

From Technical Adaptation to Ecosystem Construction: A Three-Dimensional Analysis of DeepSeek-Driven Digital Dissemination of Intangible Cultural Heritage

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Abstract

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Full Text

From Technology Adaptation to Ecological Construction: A Three-Dimensional Analysis of DeepSeek Driving the Digital Dissemination of Intangible Cultural Heritage

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Abstract:

[Objective] This study explores the pathways and mechanisms through which AIGC technology drives the digital dissemination of intangible cultural heritage (ICH) to address its inheritance dilemmas.

[Methods] From a technology adaptation perspective, this research employs literature review and case analysis to systematically investigate practices and applications across three dimensions: content production, interactive experience, and channel adaptation.

[Results] The study constructs a “technology-culture collaboration” optimization mechanism: ensuring content accuracy through dual-track review, strengthening cultural orientation to integrate ICH core values, and developing lightweight tools to promote inclusive applications.

[Limitations] Technological empowerment faces challenges including content accuracy deviations, insufficient depth in cultural expression, and limited technological inclusivity, necessitating precise coupling through typological adaptation.

[Conclusions] This mechanism provides a paradigm for AIGC to empower the cultural domain, facilitating the creative transformation and dynamic inheritance of intangible cultural heritage.

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Keywords: Artificial Intelligence Generated Content (AIGC); DeepSeek; Intangible cultural heritage; Digital communication; Knowledge service

1. Practice Path: Communication Innovation Based on Knowledge Services

1.1 Content Production: From Historical Documentation to Creative Transformation

The core of digital ICH dissemination lies in reconstructing cultural scenes through modern narrative logic, a process that must rely on rigorous historical research rather than fictional creation. AIGC technology, represented by DeepSeek, operates through a generative adversarial network mechanism where “the generator’s goal is to deceive the discriminator by producing samples similar to real data, while the discriminator must successfully distinguish whether data is real or generated by the generator” [1]. This dynamic game mechanism enables the system to generate content that conforms to cultural norms while meeting dissemination demands after learning from vast amounts of ICH historical materials.

In the realm of textual creation, traditional ICH documents are often too specialized for general audiences. Taking guqin art as an example, records in *Qin Shi* and *Xishan Qin Kuang* consist mainly of fragmented allusions and tech-

nical descriptions. AIGC technology can transform these materials into well-structured narrative texts through semantic decomposition and recombination. The logic involves first establishing audience connection through emotional resonance points, then analyzing specialized knowledge from interdisciplinary perspectives, and finally achieving dialogue between history and reality through contemporary practice cases. This transformation does not constitute alteration of historical materials but represents reasonable reconstruction based on documentation, preserving the cultural core while enhancing readability. In Kunqu text processing, the system can modernize annotations of traditional lyrics according to the metrical requirements in *Qu Lü* while supplementing details with performing artists' practical insights, making textual expression more aligned with modern audiences' cognitive habits.

For visual presentation, technology application must be premised on ICH formal specifications. Patterns such as the "Butterfly Mother" motif in Miao silver jewelry and the "Mandala" designs in Tibetan thangka have explicit cultural regulations. Generative models must learn from extensive data of authentic artifacts before they can produce visual materials that meet specifications. The technical logic involves the generator creating candidate content by imitating the structural features and symbolic systems of real patterns, followed by the discriminator verifying against original data, ultimately outputting visual results that maintain cultural accuracy while adapting to different application scenarios. This mechanism ensures that core cultural symbols remain intact during simplification or stylization.

Audio transformation similarly follows data-driven generation logic. The digitization of Mongolian long-tune "Nugula" singing and Fujian nanyin gongchepu notation both rely on extensive real audio samples as training foundations. The system constructs audio generation models that conform to traditional aesthetics by extracting key parameters such as "laryngeal vibration amplitude" and "breath interval duration." When a Fudan University professor evaluated DeepSeek's imitation of Wang Bo's *Tengwang Pavilion Preface* in writing *Shanghai Chenghuang Temple Preface*, he marveled that it "produced text quickly and could preserve the original fu's sentence patterns and rhymes, though the final product still had certain flaws in details" [2]. This phenomenon also exists in ICH audio generation, with issues such as pitch matching deviation or improper rhythm processing requiring correction through manual verification mechanisms. Nevertheless, its efficient generation capability significantly reduces time costs for content production, providing feasible solutions for ICH projects with limited resources.

