education Between Museums and Universities in the Era of AI

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Abstract

The iterative upgrading of artificial intelligence (AI) technology has provided an innovative path for the mutual empowerment of museums and art education in universities. This study focuses on the interaction mechanism between cultural resources and the education system in the AI era, revealing the feasibility and practical value of mutual empowerment. On the one hand, museums, by leveraging generative AI, neural radiance fields and other technologies, transform cultural relics into decomposable dynamic educational resource libraries. These systems facilitate the transformation of cultural and artistic works from physical forms to programmable educational primitives. Through parametric decomposition, style transfer, and spatio-temporal correlation analysis, a cognitive network that supports cross-disciplinary knowledge production is formed. On the other hand, through creative data feedback and algorithmic innovation in higher education practice, cultural connotations are cultivated, thereby transforming the role of museums from cultural custodians to educational enablers, and universities from knowledge disseminators to engines of cultural reproduction, promoting the modern translation of traditional cultural elements. This two-way empowerment mechanism provides technical solutions to historical problems such as the closed nature of cultural resources and the suspension of educational practice, and lays a theoretical foundation for the transformation of humanities education in the digital civilization era. From the perspective of the popularization of artificial intelligence technology, this article deeply explores the possibility of two-way empowerment between museums and university art education, and further explores the paths of two-way empowerment between museums and universities in the era of artificial intelligence.

Keywords

AI Technology, Art Education, Museums, Bidirectional Empowerment

1. Introduction

In recent years, the concept of the 'smart museum' has become a core topic in the innovative development of the museum sector. Currently, the deep integration of the digital economy and the real economy, along with the overlapping of various digital industry clusters, has profoundly changed the social division of labor, driving significant changes in the production relations. Under the guidance of the Ministry of Culture and Tourism's 'Guiding Opinions on Promoting the Reform and Development of Museums,' the integration of technologies such as digital twins, artificial intelligence, and

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blockchain is being applied to build a 'perceptible, breathing, and communicative' smart museum system, which has become a key path in reshaping cultural experience paradigms.

2. The Practice and Application of AI Technology in the Museum Industry

In recent years, the concept of the 'smart museum' has become a core topic in the innovative development of the museum sector. Currently, the deep integration of the digital economy and the real economy, along with the overlapping of various digital industry clusters, has profoundly changed the social division of labor, driving significant changes in the production relations. [1] Under the guidance of the Ministry of Culture and Tourism's 'Guiding Opinions on Promoting the Reform and Development of Museums,' the integration of technologies such as digital twins, artificial intelligence, and blockchain is being applied to build a 'perceptible, breathing, and communicative' smart museum system, which has become a key path in reshaping cultural experience paradigms.

2.1. The Practice of AI Technology in Museum Exhibitions

With the development of digital intelligence technology, museums moving towards smart systems no longer rely solely on traditional display methods such as exhibition panels, images, and guided tours. Instead, they have shifted to more intelligent and digital display methods, offering visitors a refreshing viewing experience. The development of the 'AI technology + application scenarios' model provides a more engaging and immersive visiting experience for the audience. The application of technologies such as digital twins, real-time cloud rendering, holographic projection, and naked-eye 3D has enabled digital art exhibitions, 360° panoramic halls, smart guides, and immersive interactive experiences to flourish in museums, creating a fun and highly engaging viewing effect for visitors. The national “15th Five-Year” key science and technology projects have received strong support from the National Administration of Cultural Heritage. Under this framework, several institutions, including the Nanjing Museum, the Palace Museum, and the Dunhuang Academy, have applied for the research topic of 'Preliminary Study on Virtual Reality Technology System for Site Preservation'. [2]

