



Digital-Bilingual Strategies for the International Promotion of Intangible Cultural Heritage: A Case Study of Chinese Willow Weaving (Liu Bian)

Meng Yang

Department of Foreign Languages, Qilu Normal University, Jinan, China

Email: 3433950872@qq.com

How to cite this paper: Yang, M. (2026) Digital-Bilingual Strategies for the International Promotion of Intangible Cultural Heritage: A Case Study of Chinese Willow Weaving (Liu Bian). *Open Access Library Journal*, **13**: e14952. <https://doi.org/10.4236/oalib.1114952>

Received: January 28, 2026

Accepted: February 21, 2026

Published: February 24, 2026

Copyright © 2026 by author(s) and Open Access Library Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

As a representative form of Chinese Intangible Cultural Heritage (ICH), Linshu Willow Weaving (Liu Bian) embodies profound historical, cultural, and artistic value. However, its international promotion faces significant challenges, including linguistic barriers, limited dissemination channels, and insufficient engagement with global, particularly younger, audiences. In response, this study proposes and examines a novel “Digital-Bilingual” strategy designed to integrate advanced digital technologies—such as Virtual Reality (VR), Augmented Reality (AR), Digital Twin, and Artificial Intelligence (AI)—with tailored bilingual (Chinese-English) communication frameworks. The core of this strategy involves constructing an immersive, AI-driven virtual willow weaving workshop and an interactive bilingual learning platform. This platform aims to transcultural and translate willow weaving techniques into accessible digital assets, embedding them within the cultural context of the “Belt and Road” initiative. Through virtual master demonstrations, personalized learning paths, and cross-cultural community interaction, the project seeks to transform Liu Bian from a local craft into a “world language”, thereby enhancing its international visibility, fostering cultural exchange, and providing a replicable model for the digital transformation and global promotion of traditional handicrafts. This research employs a mixed-methods approach, combining literature analysis, a case study of the ongoing university innovation project, and preliminary platform prototyping. The framework is anticipated to bridge cultural and linguistic gaps, create engaging and educational user experiences, and open new pathways for the living inheritance and international dissemination of ICH. The study contributes to the interdisciplinary fields of cultural heritage preservation, digital humanities, and cross-cultural communication.

Subject Areas

Cultural Heritage Studies, Digital Humanities, Cross-Cultural Communication

Keywords

Intangible Cultural Heritage, Willow Weaving (Liu Bian), Digital Strategy, Bilingual Communication, VR/AR, AI, International Promotion, Cultural Translation, Digital Twin, Belt and Road Initiative

1. Introduction

1.1. The Cultural Significance and Contemporary Challenges of Linshu Willow Weaving

Linshu Willow Weaving, with a history spanning over 1400 years and officially recognized as a National Intangible Cultural Heritage of China in 2021, represents a pinnacle of Chinese folk art and agrarian craftsmanship. Hailing from Linshu County, Shandong Province—renowned as the “Willow Weaving Capital of China”—this craft involves intricate weaving techniques using locally cultivated willow branches to produce a diverse range of utilitarian and decorative items, from baskets and furniture to sophisticated artistic installations. Beyond its economic role in rural revitalization, Liu Bian carries deep cultural meanings, reflecting Chinese philosophies of harmony with nature, meticulous craftsmanship (“Gong Jiang Spirit”), and aesthetic values embedded in daily life. It serves as a living archive of local knowledge, community identity, and sustainable material practice.

Despite its national stature and intrinsic value, Linshu Willow Weaving encounters substantial hurdles in reaching a global audience. The primary challenges are multifaceted:

- 1) Profound linguistic and cultural barriers impede effective storytelling and comprehension for international audiences. The specialized terminology (e.g., techniques like “ping bian” flat weaving, “ning bian” twist weaving), historical allusions, and cultural symbolism inherent to the craft are often lost in direct translation or lack the necessary contextualization for foreign viewers, leading to a superficial engagement.

- 2) Traditional and existing digital dissemination modes—reliant on physical exhibitions, in-person workshops, and static online galleries—are severely limited by geography, scale, and appeal. They fail to capture the tacit, procedural, and spatial knowledge crucial to handicrafts and are particularly ineffective for digitally-native younger generations both domestically and internationally who seek interactive and immersive experiences.

- 3) There is a dual crisis of inheritance and innovation. An aging population of master artisans struggles to attract young apprentices locally, while the craft’s

static, traditional image fails to resonate with contemporary global aesthetic sensibilities and interactive digital expectations, limiting its market and cultural appeal.

1.2. National Policy and Technological Context

The Chinese government has consistently emphasized the protection, inheritance, and innovative development of ICH as a cornerstone of cultural confidence. Policies such as the Opinions on Further Strengthening the Protection of Intangible Cultural Heritage (2021) and the 14th Five-Year Plan for the Protection of Intangible Cultural Heritage explicitly encourage the integration of digital technology with ICH for preservation, education, and creative transformation. Concurrently, national strategies like “Cultural Digitalization” and the cultural exchange agenda of the “Belt and Road Initiative” provide a favorable macro-environment for exploring technology-enabled, internationally-oriented promotion models for traditional crafts, aiming to enhance China’s cultural soft power.