1.2 Interactive Experience: From Passive Reception to Immersive Participation

Under the digital intelligence-driven paradigm, the social functions of information resource management are transitioning from traditional resource provision to knowledge service innovation, social problem-solving, and cultural ecology

construction, while information acquisition patterns shift from “search-filter” to “question-generate” [3]. This trend revolutionizes interactive experience models in ICH dissemination. By reconstructing experiential scenarios through intelligent interaction technology, audiences can transform from passive recipients to active participants, with the core principle being the empowerment of knowledge services rather than mere formal innovation.

The construction of intelligent Q&A systems is based on authoritative knowledge bases, with the operational logic converting ICH classics and technical specifications into interactive knowledge units. In guqin teaching scenarios, for questions such as “the correspondence between hui positions and harmonics,” the system can precisely retrieve original texts from *Qinxue Rumen* and *Chuncao Tang Qinpu* while providing practical recommendations combined with audio analysis data. This service model breaks the spatiotemporal limitations of traditional knowledge dissemination, enabling audiences to obtain customized information according to their needs, aligning with the new “question-generate” information acquisition paradigm. Its value lies not only in improving knowledge transmission efficiency but also in strengthening audience learning experiences through instant feedback, promoting the transformation of ICH knowledge from unidirectional instillation to bidirectional interaction.

The core of virtual scene interaction lies in constructing experience spaces based on cultural logic. Scene designs such as virtual exhibition halls for Suzhou garden construction techniques and Miao silver jewelry virtual workshops are grounded in the technical processes and cultural connotations of ICH, guiding audiences to understand the knowledge systems through 3D modeling and interactive design. These scenarios do not simply replicate physical spaces but reconstruct cultural cognitive paths through technical means, enabling audiences to explore the deep values of ICH from multiple dimensions. For instance, in garden virtual scenes, audiences can observe the spatial principles of “changing scenery with every step” by adjusting perspectives, or understand the mechanical balance in garden construction techniques by modifying parameters. Such interactive design transforms abstract cultural knowledge into perceptible experiences, significantly enhancing cognitive efficiency.

Personalized recommendation mechanisms achieve precise content delivery through matching algorithms that analyze user behavior and ICH knowledge graphs [3]. The system can push corresponding knowledge units based on different audience groups’ cognitive characteristics and needs. This hierarchical service model reflects the refinement trend of knowledge services, representing an extension of information resource management functions—from simple resource aggregation to knowledge reproduction based on user needs—enabling ICH culture to more widely integrate into different groups’ cognitive systems by reducing knowledge acquisition costs.

1.3 Channel Adaptation: From Single-Channel Dissemination to Cross-Media Integration

Breaking ICH dissemination out of its niche requires constructing a multi-channel coordinated communication network. While different platforms' characteristics determine differentiated content forms, the core principle is achieving consistent cultural value transmission through technology empowerment. Scholars from the Military Academy of Military Science Information Research Center argue that GAI "promotes societal transformation toward a deep knowledge society by reducing knowledge acquisition costs and enhancing cognitive efficiency" [4], a feature of crucial significance for dismantling knowledge barriers in ICH dissemination.

Content production for short video platforms must follow the principle of "lightweight expression," achieving effective transmission of cultural symbols within limited duration by extracting core features of ICH techniques. The key lies in balancing technical presentation with cultural connotation, such as demonstrating Su embroidery's "thread splitting" process through cinematography that highlights the technique's precision while conveying the craftsmanship spirit through concise narration. This content design does not simply compress technical processes but represents knowledge reorganization based on platform dissemination patterns, enabling audiences to establish a cognitive framework for ICH within short timeframes and laying foundations for further exploration.

