

Research on the Construction of a Service System for Digital-Based Virtual Teaching and Research Groups: A Case Study on Empowering Rural Aesthetic Education Through the Development of Digital Virtual Teaching and Research Groups

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ABSTRACT

Addressing the challenges of resource imbalance, implementation barriers, and technological limitations in rural aesthetic education, this study proposes a systematic solution by developing a digital virtual research and development (R&D) room. Grounded in theories of educational equity and cultural responsiveness, the study establishes the technical framework for virtual R&D and aligns it with the cultural heritage aspirations of rural aesthetic education. It innovatively designs the following implementation pathways: creating a hybrid model that integrates remote collaborative resource centres with local cultural stations to address structural resource shortages; establishing multi-tiered R&D communities to mitigate spatial shortages of teaching staff; and developing an intelligent teaching platform tailored to rural contexts to overcome technical interaction barriers. Through the deep integration of resource reorganisation, teaching and research collaboration, and technological adaptation, this approach promotes the dynamic adaptation of aesthetic education to regional culture, enhances educational equity and cultural heritage effectiveness, and provides a model for aesthetic education support for the rural revitalisation strategy.

KEYWORDS

Digitalisation; Virtual teaching and research room; Rural aesthetic education

1 Introduction

Rural aesthetic education bears the dual mission of moral education and cultural heritage, and its development quality directly impacts the overall improvement of national aesthetic literacy. Currently, national aesthetic education policies are being continuously deepened, requiring educational institutions at all levels to enhance the effectiveness of aesthetic education implementation. However, constrained by the urban-rural dichotomy, rural aesthetic education has long faced systemic challenges of inadequate and uneven development. The global process of educational informatisation is accelerating, and the use of digital technology to promote educational equity has become an international strategic consensus. The practices of developed countries in leveraging virtual teaching and research networks to achieve comprehensive coverage of educational resources have validated the feasibility of using technological means to overcome geographical limitations. The in-depth implementation of China's education digitisation strategy has created the institutional foundation and technical conditions for building a new teaching and research mechanism. The practical challenges of rural aesthetic education are primarily manifested in the following aspects: the persistent shortage of professional teachers constrains course quality, the mechanisms for converting regional cultural resources into educational resources are weak, and a significant mismatch between technological applications and teaching scenarios. These contradictions reflect structural defects in resource allocation, course implementation models, and technological empowerment pathways. Although policy efforts have focused on promoting the rural coverage of "Internet+Education," issues such as insufficient cross-regional collaboration and lagging digital literacy development continue to hinder the effective release of technological efficacy. While existing research has achieved significant results in the technical implementation of virtual research and development rooms, it lacks practical models tailored to the unique characteristics of rural aesthetic education. Exploring how digital research and development mechanisms can activate the intrinsic motivation of rural cultural and educational resources has become a key focal point for advancing educational equity.

2 Core concepts and theoretical foundations

2.1 The concept of digital virtual teaching and research rooms

Digital virtual teaching and research rooms are a new educational organisation that uses network technology to reconstruct teacher professional development mechanisms. Their core function is to break through traditional teaching and research's geographical boundaries and time constraints. Technologically, they rely on intelligent resource scheduling systems to achieve stable transmission and localised teaching and research resources storage in low-bandwidth environments, establishing multi-level channels to circulate teaching knowledge. Teaching and research data undergo four stages—generation, integration, selection, and consolidation—among teacher groups, forming a cross-regional

professional wisdom circulation system. The organisational operational mechanism adopts a distributed collaboration architecture, using encrypted identification technology to record individual contributions and converting teachers' practical experience into a shareable digital resource repository. The key value of this model lies in continuously reducing teaching cognitive differences caused by geographical isolation, utilising the real-time feedback functionality of virtual spaces to correct teaching deviations, and ultimately constructing a supportive environment for teachers' autonomous development. From an educational technology philosophy perspective, this organisational form enables rural teachers to establish professional agency in the digital environment while maintaining local connections with on-site educational practices^[1].

2.2 Core demands of rural aesthetic education

The core demands of rural aesthetic education stem from the need for deep-seated adaptation between national standardised curricula and local cultural traditions. This is specifically manifested in the compatibility dilemma between a unified aesthetic evaluation system and local visual expression methods, necessitating the establishment of a teaching conversion mechanism for cultural resources. This requires structural transformation across the following dimensions: at the material level, transforming the mechanical principles embedded in tools of production and daily life into teaching materials for visual arts education; at the ritual level, extracting colour combination patterns from folk customs; and at the sound level, integrating the visual representation of dialectal rhythms. This process faces the inherent contradiction of translating cultural symbols into educational content. When traditional crafts are simplified into teaching resources, they risk losing the cultural memories they carry. Therefore, the essence lies in constructing a culturally resilient transformation framework. Through digital technology, the semantic system of traditional crafts is fully preserved, and craft parameters are converted into operable teaching variables. This enables educational adaptation while maintaining the integrity of the cultural core. This is an inevitable requirement for cultural inheritance and the practical foundation for democratising aesthetic education.

