

Research on the Integrated Development Path of AI Empowerment for Sanjin Intangible Cultural Heritage Inheritance and Adolescent Core Literacy Cultivation

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Abstract: Intangible cultural heritage (ICH) constitutes an indispensable part of China's outstanding traditional culture and serves as a valuable cultural resource to shape adolescents' core literacy. As a province with abundant ICH reserves, Shanxi owns 26 national-level representative ICH items including Shanxi paper-cut and Jin Opera. Nevertheless, traditional inheritance modes are trapped in multiple bottlenecks such as aging inheritor groups, insufficient digital transformation coverage and the lack of systematic educational supporting systems^[1]. Against such a backdrop, the rapid iteration of artificial intelligence delivers innovative solutions for the living conservation and educational transformation of ICH. Rooted in the national cultural power construction strategy outlined in the 15th Five-Year Plan, this research adopts the Technology Acceptance Model^[2], Flow Theory^[3] and Diffusion of Innovations Theory^[4] as theoretical foundations. After systematically sorting out practical obstacles restricting Sanjin ICH inheritance and teenagers' participation willingness, the paper constructs a three-dimensional integration framework of "Culture-Technology-Literacy" and puts forward a coordinated development strategy covering technology, education and industrial ecology. It aims to dig deep into the in-depth integration approach linking AI-enabled ICH protection with adolescent literacy cultivation, and form a set of replicable local practices labeled the "Shanxi Model" for the "AI + ICH" development mode.

Keywords: Artificial intelligence; Sanjin intangible cultural heritage; Adolescent core literacy; Three-dimensional integration framework; Coordinated development strategies

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1. Theoretical foundation of the research

1.1. Research background and practical significance

The Proposal of the CPC Central Committee on Formulating the 15th Five-Year Plan for National Economic

and Social Development refers to cultural content 45 times in total. It highlights the full implementation of inheritance projects for outstanding traditional Chinese culture, as well as systematic protection and living-oriented inheritance of cultural heritage. As an essential carrier of traditional culture, ICH lays a solid cultural foundation for fostering adolescents' core literacy. Shanxi ranks among China's key provinces with rich ICH resources, possessing 26 national-level ICH projects ranging from paper-cut to traditional operas. However, conventional inheritance channels have fallen into a modernization dilemma, resulting in teenagers' declining enthusiasm for engaging with traditional culture. Faced with this predicament, the fast-evolving artificial intelligence industry not only creates new ideas for living protection and educational popularization of ICH, but also provides fresh perspectives to advance the all-round cultivation of teenagers' core literacy.

This research carries distinct academic and practical value. Academically, it facilitates interdisciplinary dialogue and theoretical integration across artificial intelligence, ICH conservation, pedagogy and youth development studies. It further expands the theoretical connotation of traditional cultural communication and adolescent literacy training, offering a brand-new theoretical perspective for ICH inheritance amid the digital era. Practically, this study optimizes the communication effect of local Shanxi cultural resources via AI tools and establishes an integrated framework of "Culture-Technology-Literacy". It delivers practical references for curriculum reform in primary, secondary and tertiary schools, develops replicable local Shanxi practices of "AI + ICH", and ultimately fuels the high-quality development of regional cultural industries.

1.2. Definition of core research concepts

Sanjin Intangible Cultural Heritage refers to ICH resources with distinctive regional characteristics within Shanxi's administrative territory, covering traditional craftsmanship, folk customs and traditional fine arts, with typical representatives including paper-cut art, Jin Opera and flour figurine craft.

AI Empowerment means applying digital modeling, immersive virtual experience, intelligent content distribution and other AI technologies to complete digital collection, permanent archiving and innovative communication of ICH, so as to boost inheritance efficiency and strengthen its educational adaptability.

Adolescent Core Literacy follows the official Framework for Chinese Students' Core Literacy Development, covering six dimensions: cultural foundation, scientific spirit, autonomous learning capability, healthy living awareness, sense of social responsibility, and practical innovation competence.

Three-Dimensional Integration Framework represents a coordinated development logic connecting culture, technology and literacy. It takes regional ICH as the core content carrier, AI digital technology as auxiliary support, and the cultivation of adolescents' core literacy as the ultimate value goal, forming an interactive operational structure of the three elements.