Long video platforms focus on constructing systematic knowledge systems, achieving layered ICH transmission through in-depth analysis. Taking Kunqu art dissemination as an example, content design can unfold across three dimensions: vocal evolution, performance techniques, and cultural connotation, constructing complete knowledge chains through literature citation, audio comparison, and expert interpretation. This dissemination model's value lies in providing audiences with pathways for in-depth exploration, enabling them to autonomously choose cognitive depth according to their interests, reflecting the deep knowledge society's demand for refined knowledge transmission.

Cross-border derivatives represent an important path for ICH culture to integrate into modern life, with the core being formal innovation while maintaining the cultural kernel. ICH applications in games, digital collectibles, and other fields require creative transformation based on full understanding of cultural symbol meanings combined with carrier characteristics. This transformation does not constitute simple appropriation of traditional elements but extends ICH value into new scenarios through matching cultural logic with carrier features. For example, applying Miao silver jewelry patterns in game decoration requires balancing the patterns' symbolic meanings with game visual aesthetics, representing technology's capacity for deconstructing and reconstructing cultural symbols, and reflecting the functional shift of information resource management toward cultural ecology construction.

Through multi-channel dissemination and innovative practice, ICH culture can break through traditional boundaries and achieve broader value transmission in the digital era. In this process, technology's role lies not only in improving dissemination efficiency but also in promoting ICH transformation from niche inheritance to mass sharing by reconstructing knowledge service models, providing strong support for cultural construction in the deep knowledge society. The collaborative linkage between different channels creates a closed loop for knowledge transmission, satisfying both immediate cognitive needs and providing pathways for in-depth exploration, ultimately achieving multi-layered realization of ICH cultural value.

2. Existing Challenges: Practical Obstacles in Technology-Enabled ICH Dissemination

AIGC technology's generative capabilities across scripts, images, videos, and audio provide innovative pathways for ICH dissemination. However, practical applications face adaptation challenges between technical features and cultural transmission requirements in each generation dimension. These challenges originate from both inherent technical limitations and the inherent complexity of ICH culture.

2.1 Script Generation: Accuracy Deviation in Historical Narratives

As the core vehicle for ICH narrative transmission, script generation quality directly impacts cultural connotation delivery. Although AIGC can rapidly construct narrative frameworks in script creation, it frequently produces deviations due to inadequate understanding of ICH historical contexts. In opera script creation, systems may confuse historical lineages across different genres—for example, erroneously inserting Cantonese opera's "Red Boat Troupe" historical background into Huangmei opera scripts, or antedating the formation of Kunqu's "Shuimo Tune" to pre-Ming periods. These deviations are not merely factual errors but stem from generative models' inability to grasp causal logic and regional associations when correlating fragmented historical materials.

The deeper issue lies in cultural symbol misreading. ICH scripts often contain numerous rituals, props, and lyrics with specific meanings—for instance, the "bell-drum dance posture" in Tibetan Reba dance symbolizes exorcising evil and praying for blessings, while "white color" in Peking Opera facial makeup represents treachery. If AIGC merely appropriates symbols based on textual frequency analysis, it may generate plotlines that violate cultural traditions, such as "using black hada in Tibetan weddings." Without deep cultural cognition, technologically generated scripts risk becoming formalistic plot splicing that fails to carry ICH's spiritual core.

2.2 Image Generation: Formal Distortion of Cultural Symbols

ICH image generation must strictly adhere to traditional formal specifications, with the core challenge being accurate reproduction of cultural meanings embedded in visual elements like patterns and shapes. In traditional paper-cutting, both the layout of “inverted fu characters” and compositional proportions of “magpie on plum branch” follow established conventions. If AIGC generates images through pixel imitation alone, minor deviations may occur—such as misaligned components in inverted fu characters or incorrect numbers of tail feathers on magpies. These seemingly trivial errors actually dissolve the cultural symbolism of visual signs; for instance, the “lotus and fish” combination in paper-cutting symbolizes “abundance year after year,” but if a generated image mistakenly renders the fish as snake-like, the original meaning is completely subverted.