2.3 Theoretical support system

The theoretical framework is constructed based on the dialectical integration of cultural capital theory and modern learning theory. From the perspective of cultural capital, the root cause of the predicament of rural aesthetic education lies in the mainstream educational standards, which obscure the value of local knowledge. Virtual teaching and research rooms need to create a mechanism for cultural equality dialogue so that different aesthetic systems can obtain equal space for expression. Knowledge dissemination theory is developed into a three-tier transformation model: traditional crafts are digitally analysed to form foundational feature data, which is then professionally processed through the research and teaching network to convert into graded teaching parameters, ultimately forming teaching plans adapted to different cognitive levels. Educational care theory injects ethical norms into the system, requiring that technological assessments preserve the diverse interpretive spaces of culture. When students produce unconventional artistic interpretations, the system traces their intrinsic connection to local cultural logic rather than simply judging them. Under the guidance of the principle of spatial justice, this theoretical integration establishes a compensatory distribution mechanism for educational resources, achieving the goal of culturally responsive teaching through technological means. This involves the material transformation of teaching, the extraction of patterns from ritual behaviours, and the preservation of the meaning of symbolic systems, ultimately achieving the effective conversion of local knowledge into educational capital.

3 The current challenges facing rural aesthetic education

3.1 Structural imbalance in resource allocation

The imbalance in rural aesthetic education resources stems from the ineffective spatial allocation of cultural capital, resulting in multi-dimensional disconnects. Teacher mobility is constrained by personnel management systems, and the targeted deployment of urban professional teachers to rural areas faces dual obstacles: constraints related to title evaluation and appointment, as well as staffing quotas. This has led to a persistent shortage of professional aesthetic education teachers. The mechanism for converting material resources into educational content has structural defects. Although intangible cultural heritage possesses rich cultural connotation, it lacks an educational suitability assessment framework, making it difficult to convert into teaching content recognised by curriculum standards effectively. This creates a contradictory state where cultural resources are abundant but curriculum carriers are weak. Digital resource allocation faces compatibility obstacles. Mainstream educational cloud platforms are primarily designed based on urban network environments, resulting in significantly reduced video transmission stability in rural low-bandwidth scenarios. Compatibility with mobile devices also has notable shortcomings. Additionally, the one-dimensional resource allocation logic, such as standardised resource packages that ignore local cultural characteristics and replace traditional handicraft techniques with industrial standardised cases, disrupts the intrinsic continuity of cultural inheritance. This imbalance is fundamentally a systemic closure in converting cultural capital, which requires the reconstruction of resource allocation

mechanisms based on the principle of spatial justice^[2].

3.2 Systematic obstacles to teaching implementation

The challenges in teaching implementation stem from the conflict between the standardisation of the curriculum and the adaptation to regional culture. Specifically, at the curriculum design level, there is a mismatch in aesthetic paradigms between the realistic technique training required by the national curriculum and the symbolic expression of folk art. For example, textbooks often misinterpret the perspective rules in folk painting as technical flaws. At the instructional process level, the collective teaching system struggles to accommodate the personalised nature of traditional craftsmanship inheritance. Specific craft techniques requiring precise guidance can only be superficially observed in classroom settings. At the evaluation mechanism level, quantitative evaluation systems fail to capture aesthetic literacy's implicit development effectively. For instance, when students transform natural materials into artistic creations, their innovative thinking is simplified into technical scores. The deeper obstacle lies in the cognitive disconnect in teaching transformation. Teachers cannot decode cultural symbols, breaking down comprehensive cultural symbols into isolated visual elements, thereby undermining the cultural narrative function of traditional art, which uses form to convey meaning. This systemic imbalance is essentially the symbolic dissolution of local knowledge by modern educational paradigms, necessitating the establishment of a two-way channel for cultural translation.

