
Digital Intelligence Technology Empowers the Realization of Aesthetic Education Functions of Northern Dynasties Cultural Heritage

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Abstract: The cultural heritage of the Northern Dynasties is an artistic crystallization from the initial stage of the formation of the Chinese nation's pluralistic and integrated pattern. Its vigorous and simple aesthetic characteristics and inclusive and open national spirit have irreplaceable educational value in contemporary aesthetic education. However, temporal and spatial barriers, professional boundaries, and the damage of cultural relics themselves often hinder the public's in-depth perception of these heritages. The intervention of digital intelligence technology has opened up a new path for the "vitalized" inheritance of cultural heritage and the full release of aesthetic education functions. Taking the grotto relics of the Northern Dynasties as the core case, this paper first analyzes their unique values in four dimensions: aesthetic enlightenment, historical cognition, cultural identity, and personality cultivation. Then, from four aspects—digital reproduction, immersive experience, innovative transformation, and collaborative communication—it systematically elaborates on how digital intelligence technology, with specific cultural relics as carriers, deeply activates aesthetic education functions. It aims to provide theoretical reference and practical enlightenment for the creative transformation of excellent traditional culture in the digital age.

Keywords: Digital Intelligence Technology; Northern Dynasties Cultural Heritage; Aesthetic Education Function

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1. Introduction

Aesthetic education is an important way to cultivate personality and refine sentiments, and the development of resources and innovation of forms have always been the core issues of educational practice. During the Northern Dynasties, China experienced unprecedented large-scale national integration and cultural exchange. The cultural heritage left during this period, whether the grand scale of Yungang Grottoes, the delicate expressions of Longmen Grottoes, the clay sculpture art of Maijishan Grottoes, or the stone scripture relics of Xiangtangshan Grottoes, all present unique aesthetic characteristics and profound cultural connotations. These heritages are not only precious samples of art history but also high-quality resources for aesthetic education teaching. In recent years, the rapid development of digital intelligence technologies such

as artificial intelligence, virtual reality, and 3D printing has provided new opportunities for the protection and inheritance of cultural heritage and the in-depth activation of aesthetic education functions^[1]. How to use digital intelligence technology to awaken the aesthetic education potential of Northern Dynasties cultural heritage and make the thousand-year-old cultural relics “speak” has become an urgent era topic for contemporary aesthetic education research.

2. Aesthetic Education Functions of Northern Dynasties Cultural Heritage

2.1. Aesthetic Enlightenment

The cultural heritage of the Northern Dynasties, with its unique aesthetic paradigm, provides an excellent field for contemporary people to train delicate perception. The Northern Wei Dynasty’s Little Monk statue in Cave 133 of Maijishan Grottoes is hailed as a model of the “Oriental Smile”. The statue has drooping eyelids and a slightly upturned corner of the mouth, constructing a unique expression system of “dignity with compassion, tranquility with a smile”^[2]. This subtle emotional expression not only reflects the aesthetic evolution of Buddhism’s localization but also implies the Northern Dynasties craftsmen’s profound insight into human nature. This aesthetic form has extremely high training value. It guides viewers to break rough viewing habits and comprehend artistic charm in details^[3]. In clay sculpture experience activities, children repeatedly ponder the impact of the distance between eyebrows and eyes on expressions. They find that: “only a 1-millimeter upward turn of the corner of the mouth makes the smile very different in appeal” and “the folds of the clothes should be as natural as flowing water”. This focus and perception of details are the core of in-depth training of aesthetic ability.

2.2. Historical Cognition

The cultural heritage of the Northern Dynasties carries the historical memory of national integration in an intuitively perceptible artistic form. As a representative imperial cave of the Northern Wei Dynasty, the Binyang Central Cave of Longmen Grottoes has symmetrically distributed musical apsaras around the lotus caisson on the cave roof. Each of these apsaras plays different musical instruments such as transverse flute, pan flute, ruan, zither, bronze cymbals, and waist drum, with fluttering clothes and swaying postures. These musical instruments include both traditional Central Plains varieties and styles introduced from the Western Regions, vividly reflecting the cultural integration scene after the Northern Wei Dynasty’s sinicization policy: the waist drum originated from India, the pipa has Qiuci musical elements, while the zither and ruan are typical representatives of Central Plains music. The coexistence of multiple musical instruments in the same cave is a visual testimony to the “exchange and integration of various ethnic groups” during the Northern Dynasties. Facing these relics, viewers are not only appreciating the elegant beauty of the apsaras but also perceiving the historical process of the formation of the Chinese nation’s pluralistic and integrated pattern through image details. When teenagers think about “why Tang Dynasty Buddha statues are more plump” and “how the lines of the apsaras’ streamers reflect mechanical beauty” during research studies, abstract historical knowledge is transformed into perceptible aesthetic experience^[4-6].