The innovation in interactive experiences further highlights the disruptive value of AI. Augmented reality tour systems no longer just overlay information but dynamically adjust the narrative focus based on the viewer's gaze duration and micro-expression changes. When visitors pause in front of the digital scroll of 'Along the River During the Qingming Festival,' AI generates real-time mechanical analyses of the Rainbow Bridge structure or economic maps of the Grand Canal trade in Bianjing, seamlessly blending art appreciation with interdisciplinary cognition. [3] The introduction of affective computing technology transforms the exhibition space into a responsive entity. Tate London's AI curatorial system, by analyzing the variability in viewers' heart rates, automatically adjusts the lighting, shadows, and sound intensity, turning the exhibition experience into an immersive theatrical event that resonates both physically and emotionally. [4]

2.2. The Practice of AI Technology in the Field of Museum Preservation

In the field of cultural heritage preservation, the storage conditions of cultural relics have been effectively improved. Particularly for fragile and valuable cultural relics, with the help of technologies such as big data, the preservation approach has shifted from traditional rescue-based conservation to preventive conservation. For instance, the 'Cultural Relics CT Scanner' developed by the Shanghai Museum integrates multi-spectral imaging with generative adversarial networks, automatically identifying types of damage in paintings and calligraphy and generating restoration plans, thus improving the restoration efficiency of treasures like the 'Shangyu Post'; the China Silk Museum has built a digital gene bank for textiles, using federated learning technology to aggregate data from national institutions. AI algorithms can predict the light-aging patterns of over a hundred types of ancient dyes [5]; the Qin Shi Huang Mausoleum Museum has deployed an intelligent micro-environment monitoring system that integrates smart identification, the Internet of Things, AI, and digital twin technologies, providing cultural relics with 'electronic IDs' and enabling full-process automated supervision and traceability from storage, registration, retrieval, to release. [6]

3. The Practice and Application of AI Technology in the Art Education Industry

3.1. Assisting in Artistic Creation and Design

AI can leverage advanced technologies like Generative Adversarial Networks (GANs) and style transfer to help students quickly create artworks or design proposals. [7] For example, with the assistance of AI systems, students can input simple sketches or descriptions to create corresponding artworks based on historical art styles or the design styles of specific designers. Tools like DeepArt, MidJourney, and Artistic Style Transfer allow users to visualize their ideas quickly through AI-generated images, assisting in the creation of concept art, design materials, or complete artworks. Similarly, AI tools like Artificial Intelligence Virtual Artist (AIVA), Amper Music, and Google Magenta can rapidly generate music snippets, experimental sound effects, or even create entire musical compositions. [8] These real-time feedback and

creative support tools not only enhance learning outcomes but also stimulate students' innovative thinking.

3.2. AI-Assisted Art Therapy and Education

AI technology is reshaping the humanistic boundaries of art therapy and education, opening new dimensions for emotional healing and cognitive development. In the field of psychotherapy, generative art systems analyze patients' doodles and color preferences, automatically generating dynamic visual imagery to help children with autism establish non-verbal communication bridges. For instance, the virtual reality painting therapy system developed by New York University uses eye-tracking and brainwave analysis to capture emotional fluctuations in real-time as the patient creates art. It then adjusts the virtual environment's colors and composition through generative AI, significantly enhancing social expression rates in children with autism. Furthermore, this virtual reality healing theater allows patients with depression to control a digital avatar and immerse themselves in the flowing brushstrokes of Van Gogh's 'Starry Night,' reconstructing self-perception through the immersive experience. [9]

The innovation brought by technology is not only reflected in the efficiency of tools, but more importantly, it has endowed art with new humanistic significance. When AI technology transforms humanity's cultural heritage into interactive meditation animations, culture gains the power of modern healing, providing a deep interpretation of the human spiritual realm.

4. Exploring the Path of Bilateral Empowerment Between AI Technology and Schools

4.1. The Transformation of Museum Cultural Resources into Educational Resources

The transformation of museum cultural resources into educational resources is, in fact, a revolutionary migration of the knowledge production paradigm. This transformation is by no means a simple digital transfer; rather, it involves the encoding and recombination of cultural genes through technological mediation, ultimately reconstructing the educational ecosystem in the cognitive dimension. The path of this evolution reveals three deep-layered logics: from the deconstruction of material carriers' symbols to the intelligent reorganization of knowledge units, from linear transmission of authoritative narratives to multidimensional interactive cognitive networks, and ultimately pointing to a paradigm shift in the subject-object relationship of education.

