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Research on the Digital Transmission of Cultural Heritage in University Art Education

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Abstract: In order to expand the mode of digital communication, promote the development of cultural heritage, and improve the art education mode of higher education, this paper discusses the strategy of integrating digital cultural heritage resources into the art education teaching system of local universities from the necessity of cultural heritage inheritance. Taking Shanxi architectural cultural heritage as an example, and combining it with the teaching practice of students majoring in environmental design in local universities, this paper studies how to use modern digital technology to integrate architectural cultural heritage elements into contemporary regional environmental design creation. It is further pointed out that it is of great significance to practice digital cultural heritage in the art education classroom, which is helpful in improving the teaching effectiveness of professional disciplines and effectively inheriting cultural heritage.

Keywords: Art education; Architectural cultural heritage; Digitalization; Inheritance

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1. The necessity of digital inheritance of cultural heritage in colleges and universities

1.1. Inheriting culture is the historical responsibility of higher education

China's excellent traditional culture is the foundation of our foothold in the world's national forest, and the uniqueness and superiority of universities make them the best institutions to inherit, develop, study, and protect traditional culture. This is because higher education determines the quality and level of cultural heritage, and the younger generation is the inheritor of excellent traditional culture. Only when the younger generation consciously realizes the importance of cultural heritage and is willing to pass it on, can we combine cultural heritage with modern science and technology, realize innovation on the original basis, and promote cultural heritage to keep pace with the times. At the same time, China, as a great country in literature and art, also needs to rely on stable art education to cultivate high-quality literary talents. At present, colleges and universities, as an important part of higher education in China, shoulder the great historical mission of inheriting cultural heritage and enhancing cultural self-confidence.

1.2. Digital inheritance of cultural heritage is an effective way to serve local communities

The idea of running a local university should be based on local conditions and serve the development of local economic and social construction. One of the important indicators to measure the level and success of running a school is whether it can better promote local economic development and social progress. Judging from the current social needs, firstly, through the technical means represented by digital technology, cultural heritage has been transformed into economic resources, creating favorable conditions for the large-scale integration of cultural industries and becoming a new social and cultural trend. Secondly, with the help of digital technology, we can repair, protect, and utilize cultural heritage more conveniently without direct contact, so that the protection and reuse of cultural heritage can be coordinated with the process of sustainable development in today's society.

1.3. Cultural heritage resources are the most important teaching materials for art education

Artistic creation is higher than life, but it comes from life. Cultural heritage resources are the bridge between art and life. They developed in the simplest and most primitive way, closely linked with people's lives, and showed obvious regional characteristics. These resources provide a rich source of inspiration for the development of artistic creation and design, and also provide valuable teaching materials for art education. However, with the continuous advancement of modernization and the strong impact of Western culture, traditional cultural resources have gradually lost their former glory, and many local cultural heritages are facing the embarrassing situation of disappearing.

Chinese culture is unique among all ethnic groups in the world and must be inherited and developed, but the role of higher education still has a long way to go. As a university that trains talent, it shoulders the great responsibility of protecting and inheriting cultural heritage. Art education in colleges and universities should encourage and guide students to inherit and preserve excellent cultural heritage resources through modern design. Therefore, only by improving our knowledge and understanding of excellent cultural heritage resources can we inspire more design inspiration and transform rich cultural resources into characteristic cultural industries with the help of digital technology.

2. Strategies for integrating cultural heritage resources into the teaching system of design disciplines in universities

2.1. Establishing a practice base combining industry, education, and research

The number and variety of architectural cultural heritage sites in Shanxi Province are enormous. According to statistics, there are 106 wooden structures from the Song and Jin dynasties in Shanxi Province, accounting for over 70% of the similar buildings in the country. The rich cultural heritage resources provide a rich teaching and research guarantee for local universities to establish high-quality cultural heritage practice bases. The establishment of cultural heritage practice bases promotes the digital inheritance of heritage and provides convenient conditions for digital protection and inheritance research. Digital information materials such as physical pictures of buildings and building components from different periods and videos of the production process can be directly collected on-site. The practice base can be integrated comprehensively to form a digital protection and inheritance research team consisting of "instructors + inheritors + students" [1].

2.2. Effectively connecting cultural heritage inheritance and digital design

The digital inheritance of cultural heritage first needs to address the relationship between cultural heritage and digital design. As early as the end of the 20th century, some well-known universities abroad, such as the Massachusetts Institute of Technology, the University of Southern California, and the AA Architecture School in the UK, began to study how to use digital technology to conduct architectural and interior design. In some key design-oriented universities in China, the application of digital technology has broken the limitations of creating renderings with computers and formed a complete digital information collection, information processing, three-dimensional model construction, and digital virtual interactive system digital process.