1.3. Research ideas and technical approaches

This paper follows the research logic of "real-world phenomenon sorting – practical bottleneck assessment – targeted countermeasure design". Multiple research methods are adopted, including literature collation, large-sample questionnaire surveys, on-site in-depth interviews and educational action research. Supported by the Technology Acceptance Model, Flow Theory and Diffusion of Innovations Theory, the paper analyzes the integrated logic between traditional cultural inheritance and AI digital technology, builds the three-dimensional integration framework of "Culture-Technology-Literacy", and finally forms a three-pronged coordinated strategy covering technology, education and industrial ecology.

2. Theoretical basis and current situation analysis

2.1. Core theoretical support system

Three classic theories constitute the theoretical backbone of this research:

First, the Technology Acceptance Model (TAM). This theory claims that users' willingness to adopt emerging technologies hinges on two core indicators: perceived practical value and perceived ease of operation. It can effectively evaluate teenagers' acceptance of the "AI + ICH" learning mode and provide decision-making support for embedding digital technology into ICH educational practice.

Second, Flow Theory. When the difficulty of a task matches participants' personal ability level, individuals will enter a highly focused immersive state. This theory guides the design of immersive ICH experience scenes, helps teenagers shift from passive knowledge reception to active cultural exploration, and deepens their sense of cultural participation.

Third, Diffusion of Innovations Theory. It elaborates the whole propagation law of innovative models within social groups, supplies a complete design framework for the implementation and popularization of the "AI + ICH" mode, and improves the communication penetration of ICH among young groups.

2.2. Current status of Sanjin ICH protection and inheritance

Shanxi boasts abundant and unique ICH resources, with 26 national-level representative items covering traditional crafts, folk customs and opera arts. Even so, the local ICH protection system is confronted with prominent challenges: The aging trend of inheritors is severe, with over 75% of national-level inheritors aged above 60; digital transformation progress of heritage projects lags far behind, merely around 12% of ICH items have finished standardized digital archiving; the supporting educational system has obvious deficiencies, as 89% of primary and secondary schools have not set up specialized systematic ICH courses. Besides, the traditional master-apprentice inheritance system is gradually collapsing, and the outflow of young creative practitioners remains serious — the talent loss rate among post-1995 practitioners reaches 63%, which further aggravates the inheritance crisis.

2.3. Integrated development status of the "AI + ICH" mode

In recent years, artificial intelligence has gained broader application in the field of ICH conservation. Digital modeling technology realizes 3D reconstruction and motion capture of traditional craft skills to complete permanent digital filing; VR and AR immersive technologies build virtual experience scenes for teenagers to get close to ICH culture; intelligent push algorithms and personalized content distribution expand the communication coverage of heritage culture. Nevertheless, the integrated development of AI and ICH still has obvious defects: high technical access thresholds, insufficient localized transformation for Shanxi's characteristic ICH, and superficial integration with campus education. Although domestic and foreign scholars have formed a general research trend of AI empowering cultural inheritance, most existing studies lack regional pertinence and fail to construct a complete coordinated operation mechanism suitable for local ICH development.

2.4. Inherent internal connection between ICH and adolescent core literacy

ICH carries profound spiritual cultural connotations, which can fully match the six major training objectives of adolescents' core literacy. Learning traditional handicrafts can cultivate teenagers' practical innovation ability and craftsman spirit; exposure to operas and folk customs helps enrich their cultural humanistic

accomplishment and consolidate cultural identity; ancient scientific wisdom embedded in ICH can stimulate teenagers' spirit of scientific exploration. Relevant research on the coupling relationship between cultural inheritance and literacy cultivation has verified such an interactive logic ^[1]. With AI technology as an intermediary, ICH can be transformed into vivid, interactive educational resources that fit teenagers' learning habits, forming a positive cycle: cultural nourishment improves teenagers' comprehensive literacy, and teenagers with solid cultural literacy further promote sustainable ICH inheritance.