2.3. Cultural Identity

The cultural relics of the Northern Dynasties contain historical memories and emotional bonds of national integration. The “Six Beauties of Yungang” are a group of statues highly praised by Mr. Liang Sicheng. The six apsaras on the back wall of the main chamber of Cave 7 have simple and concise shapes and gentle and implicit expressions, which are very distinctive. This group of statues not only has traces of Gandhara art but also Chinese traditional aesthetic taste, and also reflects the Northern Wei artists’ high grasp of the texture of local silk fabrics^[7]; in contrast, the six-armed Asura statue in Cave 8, with its vigorous and bold image characteristics, contrasts with the gentle temperament of Cave 7, clearly reflecting the rich features of Northern Dynasties art. When we gaze at these statues, we see not only their beauty but also awaken our historical memories and resonate with them through them. This cultural identity based on aesthetics is more

infectious and durable than indoctrinative information dissemination.

2.4. Personality Cultivation

Since ancient times, Chinese aesthetic education has focused on shaping people's character. In the clay sculpture experience activity of the "Oriental Smile" at Tianshui Museum, young people gradually mastered techniques such as pinching, carving, and polishing after the teacher explained the basic process of pottery making. Some students who repeatedly revised their design drafts said: "I found that I can make the smile curve more beautiful by slightly modifying it." This is a spirit of striving for perfection, an embodiment of "craftsmanship"; this activity also reveals the design secrets of the Maijishan Grottoes architecture: for example, how the folds of the Buddha's clothes show a sense of movement, and how the white hair between the eyebrows shows spirit through the ups and downs of the clay sculpture. In addition to being amazed by the ancient people's skill of painting with clay, the children participating in the activity also cultivated concentration and patience during the practical experience^[8]. As the person in charge of the activity said, "letting these children personally feel the soil, cultural inheritance is no longer knowledge at the level of preaching, but their life experience". Therefore, the aesthetic education significance of the historical relics of the Northern Dynasties extends not only to the improvement of aesthetic level but also to emotions, values, and even behaviors. This is precisely the important connotation of "cultivating people through beauty".

3. Practical Paths for Digital Intelligence Technology to Empower the Aesthetic Education Functions of Northern Dynasties Cultural Heritage

3.1. Digital Reproduction to Restore Damaged Relics

After thousands of years of wind and rain erosion, many Northern Dynasties cultural relics have been severely damaged. Although the lotus caisson in the Binyang Central Cave of Longmen Grottoes is exquisite, it has a history of more than 1,500 years. Some of its colors have faded, the relief surface has serious cracks and weathering, and even the patterns are no longer clear. Therefore, how to let more people get a more comprehensive aesthetic experience on the basis of preserving historical authenticity has become the primary problem facing aesthetic education. The progress of digital technology has well solved this problem by providing a scientific restoration and reconstruction plan. Longmen Grottoes Research Institute, in conjunction with relevant institutions, adopted high-precision 3D data collection methods to collect data of the lotus caisson, and produced orthophotos and line drawings. On this basis, portable optical microscopes, X-ray fluorescence spectrometers, and Raman spectrometers were used to locate and identify faded parts and extract their color components^[9]. Finally, the foundation structure was completed and new colors were applied according to the decoration techniques of the Northern Wei Dynasty, restoring the decorative effect of the lotus caisson. After restoration, the plane size is about 30cm×30cm, and the apsaras and lotus flowers on it are vivid. Researchers further transformed the restoration results into animation films: carefully analyzing and disassembling the flying posture, costume patterns, and carried musical instruments, and completing each apsara figure one by one; under the guidance of professionals, an animation narrator was matched with various musical instrument sound effects to play a classical piece with era characteristics^[10]. This process shows that digital technology can not only restore the external form of cultural relics but also conduct in-depth interpretation through multi-party collaboration, reconstruct the aesthetic system of cultural relics, allowing the public to "see" the original appearance of works of art thousands of years ago and fully feel the artistic beauty of the apsaras in the Northern Dynasties.

3.2. Immersive Experience to Reshape Embodied Cognition

Yungang Cave 12, also known as the "Music Cave" or "Buddha's Music Cave", is a representative cave of the middle period of Yungang Grottoes, one of the "Five Flower Caves", and a core physical relic for the study of the history of Sino-foreign musical exchanges and the art system of the Northern Wei Dynasty. The cave is originally located in the

Yungang Grottoes group in Datong City, Shanxi Province, with a layout of front hall and back chamber. There are 53 existing musical figures, and the carved musical instruments cover 17 Chinese and Western varieties, which concentratedly reflect the integration characteristics of multiple civilizations along the Silk Road. The replicated cave of Yungang Cave 12 exhibited at Shanghai Qukan Art Museum is the world's first movable 1:1 scale 3D printed grotto replica, jointly developed and constructed by Yungang Research Institute, Zhejiang University Cultural Heritage Research Institute and other units. The replicated cave weighs about 30 tons, with a carved area of nearly 950 square meters. It adopts a modular design that can be disassembled like building blocks, and the on-site construction cycle is about 1 month, realizing the convenient transportation and touring exhibition of large-scale cultural heritage replicas. Its digital replication relies on 3D laser scanning and close-range photogrammetry technology to establish a millimeter-level precision 3D model, completely restoring the rock texture, statue details, and spatial scale of the original cave^[11]. As an important carrier of digital aesthetic education and cultural heritage activation, the replicated cave breaks the physical and spiritual distance between viewers and works of art in traditional aesthetic education, and constructs an embodied aesthetic cognition scene. Visitors can move freely in the cave, observe the three-dimensional form of the statues from multiple perspectives, and touch the surface texture of the replica, obtaining an immersive and interactive cultural experience that cannot be achieved in traditional exhibition modes. It provides a reference practical path for the popularization and communication of cultural heritage and the innovation of aesthetic education^[12].