This distortion becomes more pronounced in virtual character design. Kunqu dan role makeup must conform to “junban” (elegant makeup) specifications, with precise requirements for the color of “diancui” (kingfisher feather) head ornaments and the length of “shuixiu” (water sleeves). If generative models excessively pursue visual impact, they may create hybrid designs such as “water sleeves longer than body height” or “diancui head ornaments paired with phoenix crowns,” disrupting the integrity of traditional aesthetics. The “knowledge inclusiveness” emphasized by scholars from the Military Academy of Military Science Information Research Center manifests in image generation as steadfast adherence to cultural symbol accuracy. Once formal distortion becomes normalized, it will cause cognitive bias in audiences’ understanding of ICH visual culture.

2.3 Video Generation: Logical Disruption of Craft Processes

ICH technique video generation must rest upon complete process logic. AIGC’s limitations in this area primarily manifest as inadequate comprehension of correlations between craft stages. Cloisonné production’s six-step sequence—mold making, filigree, enamel filling, firing, polishing, and gilding—features interlocking stages where errors in preceding phases directly impact subsequent results; for example, curvature deviation in filigree causes enamel overflow during filling. Without understanding these causal relationships, generative models may produce logically reversed sequences such as gilding before firing, or omit critical details like the requirement for three repeated firings, preventing audiences from grasping the craft’s rigor.

Dynamic scene generation presents similar issues. In Miao silver jewelry forging, heat control during “silver melting” and force variation during “engraving” must be combined with artisans’ experience. If video generation merely presents action splicing, it may treat “slow heating” as “rapid melting” or simplify “engraving patterns” into mechanical repetitive motions, neglecting subtle differences in force and rhythm across steps. This dissolution of craft essence reduces videos to technical demonstrations, violating the functional requirement for information resource management to transform into “cultural ecology constructors.”

2.4 Audio Generation: Inheritance Gap in Traditional Rhythms

The core challenge in audio generation for ICH dissemination lies in accurately capturing rhythmic characteristics and emotional expression. In guqin performance, the clarity of “harmonics” and depth of “pressed tones” carry specific emotional imagery [5]. If AIGC generates audio through pitch matching alone, it may confuse timbral differences between “open strings” and “harmonics,” or erroneously introduce rushed rhythms to “Wild Geese on a Sandbank,” destroying the piece’s ethereal artistic conception. The “Nugula” singing style in Mongolian long-tune features vibrato frequency and amplitude that embody grassland culture’s vastness; without understanding this cultural emotion, technically simulated audio appears rigid and stereotyped, losing traditional music’s vitality.

The generation of opera singing highlights this issue more prominently. Kunqu’s “shuimo tune” [6] follows the principle of “following character tones” (依字行腔), requiring singing to highly correspond with character tonal pronunciation. For instance, the extended note length for “Jiangyang Rhyme” must match emotional expression. If AIGC generates singing segments based solely on melodic templates, it may produce conflicts between character tones and melodic sounds, or excessively accelerate rhythms in “The Peony Pavilion • Garden Tour,” altering the “graceful and lingering” style. This inheritance gap in rhythm transmission not only affects auditory experience but also dilutes the essential characteristics of ICH musical culture.

3. Optimization Strategies: Constructing a Technology-Culture Collaborative Mechanism

The rational application of AIGC technology in ICH dissemination requires transcending the binary opposition between “technology-led” and “culturally conservative” approaches, establishing a collaborative mechanism that coordinates technological empowerment with cultural inheritance. Such a mechanism respects technology’s efficiency advantages while safeguarding ICH’s cultural authenticity, achieving positive interaction between technological enablement and cultural transmission through institutional design, value guidance, and tool innovation.

3.1 Establishing a “Dual-Track Review” System to Ensure Content Accuracy

Content accuracy constitutes the lifeline of ICH dissemination. The “dual-track review” system’s core lies in constructing dual defense lines of technical verification and cultural gatekeeping, establishing full-process quality control from data input to content output. During training data preparation, advisory groups comprising ICH practitioners, historians, and archaeological experts must systematically organize and annotate raw data. For traditional textile techniques, for instance, textual comparisons of sericulture and weaving records in *Tiangong*

Kaiwu • *Naifu* are required to clarify structural differences between waist looms and flower-tower looms [7], while annotating evolution characteristics of fabric patterns across dynasties to create structured training datasets. This preprocessing effectively reduces generation deviations stemming from data ambiguity, establishing foundations for content accuracy.