Architectural and environmental design face complex spatial forms. Through digital technology, people can flexibly modify and repeatedly refine design schemes during the spatial conception or production process. Universities should utilize their own professional technical advantages and jointly establish a digital resource library of architectural cultural heritage with the cultural heritage practice base. Through the digital collection system, information on architectural cultural heritage in all aspects can be sorted, collected, managed, and displayed, and corresponding digital archives can be classified and established. This not only realizes permanent preservation but also realizes the network sharing of resource information.

2.3. Promoting discipline construction through cultural heritage research

Discipline construction is the main indicator of a university's core competitiveness. Scientific research is the foundation of discipline construction and an important way to promote the progress of discipline construction. Universities should take discipline construction as the lead, gather characteristic discipline directions, and support with relevant research topics. Shanxi Province has abundant architectural cultural heritages, which provide geographical advantages for local universities to engage in related research activities. Encouraging and advocating local university teachers to actively participate in cultural heritage protection work and using digital technology means to deepen the depth and breadth of architectural heritage protection and inheritance through research projects. Through related research work, one can grasp the most cutting-edge academic frontiers of this discipline, thereby improving teaching and research levels.

2.4. Strengthening the professionalization of the teaching staff in the integration of industry and academia

Teachers are the main force in cultural inheritance. However, in the inheritance of cultural heritage, currently, university teachers' ability to conduct research on such cultural heritage projects or teach related courses is limited. The issue of insufficient teaching staff is a major bottleneck. To solve this problem, the practical bases established through school-enterprise cooperation can be utilized to establish relevant cultural heritage inheritance studios. Industry experts, folk artists, or cultural heritage project inheritors can be invited to the school for on-site skills demonstrations to promote the normalization of cultural heritage inheritance. It is necessary to support enterprise technical talents to teach at the school and encourage certain regions to explore the establishment of special positions for industry teachers (mentors).

3. Digitalization of architectural cultural heritage integrated into environmental design teaching practice

Integrating regional cultural heritage digitalization into professional course teaching has strong practical

relevance, guidance, and innovation. This article proposes adding this teaching content based on a comprehensive understanding of regional cultural heritage digitalization and social demands. Here, the main example is the architectural cultural heritage of Shanxi, and the teaching practice of related environmental design courses is analyzed [2].

This teaching process strictly follows the principles of progressive learning, theme presentation, and team collaboration, and divides the entire teaching process into four interrelated stages, namely, formulating distinctive themes, architectural context research, creative scheme conception, and digital technology expression.

3.1. Developing distinctive research topics: Dual focus on regional culture and digital technology

During the stage of formulating distinctive research topics, university teachers should, based on their respective research directions, select regional environments within Shanxi Province that have distinct traditional cultural characteristics as the design topics. For example, ancient villages, ancient architectural complexes, traditional dwellings, etc., are typical regional landscapes. Due to the uniqueness of Shanxi's natural and cultural environment, architectural remains in different regions show significant regional differences in terms of material selection, construction techniques, and spatial forms. In environmental design teaching practice, the key to integrating regional architectural culture lies in extracting typical elements of traditional architecture and applying modern design concepts creatively, thereby finding the convergence point between modernity and tradition. Teachers can systematically link the key teaching content of architectural heritage within Shanxi Province with various professional directions of environmental design. The specific approach is to divide students into four groups according to their professional directions. During the topic selection process, teachers should also encourage students to use geographic information systems and digital mapping platforms, such as Baidu Map API or Google Earth Engine, to conduct spatial overlay analysis of the distribution of heritage sites in different cultural sub-regions of Shanxi. This helps to determine the scope of the topic more scientifically. At the same time, AIGC tools (such as DALL E 3) can be used to generate topic imagery boards to help students intuitively experience the cultural atmosphere and spatial temperament of the topic [3].

3.2. Architectural gene research: Digital collection and systematic extraction of cultural genes

After the topic selection and student grouping are determined, teachers need to lead students to the actual site for systematic architectural gene research. Each group of students, based on their research focus and design direction, conducts targeted investigation activities. The focus of the research mainly lies in the natural geographical environment and historical background of the study site, including settlement spatial forms, architectural courtyard relationships, architectural form characteristics, decorative themes, and construction techniques. Teachers should guide students to learn to find regularity in differences and analyze the cultural genes, artistic concepts, folk customs, and construction techniques inherited by the architectural heritage, and based on this, conduct classification and summary. Students need to conduct detailed analysis of architectural heritage from multiple perspectives, identify and extract architectural cultural symbol features, and classify them according to the form and structure of the architecture, the content and source of graphic patterns, usage and cultural meaning, etc. This lays the foundation for subsequent digital summarization and refinement. At

this stage, the intervention of digital technology has become an indispensable part of the teaching process. Specifically, students can use drones and ground laser scanning equipment, such as DJI drones and laser radar systems, to collect point cloud data of the entire architectural complex and generate 3D models with millimeter-level accuracy. Using photogrammetry and texture mapping technology, with single-lens reflex cameras for multi-angle shooting, and with the help of software such as RealityCapture or Metashape, a 3D mesh model with real texture can be generated.