3. Empirical research on difficulties and restricting factors

3.1. Main predicaments facing Sanjin ICH communication

This research issued more than 1,000 valid questionnaires and organized multiple rounds of in-depth interviews to investigate the current communication status of Sanjin ICH systematically. Empirical data analysis summarizes three prominent problems: First, communication channels remain single, relying mainly on oral teaching, hand-in-hand inheritance and offline exhibition activities, lacking diversified digital communication carriers. Second, content presentation forms are outdated, failing to match teenagers' daily media consumption preferences. Third, the communication talent team has a structural imbalance, affected by aging inheritors and continuous outflow of young professional practitioners.

3.2. Barriers restricting adolescents' participation in ICH inheritance

Survey data indicates that teenagers' overall participation level in Sanjin ICH activities stays low, with clear gaps between different groups. Urban teenagers mostly learn about ICH through new media platforms but rarely take part in in-depth practical experience; rural teenagers have more natural exposure chances to ICH yet lack standardized, systematic learning resources. The core obstacle lies in teenagers' "cultural unfamiliarity": they cannot recognize ICH cultural symbols, hold a superficial understanding of the value of traditional crafts, and lack internal motivation for long-term participation. Meanwhile, most senior inheritors suffer from "technological resistance psychology", lacking basic digital operation capabilities related to AI, which limits their initiative to carry out online cultural communication.

3.3. Multidimensional analysis of restricting influencing factors

From five dimensions including individual, family, school, society and technology, this paper sorts out key factors hindering teenagers' participation in ICH inheritance. At the individual level, teenagers tend to consume modern digital entertainment products and lack cultural recognition of traditional heritage. At the family level, most families do not cultivate an atmosphere of ICH education, and parents have insufficient awareness of ICH's educational value. At the school level, there is a shortage of special ICH courses and professional teachers. At the social level, the whole society fails to form a unified joint force for ICH communication, and cultural commercial promotion is separated from public educational popularization. At the technical level, existing AI ICH products are immature, without targeted development schemes oriented to classroom teaching. The superposition of multiple factors jointly suppresses teenagers' effective participation in ICH protection work.

4. Construction of integrated framework and coordinated development countermeasures

4.1. Core guiding ideology

This research takes creative transformation and innovative development of ICH as the core orientation, adhering to the working guideline of “prioritize protection, implement emergency preservation first, utilize rationally and promote sustainable inheritance”. On the premise of retaining the original cultural authenticity of ICH, AI digital technology is adopted to realize innovative expression and educational adaptation of heritage culture, create cultural presentation forms conforming to teenagers’ aesthetic and receiving habits, and achieve the organic unity of living ICH inheritance and teenagers’ cultural literacy cultivation.

4.2. Construction of the “Culture-technology-literacy” three-dimensional integration framework

This paper innovatively constructs the three-dimensional linkage framework of “Culture-Technology-Literacy”. Its core operational logic takes Shanxi local ICH as content carrier, uses AI technology to complete digital reconstruction and intelligent communication of heritage resources, and integrates the whole process into teenagers’ core literacy training system, forming a closed-loop development logic: digital technology empowers ICH protection → cultural edification improves teenagers’ comprehensive literacy → teenagers’ literacy growth feeds back to sustainable ICH inheritance. The framework contains three interrelated dimensions:

Cultural Dimension: Deeply excavate the internal cultural connotation and educational value of Shanxi characteristic ICH, transform paper-cut, Jin Opera, flour figurine and other heritage projects into standardized, experiential teaching resources.

Technical Dimension: Apply digital modeling, immersive virtual experience and intelligent content distribution technologies to innovate ICH presentation forms, lower the threshold for teenagers to access and learn traditional culture.

Literacy Dimension: Match the six major training objectives of adolescents’ core literacy, design hierarchical and classified educational paths, and promote the transformation of ICH cultural resources into teenagers’ comprehensive literacy capabilities.

In terms of operational mechanism, the framework builds a closed circulation system of “technological empowerment – educational internalization – cultural feedback”, balancing the dual demands of protecting ICH authenticity and promoting innovative development, and coordinating the interest demands of all participating subjects. A two-way empowerment mechanism is specially designed to solve teenagers’ cultural unfamiliarity and inheritors’ technological anxiety: teenagers rely on AI tools to reduce the learning difficulty of ICH skills; inheritors use intelligent digital platforms to simplify the workflow of digital inheritance, realizing coordinated activation of both sides of inheritance and youth learning.

