

Research on The Application of AI-assisted Campus Virtual Digital Environment Construction in The Infiltration Education of Aesthetic Education in Colleges and Universities

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Abstract

In the era of digital economy, the application of AI technology in the field of virtual digital environment construction and education is becoming more and more extensive, which provides a new path for the infiltration education of aesthetic education in colleges and universities. This study deeply explores how AI can help create a virtual digital environment, and analyzes the application path of this research in college aesthetic education. AI technology creates immersive cultural interaction situations and personalized learning resources through the display environment of three-dimensional virtual art culture, further enriches the communication channels and forms of culture and art, and promotes the intelligent development of aesthetic education.

Keywords

AI technology; virtual digital environment; aesthetic education in colleges and universities; infiltrative.

1. The Research Value of AI-assisted Virtual Digital Environment in The Field of Aesthetic Education in Colleges and Universities

The rise of virtual digital technology provides an innovative path for infiltrating aesthetic education. Immersive virtual reality technology enables learners to break through the limitations of physical space and deeply participate in the immersive experience of culture and art by constructing a highly simulated three-dimensional environment. For example, in the field of surgical education, researchers have verified the effectiveness of immersive learning on skill acquisition by simulating surgical scenarios with VR technology.

At the same time, artificial intelligence technology is reshaping the education model of colleges and universities through multiple dimensions. Its core value is to break through traditional restrictions and build an immersive learning experience space that integrates virtual and real. AI technology significantly enhances students' sense of participation by constructing interactive scenes of virtual and real integration, thus increasing their understanding and love of culture and art. The personalized learning path design supported by intelligent algorithms can dynamically adjust the presentation of intangible cultural heritage knowledge according to the cognitive level of learners. For example, in Yao costume education, AI virtual fitting system combines traditional pattern database to enable students to independently design costume patterns through digital interface, so as to deepen their understanding of aesthetics in interaction[1]. In addition, the application of AIGC generation technology in innovative design also shows unique value. By analyzing the composition rules of traditional patterns, music melody and other elements, it generates a new form design in line with cultural genes. This exploration is not only related to the development direction of traditional skills in the contemporary context, but also points to the innovation of education mode in the dimension of

cultural inheritance, and provides an important practical direction for the path innovation of aesthetic education infiltration education in colleges and universities.

In the infiltration education of aesthetic education in colleges and universities, the construction of virtual digital environment is to transform the technological process and cultural connotation of aesthetic education content into interactive virtual scenes through three-dimensional modeling and AI-driven narrative technology, so that learners can understand the inheritance logic of cultural genes in exploration[2]. Secondly, combined with augmented reality and mixed reality technology, the virtual elements are integrated with the real campus space to form an infiltration field of virtual and real symbiosis. For example, dynamic art projection is embedded in the campus landscape to strengthen the aesthetic penetration of the daily environment. Finally, relying on generative AI tools, learners can create digital art based on learning content, transform cultural cognition into innovative expression, and realize the transformation from passive acceptance to active construction.

2. The Innovative Application of AI Technology in Infiltrating Aesthetic Education in Colleges and Universities

2.1. The application strategy of AI in the infiltration education of aesthetic education

The deep intervention of artificial intelligence technology provides a systematic innovation path for the infiltration education of aesthetic education in colleges and universities. In the process of building a virtual digital environment, artificial intelligence technology has realized the transformation from traditional aesthetic education mode to intelligent education ecology through three core strategies : interactive experience optimization, data-driven decision-making and creative assistance. The technology-enabled multimodal interaction system can construct an immersive field of virtual and real integration, and dynamically adjust the multi-dimensional sensory stimulation intensity of vision, hearing and touch by capturing user behavior data in real time. For example, the virtual workshop of intangible cultural heritage technology based on AR / VR technology can generate the traditional process demonstration in real time, which is synchronized with the user 's operation. Combined with the force feedback device, the raw material texture is also returned, so that learners can obtain a near-real intangible cultural heritage experience in the digital space. This immersive interaction not only breaks through the time and space constraints of traditional aesthetic education teaching, but also deepens the cultivation of aesthetic perception ability through sensory collaborative stimulation[3].

The creative auxiliary function of artificial intelligence has opened up a new innovative dimension for aesthetic education. The traditional patterns are transformed into modern design language by style transfer algorithm, or the digital presentation effect of art and culture is optimized by reinforcement learning algorithm. For example, in the digital derivative creation laboratory, students can use AI tools to realize the parametric design of design modeling ; or inject modern rhythm elements into traditional folk music arrangement through emotional computing technology. This kind of technical empowerment not only reduces the technical threshold of creation, but also stimulates the awareness of cultural dialogue across time and space, and promotes students to form unique aesthetic judgment and innovative expression ability in digital practice.