4.1.1. From Material Entities to Cognitive Symbols

The educational potential of museum collections has long been constrained by the inaccessibility of their physical form and the closed nature of their interpretive systems. The intervention of digital twin technology allows cultural relics to break free from physical limitations and enter an editable state — the casting techniques of bronze vessels are deconstructed into parametric models, while the brushstrokes of calligraphy and painting are transformed into computable vector trajectories. This deconstruction process is essentially a technical peeling away of what Foucault refers to as the 'archaeology of knowledge': through high-precision scanning and multi-modal analysis, the craft codes, aesthetic paradigms, and social memories carried by artifacts are extracted into structured data units. [10]

When the cobalt ratio in Ming Dynasty blue-and-white porcelain became an adjustable variable, and the mineral pigments in the Dunhuang murals were analyzed through dynamic spectrograms, cultural relics evolved from mere cultural symbols into open fields of knowledge production. In this context, technology plays the role of a 'cultural gene sequencer,' transforming the traditionally experience-based, intuitive understanding of art into quantifiable and interactive educational elements.

4.1.2. Paradigm Shift of Educational Narrative

The generation of digital genes is merely the starting point of transformation; the real educational value lies in reconstructing the cognitive interface of knowledge dissemination. Traditional museum education follows a linear logic of 'artifact—label—explanation,' [11] while AI-driven educational narratives exhibit topological network characteristics: knowledge graph technology weaves discrete artifact nodes into a cross-temporal and spatial web of meaning. When the 3D data of artifacts are made accessible to the education system, curators, teachers, and students all become nodes in the knowledge network: historians extract ritual norms from bronze inscriptions, physics teachers turn their casting techniques into material science cases, and students reconstruct their understanding of the history of technology through virtual restoration practice. This distributed model of knowledge production transforms artifacts from being static historical specimens. The digital version of the Forbidden City's 'Along the River During the Qingming Festival' allows students to deconstruct the compositional logic and reorganize color relationships. It transforms the cultural authority's 'ultimate answers' into 'open questions' in the educational process, achieving knowledge reproduction through deconstruction and reconstruction.

4.1.3. Building the Meta-System of Cultural Cognition

The ultimate transformation is to elevate museum resources into a meta-tool for cultivating cultural cognition skills. Through digital technology, it converts static material civilization into a dynamic cognitive interface, shifting education from a tool for cultural inheritance to the main force in the

evolution of civilization. When students simulate ancient military formations through the digital avatars of the Terracotta Warriors, they are not just acquiring historical knowledge, but also training their spatial thinking and systems decision-making abilities; when AI transforms the banquet scene in the 'Night Revels of Han Xizai' into a sociological research sample, the aesthetic experience becomes a vehicle for critical thinking. This transformation echoes the idea that education should not stop at conveying the 'facts' of cultural relics, but should activate learners to reconstruct the 'creation' of civilization's context. [12] The construction of the meta-system requires not only twin technologies to establish a microscopic perspective of observation, but also the use of knowledge graphs to form a macro view of connections, ultimately turning each cultural fragment into a cognitive touchpoint that questions the essence of civilization, thus achieving a paradigm shift in education from 'teaching the known' to 'exploring the unknown' through technological empowerment.