Machine pre-screening during generation must rely on professional knowledge bases to construct verification rules. Technical teams can develop specialized verification modules for different ICH types based on specifications provided by advisory groups: in opera, focusing on verifying genre and vocal pattern compatibility, such as ensuring Sichuan opera's "gaoqiang" structure does not mix with Peking Opera's "xipi erhuang" patterns; in traditional medicine, focusing on herbal processing and formula compatibility, such as verifying the temperature range for donkey-hide gelatin "stir-fried with clam powder until bulging." Machine pre-screening can quickly identify obvious errors, such as temporal mistakes like categorizing "Longquan celadon" as Tang Dynasty craft, or anachronistic tool usage like "acupuncture with stainless steel needles," substantially reducing manual review workload.

The expert review stage requires establishing a hierarchical review mechanism that matches content types with corresponding domain experts. For narrative content like ethnic epics, folklorists and practitioners jointly review, focusing on epic fragment completeness and chanting rhythm standardization; for traditional instrument images, music scholars and instrument makers ensure accuracy in details like string numbers and resonance box structures. The review process must establish clear correction standards, such as "rhyme errors in Mongolian long-tune lyrics require full team review, while rhythm deviations can be confirmed by practitioners alone," ensuring both review efficiency and cultural bottom lines. This "machine pre-screening + expert final review" model leverages AIGC's generation efficiency while preventing cultural distortion through humanistic gatekeeping, aligning with the concept that "knowledge inclusiveness must be premised on accuracy" emphasized by scholars from the Military Academy of Military Science Information Research Center.

3.2 Strengthening the Cultural Orientation of Knowledge Services

The cultural orientation of knowledge services emphasizes maintaining ICH's cultural core as the central focus in technological application, preventing innovation from degenerating into formalistic showmanship. Realizing this orientation requires integrating cultural connotations throughout the entire technological application process across three dimensions: narrative design, value extraction, and experience construction. In narrative design, structural thinking from dramatic narratives should combine ICH techniques with cultural contexts to construct engaging cultural stories. When presenting Longquan celadon firing techniques, for example, content should not merely demonstrate the throwing-trimming-glazing-firing sequence but also incorporate craftsmen's philosophies such as "clay must be aged for three years" and ecological wisdom like "dragon kiln

temperature adjusted seasonally,” designing themes such as “dialogue between earth and fire” to help audiences comprehend the philosophical underpinnings of the craft. This narrative approach is not simple information superposition but enriches content with deeper spiritual meaning through cultural logic organization.

The value extraction stage must excavate connection points between ICH and contemporary life, achieving meaningful dialogue between tradition and modernity. AIGC-generated content should avoid remaining at the “retro display” level but should highlight ICH’s contemporary value through cross-temporal comparison and contemporary reflection. For instance, in disseminating traditional construction techniques, content can analyze the mechanical wisdom of “mortise-tenon structures without a single nail” in conjunction with modern green building concepts; in solar term folklore content, it can connect with modern health knowledge to explain the scientific principles behind “winter solstice nourishment.” This value extraction is not modern misinterpretation of traditional culture but meaning extension based on cultural essence, enabling younger audiences to understand ICH value from their own experiences and enhancing cultural identity.

Experience construction must emphasize creating cultural immersion, allowing technological applications to serve deep cultural perception. In virtual exhibition hall design, “spatiotemporal folding” interaction methods can allow audiences to access relevant sections of the *Sculpture Measurement Sutra* at any moment while appreciating Tibetan thangka painting, comparing painting specifications across different sects; in traditional martial arts ICH interaction, experience chains like “move decomposition—offense-defense principles—modern fitness” can be designed, where users not only view movement essentials but also understand their transformation applications in modern combat training. This experience design avoids isolated use of technical means but serves as a bridge connecting audiences with cultural cores, guiding audiences from surface cognition to deep understanding, meeting the deep requirements of the deep knowledge society for cultural dissemination.