3.3 Functional deficiencies in technology applications

The failure of technology applications stems from the profound disconnect between instrumental rationality and the educational context, primarily manifested in hardware-level pursuits of technological cutting-edge advancements at the expense of contextual applicability. Some immersive devices exhibit significantly reduced comfort levels in rural teaching environments and consume energy exceeding the capacity of existing infrastructure. Software design suffers from functional cognitive biases, with research and teaching platforms reducing instructional discussions to mere file transfer functions, failing to support the implicit knowledge transfer required for pedagogical innovation effectively. At the human-machine interaction level, there is excessive reliance on graphical interface operation logic, causing cognitive overload for experienced teachers navigating multi-level menus. Voice interaction systems exhibit significantly reduced recognition efficiency in dialect-speaking regions. This is primarily due to the urban-centric orientation of technological research and development, where digital tools are optimised for urban teaching environments but struggle to address the open-space acoustic and visual disturbances common in rural classrooms. This deficiency stems from the absence of technological ethics, where instrumental rationality suppresses the technical expression space for local knowledge. It is necessary to reconfigure the human-technology relationship through embodied cognition theory^[3].

4 Empowerment pathways for digital virtual teaching and research rooms

4.1 Innovation in resource integration mechanisms

The core of resource integration lies in establishing a spatial coordination and allocation system for cultural resources and constructing a collaborative operation model between remote resource centres and local workstations. The remote system adopts adaptive transmission strategies, dynamically adjusting content formats based on network conditions to prioritise the stable access of foundational teaching resources. Local workstations utilise cultural transformation mechanisms to reconfigure traditional craftsmanship elements into teaching materials, such as extracting spatial organisational patterns from craft processes to form formative training content, or integrating phonetic characteristics to convert them into musical teaching diagrams. Additionally, a cultural significance protection mechanism is established, where a review team composed of diverse stakeholders conducts substantive reviews of converted resources to prevent symbolic systems from being reduced to formalistic treatments. This system incorporates a principle of differential adjustment, allocating customised resource packages to special cultural regions, such as designing mobile resource carriers for specific cultural groups, thereby enhancing resource supply quality from basic coverage to alignment with cultural connotations. This mechanism fundamentally optimises the fairness of cultural resource allocation through institutional design^[4].

4.2 Reconstruction of the teaching and research community

The focus of reforming the teaching and research community lies in establishing a multi-tiered professional development system to transmit local knowledge effectively. Higher education institutions assume the role of cultural analysis, transforming the core elements of traditional crafts into applicable teaching parameters. Urban teachers serve as intermediaries in this transformation, utilising collaborative tools to reconfigure raw materials into age-appropriate teaching plans, creating tiered training content that includes operational guidelines. Rural teachers implement contextualised teaching validation, continuously refining teaching elements through practical feedback. The key lies in establishing intergenerational channels for experience transmission, leveraging assistive technologies to build teaching support systems, enabling teachers to receive real-time expert guidance videos at the teaching site, and facilitating the

practical application of tacit knowledge. This structure fundamentally represents the technological application of practical educational philosophy, achieving the intergenerational continuity of local knowledge through digital professional communities. The system incorporates a dynamic adjustment mechanism: when teaching effectiveness data is insufficient, cross-level discussions are initiated to create a professional growth environment that fosters continuous improvement.

4.3 Deepening technological integration

Technological integration is manifested in the balance between tool efficiency and humanistic value, establishing a technological application framework that aligns with cognitive principles. Distributed processing devices reduce system load and address infrastructure capacity constraints at the hardware level. A teaching behaviour analysis network is established at the software level, utilising dynamic recording technology to generate annotated videos of critical teaching segments, thereby creating a referenceable repository of demonstration resources. Dialect-adaptive command modes are developed at the interaction level, establishing a mechanism for mapping professional terminology to dialect equivalents to reduce technical operational barriers. Additionally, a cultural value assessment module is integrated. When the system identifies unique artistic interpretations, it automatically links to local cultural contexts to generate explanatory pathways, preventing single-dimensional evaluations from suppressing diverse expressions. This technological approach positions digital tools as supportive carriers for cultural continuity, ensuring technological practicality while respecting the expressive logic of local knowledge. By creating human-technology collaborative interactive interfaces, technological applications are transformed into media for artistic expression, ultimately achieving the organic unity of technological functionality and cultural value^[5].

5 Conclusion

This study addresses the imbalance in rural aesthetic education resources, implementation obstacles, and technological disengagement. It provides a framework for constructing a digital virtual teaching and research room based on spatial justice and cultural capital theory. Through dynamic hierarchical transmission of resources from a remote centre, cultural symbols can be translated into teaching materials at local stations. This can connect the practical chain of university analysis, urban transformation, and rural verification. Human-computer interaction barriers can be broken down through the development of dialect interaction modules and distributed hardware. This model can narrow the gap in aesthetic education resources between urban and rural areas, activate the agency of rural culture, and facilitate a qualitative leap in the effectiveness of aesthetic education from physical coverage to the preservation of cultural genes, providing a replicable, practical model for educational equity and rural revitalisation.

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