2.2. The practical application of AI technology in virtual environment construction

The practical application of AI technology in the construction of intangible cultural heritage environment presents multi-dimensional technology integration and scene innovation. First of

all, through the deep learning algorithm, the historical background, process flow and cultural symbols of aesthetic education content are structurally analyzed. AI can build a three-dimensional visualization model and dynamically restore the historical context of culture and art. For example, in the drawing process of classical oil painting, AI system can integrate literature records, oral materials and physical scanning data to generate virtual restoration scenes including material evolution, tool iteration and artistic operation specifications, so that users can observe the inheritance of classical oil painting in different time and space dimensions. This data-driven environment reconstruction technology effectively breaks through the limitations of planarization and static in traditional display, and provides technical support for the reproduction of the original environment of culture and art. At the level of interactive experience, the collaborative application of AR and VR technology creates an immersive cultural and artistic field. Through sensor and space computing technology, the system can capture the user's action and gaze focus in real time, and dynamically adjust the light, sound and interactive elements in the scene. For example, in the digitization of sports events, the combination of intelligent sensor devices and motion capture technology has been successfully applied to virtual training scenarios. Users can master standard actions through gesture recognition and real-time error correction functions[4].

Data analysis technology provides a scientific decision-making basis for the optimization of inheritance path. By integrating project communication data, user behavior logs and cultural semantic networks, AI system can identify the popular trends, audience acceptance characteristics and communication bottlenecks of cultural and artistic elements. For example, based on the knowledge map constructed by community experts' experience, AI can predict the adaptation direction of skills in modern transformation, and recommend innovative schemes with cultural continuity for aesthetic education curriculum design. In the protection of indigenous cultural heritage, by analyzing the related data of traditional land use patterns and modern resource management, AI-assisted decision-making system can help the community to formulate sustainable development strategies in line with cultural values. The combination of this technology application and the principle of self-determination effectively enhances the autonomy and scientificity of traditional culture and art. The deep integration of technology and humanities will eventually promote the transformation of the environment from one-way display to co-creation and sharing space, and open up a more viable cultural inheritance path for aesthetic education in colleges and universities.

The virtual grotto aesthetic education project launched by Tsinghua University is based on cultural heritage such as Dunhuang grottoes, and builds a high-precision digital twin space through three-dimensional laser scanning and virtual reality technology. This technology system uses millimeter-level precision 3D scanning equipment to collect multi-angle data of grotto murals and sculptures, and combines ambient light field modeling to restore the light and shadow change characteristics of grottoes, and finally forms an interactive immersive virtual scene. In the process of project implementation, the research team pays special attention to the complete presentation of cultural information. It not only digitally restores the shape of cultural relics, but also analyzes the cultural connotation of elements such as clothing patterns and architectural structures in murals through AI algorithm, and constructs a multi-dimensional knowledge map. In teaching practice, students can freely shuttle through the virtual grotto space by wearing VR equipment, magnify the details of murals through gesture operation, and trigger hidden expert explanations and historical background materials. This embodied cognitive model breaks through the time and space constraints of traditional classrooms, enabling students to achieve a 'physical presence' experience of cultural heritage in a virtual environment.

The technological innovation of virtual aesthetic education project is not only reflected in the accuracy of spatial modeling, but also in the construction of a complete cultural inheritance

chain. The whole process design from data collection, intelligent analysis to educational application has realized the organic unity of digital preservation of cultural heritage, academic research and aesthetic education practice. In particular, its embodied interaction mode and personalized learning mechanism provide a new paradigm for solving problems in aesthetic education in colleges and universities. With the popularization of 5G and edge computing technology, the project plans to access more cultural heritage sites in the future, forming a virtual aesthetic education ecosystem covering multi-regional and multi-ethnic art treasures.

3. The Multi-dimensional Construction of Infiltrating Education

3.1. Construction of aesthetic education digital resource library

The construction of aesthetic education digital resource library is the core support for cultural inheritance and innovation in the infiltrating education system. Through systematic data collection and multi-dimensional resource integration, the resource library has formed a multi-modal cultural database covering text, image, audio and three-dimensional models. In the data collection stage, the combination of field investigation and digital scanning technology is used to record the traditional crafts, folk rituals and other projects in a panoramic manner, and a standardized data cleaning and classification process is established simultaneously to ensure the integrity and accuracy of information. By constructing a knowledge graph, the scattered elements are transformed into structured data, forming a multi-dimensional association network including technical process, cultural connotation, historical context, etc., which lays a foundation for subsequent intelligent analysis and teaching application.

The functional design of the resource library emphasizes the characteristics of interactivity and openness. Its core modules include project database, virtual experience platform, creative material library and collaborative communication space. The database adopts a multi-level classification system, supports multi-dimensional retrieval by region, category, inheritor, etc., and combines AI image recognition technology to realize intelligent labeling and similar retrieval of symbols. The virtual experience platform integrates three-dimensional modeling and augmented reality technology to transform static resources into interactive immersive scenes, such as restoring traditional craft production sites through digital twin technology, so that learners can understand the dynamic process of skills through virtual operations. The creation material library provides authorized digital materials such as patterns and music scores, and guides students to carry out secondary creation with the help of intelligent design tool chain. Collaborative space promotes cultural and artistic dialogue and resource sharing between teachers and students and between schools through functional modules such as forums and work display walls.