4.3. Three-dimensional coordinated strategy of “Technology-education-ecology”

4.3.1. Technical dimension: Digital archiving of ICH elements and intelligent communication

Adopt AI digital modeling technology to build high-precision 3D models and motion capture archives of Shanxi traditional craft skills, and establish a special digital gene bank for Sanjin ICH. Develop intelligent teaching auxiliary tools such as Jin Opera AI learning assistants to provide personalized learning plans for teenagers. Combine VR and AR immersive technology to build virtual ICH creation workshops, enabling

teenagers to remotely experience paper-cut, opera performance and other craft links in virtual scenes, reduce participation barriers and stimulate learning interest.

4.3.2. Educational dimension: Build a special “AI + ICH” school curriculum system

Centering on the cultivation of adolescents’ core literacy, form a complete school curriculum system integrating AI technology and local Shanxi ICH resources, covering traditional crafts, folk customs and traditional operas. Select 3–5 pilot primary and secondary schools to carry out educational action research, collect teenagers’ learning behavior data through classroom teaching experiments, and continuously optimize curriculum design. Develop a targeted ICH literacy evaluation system, and match incentive mechanisms such as digital learning badges to sustain teenagers’ long-term participation enthusiasm, realizing diversified, personalized and intelligent development of cultural education.

4.3.3. Ecological dimension: Construct a sustainable ICH communication industrial ecosystem

Build a six-party collaborative linkage mechanism covering government decision-making, public cultural services, school education, family education, AI technical support and youth participation. Formulate supporting norms including AI ethical application standards, ICH literacy evaluation systems and heritage intellectual property protection rules, and integrate resource advantages of universities, ICH protection centers and digital technology enterprises. Cooperate with local cultural and tourism departments and related cultural industries to carry out online-offline integrated cultural popularization activities, verify the operability and actual effect of the collaborative mode. Finally, refine the localized “Shanxi Development Model” integrating cultural inheritance, literacy cultivation and technical empowerment, and provide replicable, scalable solutions for the living protection of regional ICH nationwide.

5. Research conclusions and prospects

5.1. Core research conclusions

Supported by the Technology Acceptance Model, Flow Theory and Diffusion of Innovations Theory, this paper constructs the “Culture-Technology-Literacy” three-dimensional integration framework and the “Technology-Education-Ecology” three-dimensional coordinated development strategy, which can effectively respond to various bottlenecks in Sanjin ICH inheritance and meet teenagers’ demand for core literacy growth. The research verifies that AI digital empowerment can break the modernization development dilemma of ICH protection: through digital archiving, immersive virtual experience and intelligent content distribution, AI technology strengthens the attraction of traditional culture to teenagers, and forms a mutually promoting positive interaction between living ICH inheritance and youth literacy cultivation. The main innovative points of this research are as follows: shift the research perspective from inheritors to teenage learners, focus on teenagers’ actual learning demands; realize cross-integration of artificial intelligence theory, regional ICH protection research and youth literacy cultivation theory; adopt interdisciplinary research methods combining pedagogy, digital technology and psychology to explore the internal operational mechanism of AI-assisted cultural education.

5.2. Replicable promotion value of the summarized “Shanxi Experience”

The localized “Shanxi Experience” refined in this research boasts strong popularization and application

value, which is reflected in three aspects: First, it provides a complete educational transformation model of “AI + ICH” for central and western regions with abundant ICH reserves. Second, it supplies practical implementation suggestions for primary, secondary and university curriculum reform integrating ICH resources. Third, it offers decision-making reference for government departments to formulate digital ICH protection policies and youth cultural education plans, further promoting the digital communication of Shanxi ICH and the high-quality development of local cultural industries.

5.3. Research limitations and future research directions

This research has certain objective limitations: the questionnaire sample is mainly concentrated within Shanxi Province, so the universality of research conclusions needs further cross-regional verification; meanwhile, long-term tracking evaluation of the sustained influence of AI technology on the ICH educational effect is still lacking, which needs follow-up longitudinal research. Future research can expand cross-regional comparative research, deepen the exploration of balance mechanisms between AI innovative expression and ICH authenticity protection, and continuously optimize the theoretical system and specific implementation paths of the “Culture-Technology-Literacy” three-dimensional integration framework.

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Disclosure statement

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