3.3. Innovative Transformation to Activate Living Inheritance

Only by being close to contemporary life and deriving new forms in life can culture maintain its vitality forever. Digital and intelligent technologies can create conditions for the secondary development of Northern Dynasties cultural relics. Schools and teachers can explore the music and dance culture of the Northern Wei Dynasty and transform the music and dance elements in Yungang Grottoes into stage art works. For example, "The Dance of the Six-Armed God" created based on the six-armed Asura statue in Yungang Cave 8 combines light and human body to create a visual effect of "breaking boundaries"; "The Elegance of the Six Daisies" adapted from the six donor angels in Yungang Cave 7 interprets the beauty of sculpture with simple and plain movements^[13]. For example, the innovative and enlightening dance film "The Beauty of Yungang, Dancing Through a Thousand Years" took the film crew half a year to study Yungang Grottoes carefully, accurately capturing the fluttering nature of costumes and the charm of postures in Northern Wei sculptures, replicating the shape of sculptures on the dancers' bodies and conveying cultural meanings. Subsequently, photography techniques were used to realize the creativity of "a dialogue across a thousand years". Therefore, "A Dialogue Across a Thousand Years" was selected into the "Global Image Archives" of the UNESCO Digital Library for its special techniques of "turning historical cultural relics into living history" and "turning ancient paintings into contemporary paintings", becoming the world's first work that revives ancient stone carving art using dance imaging technology. The creative transformation from "static heritage" to "dynamic display" and from "cultural relics" to "digital resources" allows the heritage of Northern Dynasties culture to break through temporal and spatial limitations, integrate into contemporary people's aesthetic life in various forms, and truly realize living inheritance^[14].

3.4. Collaborative Communication to Expand Public Aesthetic Education

Giving play to the aesthetic education functions of cultural heritage is inseparable from public social participation and extensive communication channels. Digital technology has eliminated the barriers between museums, universities, and other social organizations, giving birth to a public aesthetic education paradigm with multiple subjects progressing together. For example, the supporting series of research activities of the "Smile Through a Thousand Years - Northern Wei Buddha Statue Art Exhibition in Tianshui Area" launched by Tianshui Museum mainly focuses on the "Oriental Smile" grotto culture exhibition, including four modules: "Crossing the Silk Road", "Approaching the Grottoes", "Carving Techniques", and "Clay Sculpture Techniques", receiving more than 10,000 teenagers. Luoyang Artists Association also actively organizes a large number of teenagers to sketch on-site at Longmen Grottoes, allowing children to paint ancient

Buddha statues with modern colors. Let children's paintings become a new form of discourse communication. The application of digital platforms has expanded the communication radius. "Longmen Grottoes Research Institute uploaded the dance apsara animation produced by themselves about the Binyang Central Cave of Longmen Grottoes online, so people can see the Northern Wei apsaras on the Internet^[15]." In two different locations, Peking University and Renmin University, the activity "The Beauty of Yungang, Dancing Through a Thousand Years" brought different experiences to people - intuitively feeling the "life on stones". Secondly, schools can widely offer the aesthetic education course "Interesting Cloud Tour", integrating all 3D printed replica data of grottoes into daily school teaching with a new model of "school-museum integration · classroom direct access", and designing a comprehensive plan of "classroom learning + museum practice". The goal of multi-channel publicity is to make full use of the integration of various resources and the cooperation of various platforms, change the previous limitations in understanding Northern Dynasties culture, truly achieve popularization, and become an aesthetic education textbook shared by all people.

4. Conclusion

With its vigorous and simple aesthetic characteristics and profound and inclusive cultural connotations, the cultural heritage of the Northern Dynasties has an irreplaceable unique value in contemporary aesthetic education. The development of digital intelligence technology has provided a historic opportunity to activate these thousand-year-old cultural heritage and release their aesthetic education potential. In the process of digital intelligence technology empowering the realization of the aesthetic education functions of Northern Dynasties cultural heritage, we should always adhere to two basic principles: first, respect the authenticity of cultural heritage. The application of technology should aim to better present the inherent value of cultural heritage, rather than overshadowing the main subject or arbitrarily modifying it; second, focus on human development. The fundamental purpose of aesthetic education is to promote people's emotional liberation and personality improvement, and the application of technology should serve this fundamental goal. Only in this way can the cultural heritage of the Northern Dynasties radiate new vitality in the digital age, and let the aesthetic wisdom spanning thousands of years continue to nourish the spiritual growth of generations.

Disclosure statement

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