3.3. Creative conceptualization: Digital integration and contemporary transformation of traditional genes

The core task during the creative concept formation stage is to effectively integrate regional architectural cultural heritage with modern design thinking through digital technology. Students, based on their professional directions, conduct thorough research and explore the relevant regional architectural culture. Through refinement and reorganization, they incorporate it into contemporary environmental design [4]. Specifically, the group specializing in regional landscape design should focus on analyzing the planning concepts, spatial forms, and settlement forms of urban and rural settlements, absorbing inspiration, and using parametric landscape modeling tools (such as the Landscape Architecture plugin) to generate terrain and vegetation layouts, simulating the spatial patterns of traditional settlements with the concept of "negative shadow embracing positive light."

The group specializing in residential area space design should focus on the combination elements, spatial forms, and horizontal and vertical scales of Shanxi quadrangle courtyards, using generative design algorithms (such as Wallacei for Grasshopper) to automatically generate residential unit combination schemes that conform to the ethical principles of traditional quadrangle courtyards. Students specializing in regional architectural design should focus on analyzing the structural forms, building materials, load-bearing systems, and design features of Shanxi ancient buildings, using structural simulation software (such as Karamba3D) for mechanical verification, and generating lightweight and highly expressive contemporary wooden structure nodes using topological optimization techniques. The group specializing in interior decoration design should focus on the types, regional characteristics, and thematic features of various architectural decoration components and patterns, using AI image generation tools (such as ControlNet) to generate variant decoration schemes, and using parametric pattern generators (such as Tortuga) for style evolution and arrangement [5]. During the conceptualization process, digital technology auxiliary means play an irreplaceable role. Additionally, real-time collaborative design platforms, such as NVIDIA Omniverse or Rhino's collaboration plugins, can enable cross-professional and cross-regional synchronous modeling and review. During this period, teachers regularly organize presentation reports and digital reviews to encourage students to use real-time rendering and VR roaming to showcase interim results, thereby enhancing the perceived and persuasive power of the plan.

3.4. Digital technology expression: Comprehensive construction of immersive display and interactive systems

During the design conception and formation stage, students need to proficiently use various digital tools for digital expression and final output of the plan [6]. Traditional teaching software such as AutoCAD, 3ds Max, SketchUp, and Photoshop remain the foundation, but this stage emphasizes the popular immersive and interactive expression methods in recent years. Specifically, students should be able to use VR, AR, and MR

technologies for interactive display, import design models into Unity3D or Unreal Engine, construct VR roaming scenes, and users can freely walk and interact in the virtual space through HTC Vive or Meta Quest and other head-mounted devices. In augmented reality, design models can be superimposed onto the real environment using Vuforia or ARKit for on-site comparison and public display. Mixed reality collaborative review can utilize Microsoft Mesh or spatial platforms to enable multiple people to simultaneously enter the same mixed reality space to annotate, modify, and discuss the design plan. In real-time rendering and animation narration, students should utilize real-time rendering technologies (such as Lumen and ray tracing) to generate high-quality renderings and animated roams. Then, they should integrate these with Premiere or DaVinci Resolve for editing and music creation, to produce a complete narrative short film. Through these digital expression methods, students can not only complete high-quality design plans, but also master the entire digital technology process from data collection to interactive experience output [7]. This "immersive and interactive" teaching method significantly enhances the learners' sense of participation and achievement, solves the problem of traditional teaching software lacking sufficient human-computer interaction, has high authenticity and operability, can attract the learners' attention, has the characteristic of teaching through entertainment, and enables students to cultivate their learning interest more quickly.

4. Conclusion

To sum up, the integration of cultural heritage resources with contemporary environmental art design has great potential for development. The rich architectural heritage in Shanxi is not only a witness to history but should also serve as an inspiration source for creative concepts in university art education and a treasure trove of teaching resources. Conversely, modern art creation and design education can also become the driving force for the protection and inheritance of cultural heritage. In university art education, consciously integrating regional cultural heritage into teaching activities and utilizing rapidly developing digital technologies—including point cloud scanning, digital twins, AIGC, VR, AR, MR, real-time rendering, and blockchain—to extract, reorganize, and revitalize traditional architectural information can not only greatly expand the application and development space of cultural heritage resources, but also inject unprecedented technological vitality and interdisciplinary perspectives into modern art education. This "cultural inheritance + digital technology + design education" integration model has profound and significant implications for promoting the long-term development of university art education and cultivating interdisciplinary design talents adapted to the digital age. In the future, as artificial intelligence and spatial computing technologies further mature, the architectural cultural heritage of Shanxi will surely be integrated into environmental art design teaching in a more vivid, immersive, and interactive way, becoming a solid cultural bridge connecting the past and the future, the region and the world.

Disclosure statement

The authors declare no conflict of interest.

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