4.2. Art Education Nourishes Cultural Connotations.

The reciprocal relationship between art education and culture is essentially the dialectical movement of the cognitive subject and the historical object in practice. This relationship is neither a simple transmission of culture nor a crude negation of values, but rather a dynamic exploration of culture's vitality through dialogue and interaction. In the educational process, culture is no longer a static, fixed object, but reveals its diversity and adaptability through interaction with people. AI technology not only provides new tools and methods for education but also opens up new possibilities for the dynamic transmission of culture. For example, on digital education platforms, AI can help students deeply understand the essence of classical literature through natural language processing and speech recognition technology, enhancing the learning experience with multi-dimensional presentations. [13] With the support of virtual reality and augmented reality technologies, students can personally experience historical events and cultural scenes, thus achieving a profound understanding and emotional resonance with culture in an immersive learning environment.

In this dynamic feedback mechanism, the core of culture maintains its vitality within the tension of deconstruction and reconstruction. Art education revitalizes cultural elements by reinterpreting, organizing, and transforming them in new contexts, thereby achieving the creative continuation of culture in the process. For example, when we reinterpret the ancient Mayan calendar using mathematical modeling, we not only preserve its scientific and systematic nature but also translate it into a language and methodology comprehensible to modern audiences. Similarly, when we reimagine Zen koans in theatrical form, we both inherit their profound philosophical essence and expand their interpretative space through a new artistic medium.

The ultimate mission of education is no longer to reduce culture to a collection of 'specimens' for display, but to create an environment where it can continue to grow. In this environment, culture is no longer static; it becomes an open, dynamic system. With the guidance and impetus of education, culture can constantly renew and enrich itself through its dialogue with real life, maintaining its eternal vitality. The core value of education is realized to its highest degree in this process, which is the creative transformation of culture that injects new vitality and possibilities into human civilization.

5. Future Trends and Risk Outlook

The mutual empowerment of museums and universities driven by AI will continue to deepen. Neural rendering and multimodal models will drive a qualitative transformation of cultural resources into programmable cognitive primitives. The integration of technologies like brain-machine interfaces may even reshape the perception paradigm in art education. Interdisciplinary collaboration will give rise to decentralized cultural innovation networks, transforming traditional civilizations into a global meta-language for dialogue. However, the deep risks such as the colonization of cultural perception modes by technological rationality and the dissolution of creative subjectivity through human-machine collaboration still require vigilance and reflection in the innovation process. [14] Only then can technology truly become a symbiotic medium for the survival of civilization rather than a deconstructive force.

6. Conclusions

The intervention of artificial intelligence technology has restructured the interactive logic between museums and higher education in the field of art, establishing a dynamic symbiotic system of mutual empowerment. The core value of this system lies in breaking the inherent boundaries between cultural resources and educational practice, allowing the museum's collection of cultural heritage to continuously generate a value cycle with educational cognitive innovation.

For higher education in the arts, AI technology has catalyzed the feedback of educational outcomes into cultural connotations. The creative data and cognitive trajectories generated during the teaching process continuously optimize cultural interpretation models through machine learning, expanding the interpretative dimensions of traditional art from a single aesthetic perspective to interdisciplinary cognition.

The deep cooperation between the two has fostered a new type of cultural ecosystem. The cultural authority of museums and the innovative educational dynamics are dialectically unified under the AI framework, with the former providing historically validated cultural genes for education-

al practices, and the latter injecting contemporary cognitive perspectives and technological innovations into cultural resources. [15] This bidirectional empowerment ultimately shifts cultural cognition from knowledge transmission to practical creation, while elevating art education from skill training to cultural innovation, thereby facilitating a transformation of the civilization inheritance mechanism for the modern era. In this process, AI technology acts both as a catalyst and a regulator, accelerating the modern transformation of cultural resources while preserving the core position of humanistic values. This deep integration of technology and humanity offers a new approach to tackling the crisis of cultural homogenization, breathing new life into traditional culture amid the digital wave, and also building an innovative platform empowered by technology for global civilizational dialogue.

Abbreviations

AI	Artificial Intelligence
GANS	Generative Adversarial Networks
AIVA	Artificial Intelligence Virtual Artist

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Conflicts of Interest

The authors declare no conflicts of interest.

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