The deep integration of artificial intelligence technology has significantly improved the intelligent service level of the resource library. Natural language processing technology is applied to the semantic analysis of literature to automatically generate knowledge cards and teaching guide paths. The machine learning algorithm realizes personalized resource recommendation and learning progress tracking by analyzing user behavior data. At the content production end, generative AI technology can automatically generate cultural and artistic interpretation scripts according to the input theme, or combine traditional elements to generate design schemes that conform to modern aesthetics. This human-machine collaborative working mode not only reduces the technical threshold of resource development, but also stimulates learners' innovative thinking and enables them to explore new paths of activation in the collision between tradition and modernity.

The application of resource library in infiltrating education has formed a multi-dimensional teaching support system. At the level of curriculum design, teachers can build a modular teaching unit based on the resource library, such as setting up an interdisciplinary aesthetic

education course based on the digital resources of Dunhuang murals, and integrating art appreciation, historical research and digital creation. In practice, students carry out simulation training of skills through the combination of virtual and real scenes of the resource library, experience the production process of traditional crafts with VR equipment, or use the digital material library for cultural and creative product design. This deep participation significantly improves the immersion and practical effectiveness of learning. The resource library also provides a digital basis for teaching evaluation. By recording learning trajectories and creative achievements, an evaluation index system including dimensions such as cultural understanding and innovative practical ability is constructed to achieve accurate evaluation and continuous optimization of educational effects.

3.2. AI helps build a digital virtual campus

As an innovative practice carrier of infiltrating education, AI virtual campus constructs a cultural and artistic learning field of virtual and real integration through the deep application of artificial intelligence technology. Its core value lies in the use of three-dimensional modeling, virtual reality and augmented reality technology to transform the historical scenes, technical processes and cultural symbols of culture into an interactive digital space. The environment restores the physical characteristics and production process of the traditional process through high-precision modeling. For example, the principle of warp and weft interweaving in traditional weaving techniques is transformed into a dynamic demonstration module, so that students can intuitively understand the technical logic through virtual operation. At the same time, through semantic analysis technology, literature, image data and oral archives are integrated to construct a multi-dimensional cultural knowledge map and form a learning scene with a sense of historical depth.

The personalized learning support system analyzes students' behavior data and cognitive characteristics through machine learning algorithms, and dynamically adjusts the content presentation. The system first determines the students' cultural cognitive basis and interest preference through the initial evaluation, and then pushes the differentiated learning path. For example, for students interested in architecture, the system will give priority to the virtual workshop module of ancient building construction skills, and gradually unlock advanced projects such as mortise and tenon joint structure design and color painting drawing according to their operational proficiency. In terms of feedback mechanism, emotional computing technology can identify learners' expressions and micro-actions. When the system detects that students have a continuous interest in a skill, it will actively expand the multimedia content of relevant historical background and inheritance stories, forming an interest-driven knowledge extension model.

The comprehensive application of multimodal interaction technology further strengthens the immersion experience of culture and art. By combining the tactile feedback device of VR head display with the spatial sound system, students can not only observe the three-dimensional structure of art works, but also perceive the odor simulation of traditional dyes and the tactile feedback of production tools. In the study of opera art, motion capture technology transforms students' body language into the performance of virtual characters, and combines the virtual audience reaction generated by AI to form a complete stage immersion experience. The synergy of this multi-sensory stimulation enables students to understand the norms of skills in the virtual scene and to appreciate its social value as a cultural living inheritance.

The construction of this environment also reflects the deep integration of interdisciplinary education concepts. Its technical architecture integrates the research results of computer graphics, cultural digital protection and educational psychology, and the curriculum design integrates the dual dimensions of aesthetic education and technical ethics. At the practical level, AI virtual campus provides a scalable digital infrastructure for aesthetic education in colleges

and universities. It can not only adapt to the needs of different majors through modular design, but also support cross-school cultural co-creation projects through cloud collaboration platform. In the future, with the evolution of generative AI technology, the system is expected to further realize the intelligent reorganization and creative expression of design elements, and promote the creative transformation of traditional culture in contemporary education scenes.

4. Conclusion

The continuous innovation of artificial intelligence technology and the deepening and expansion of application scenarios in the future. At the technical level, with the deep integration of generative artificial intelligence, multimodal interaction and immersive virtual reality technology, the digital protection of culture and art will break through the static archival recording mode and turn to the intelligent construction of dynamic scenes. On this basis, combined with extended reality equipment and spatial computing technology, the immersive experience dimension of virtual environment will be further expanded to realize multi-sensory collaborative perception from vision, hearing to touch, so that learners can deepen their understanding and recognition of culture and art in embodied cognition, provide learners with a digital practice field of cultural and artistic skills, make the inheritance of traditional handicraft break through regional and time constraints, form a cross-generational and cross-regional collaborative innovation network, and promote the creative transformation of culture and art in the contemporary context.

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