3.3 Promoting the Inclusive Implementation of Lightweight Tools

Lightweight tool development must address the actual needs of small and medium-sized ICH projects, adopting low-threshold, high-adaptability design principles to reduce technological access costs. Drawing from the “intelligent audio-visual creation path for low-cost production” proposed by scholars at Zhejiang Media College [8], modular generation tools can be developed for different ICH categories: for ethnic song and dance, integrated templates for lyric generation, melody matching, and choreography arrangement allow users to simply input descriptions of folk scenes to generate scripts matching ethnic characteristics with automatically matched rhythm patterns; for traditional cuisine, modules for ingredient processing, cooking steps, and flavor narration enable practitioners to upload demonstration videos and automatically generate

subtitled instructional content. These templates embed expert-reviewed cultural specifications—such as movement trajectory parameters for Dai peacock dance or filling ratio ranges for mooncake production—allowing users to generate standardized content without specialized technical expertise.

Tool usability design must fully consider inheritors' usage habits, adopting a dual-mode approach of "voice interaction + visual operation." For elderly inheritors, dialect voice command functions can be developed, supporting natural language instructions like "generate a harmony score for a Dong ethnic chorus" to complete operations; interface design employs intuitive flowchart illustrations, simplifying complex parameter settings into options like "traditional method vs. innovative adaptation" or "home-style vs. festival specifications," allowing users to complete content generation settings through click selection. Additionally, tools must feature auto-save and version rollback functions to prevent content loss from operational errors and reduce usage anxiety. This humanized design effectively eliminates inheritors' fear of technical tools and enhances actual usage rates.

Constructing technical training and service systems constitutes key support for promoting tool inclusiveness. A three-level service network can be established in collaboration with local cultural and tourism departments: "provincial training centers—municipal service stations—county promotion points." Provincial training centers are responsible for cultivating backbone technical instructors, focusing on training tool principles and advanced application skills; municipal service stations undertake regional practitioner rotation training, demonstrating tool applications in specific ICH projects through case teaching, such as practical operations in digital generation of Yi lacquerware patterns; county promotion points provide daily technical support, assisting practitioners in solving common tool usage problems. Training content must emphasize practicality, such as operational skills like "how to shoot ingredient processing videos with mobile phones and import them into the tool" or "how to adjust the sequence of steps in generated recipes," rather than abstract technical theories. This hierarchical service system ensures lightweight tools truly reach grassroots ICH projects, enabling technological empowerment to benefit more endangered ICH and avoiding cultural transmission imbalance caused by the "Matthew effect" [9], thereby fulfilling information resource management's mission of "knowledge inclusiveness."

Through the dual-track review system that fortifies accuracy safeguards, cultural orientation that guides technology application values, and lightweight tools that expand technological empowerment coverage, this collaborative mechanism leverages AIGC's efficiency advantages while safeguarding ICH dissemination's cultural integrity, providing a viable pathway for deep technology-culture integration. The mechanism's core is not to restrict technological innovation but to establish a healthy ecosystem where technology serves cultural inheritance, enabling AIGC to become a catalyst rather than an obstacle for ICH's dynamic inheritance.

The integration of AIGC technology and ICH dissemination essentially repre-

sents an innovation in knowledge service models. DeepSeek' s demonstrated multimodal generation and intelligent interaction capabilities not only reconstruct ICH content production logic but also open up transformation channels from cultural resources to public cognition through precise and personalized service forms, providing a new paradigm for technology-enabled ICH dynamic inheritance. However, the boundary of technological empowerment always lies in safeguarding cultural authenticity. Current challenges in content generation accuracy, cultural expression depth, and technological inclusiveness are indeed inevitable results of collisions between technical rationality and cultural logic. Constructing a technology-culture collaborative mechanism requires both institutional design to fortify ICH' s cultural defense lines and tool innovation to lower technological application thresholds, allowing technology to become a force that activates rather than dissolves cultural value.

Future explorations should focus more on typological adaptation of ICH—for craft ICH, strengthening technical restoration of process logic; for folk custom ICH, emphasizing immersive construction of cultural contexts; for linguistic ICH, breaking through technical bottlenecks in rhythm inheritance. Only by achieving precise coupling between technical characteristics and ICH traits can AIGC enable ICH to bloom with more enduring vitality in the digital intelligence era while safeguarding cultural roots, ultimately achieving the deep transformation from “digital dissemination” to “digital inheritance.”

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