Parallely, the rapid and convergent advancement of digital technologies offers unprecedented tools. High-fidelity 3D scanning and photogrammetry allow for the precise capture of artifacts. Digital Twin technology enables the creation of dynamic virtual counterparts of physical processes. Virtual Reality (VR) and Augmented Reality (AR) provide immersive and interactive platforms for experiential learning. Artificial Intelligence (AI), particularly in natural language processing (NLP) and computer vision, powers real-time translation, personalized content delivery, and automated skill assessment. These technologies collectively can create compelling, accessible, and interactive experiences that transcend physical, temporal, and linguistic boundaries, forming the technological backbone of a new promotional paradigm.

2. Literature Review

2.1. Digital Preservation and Revitalization of Intangible Cultural Heritage

Global scholarship on ICH preservation has progressively evolved from static, archival documentation towards dynamic, participatory, and technology-mediated approaches to revitalization. Artificial Intelligence (AI) has revolutionized the preservation and inheritance of Intangible Cultural Heritage (ICH) by enabling digital conservation and interactive dissemination. Xu and Wu (2025) [1] developed a Galactic Swarm Optimized Graph Neural Network (GSO-GNN) that achieves 99% accuracy in modeling cultural elements, optimizing feature selection and enhancing global accessibility for sustainable heritage protection. Internationally, researchers such as Zabulis *et al.* (2024) [2] in their study “Modelling and Simulation of Traditional Craft Actions” emphasize the application of 3D visualization, motion capture, and interactive virtual tools to deconstruct, simulate, and digitally preserve complex craft actions. Their work demonstrates that such technologies not only aid in precise archival preservation for scholarly purposes but

also create engaging, pedagogically effective training and demonstration modules for wider publics. This body of work provides a strong foundational rationale for employing Digital Twin and VR/AR technologies to meticulously document and authentically replicate the full material and processual spectrum of willow weaving, ensuring its techniques are preserved in an interactive, rather than static, form. The shift from viewing ICH as a static artifact to a dynamic process that can be digitally simulated and interacted with marks a significant paradigm shift, opening new avenues for both preservation and engagement.

2.2. Cross-Cultural Communication and “Cultural Discount” in ICH Promotion

A major, persistent hurdle in the internationalization of ICH is the phenomenon of “cultural discount”, a concept articulated by Yu *et al.* (2025) [3], where the cultural value and appeal of a product diminish when exposed to foreign audiences due to differences in historical context, social values, practices, and language. Effective international promotion strategies must, therefore, involve sophisticated cultural translation—a process that goes far beyond mere linguistic conversion to encompass the adaptation of content, narrative, and form to resonate with the target culture’s cognitive frameworks, values, and aesthetic preferences. Research on the overseas dissemination of Chinese culture, exemplified by Mao and Chen’s (2025) [4] study on picture book translation, constructs and validates a “text-image-translation” triadic model for cross-modal transformation. Their findings demonstrate that the synergistic integration of textual adaptation, visual symbolism, and translational strategies—centered on core cultural values—effectively reduces cultural discounting, with 88.3% audience recognition. This approach underscores the necessity of moving beyond mere subtitling toward deeply contextualized, multimodal adaptation embedded within relatable narratives and contemporary discourses (e.g., sustainability, craftsmanship) for diverse audiences. Such a participatory, dialogic model of meaning co-creation directly informs our project’s bilingual design principle and community-layer engagement strategy.

2.3. Technology-Enhanced Language Learning and Cultural Education

The pedagogical application of immersive technologies (VR/AR) and AI in language acquisition and cultural education is a well-established and growing field. Wang’s (2025) [5] strategic study on integrating Virtual Reality (VR) into business education demonstrates how purpose-built immersive environments create contextualized, experiential learning. This approach directly aligns with situated learning theory, as the virtualization of teaching content and interactive scenarios places learners inside simulated professional situations. Such VR-enhanced immersion has been shown to boost learner motivation, knowledge retention, and the development of practical skills and cultural empathy. Sahu *et al.* (2026) [6], in their scoping review of AI in higher education, conclude that artificial intelligence has significantly enhanced instructional design, real-time feedback, and personal-

ized learning across disciplines. Their findings indicate that AI's capabilities extend to powering adaptive, personalized learning paths, real-time translation, and intelligent interactive Q&A systems, which collectively enable a new paradigm of scalable and individualized instruction. Our project draws substantively from this domain by conceptualizing the willow weaving platform not merely as a digital museum or showcase but as an interactive bilingual learning ecosystem. It synergistically combines the immersive, embodied power of VR (for skill simulation) with the structured pedagogical guidance of AI-driven tutorials and the social-constructivist dimension of a multilingual community forum. This alignment with modern constructivist and experiential learning theories ensures the platform is educational as well as engaging, transforming passive viewers into active learners and practitioners, even from a distance.

2.4. Integration of “New Liberal Arts” in Cultural Heritage Studies

The “New Liberal Arts” (Xin Wenke) paradigm in Chinese higher education explicitly encourages breaking down traditional disciplinary silos to address complex real-world problems through integrative knowledge. As highlighted by Tian and Hemchua (2023) [7], this approach is grounded in cultural semiotics and emphasizes disciplines integration, the cultivation of “T-shaped” innovative talents, and institutional-platform innovation. Our project is a direct embodiment of this philosophy. It actively integrates Foreign Languages (applied English for cross-cultural communication), History (for contextualizing the craft's evolution), Information Science and Computer Technology (for VR/AI development and platform engineering), and Art & Design (for aesthetic digitization, symbolic analysis, and creative innovation). This interdisciplinary fusion is not incidental but crucial for tackling the multifaceted challenge of ICH internationalization. It ensures the final output is culturally authentic (informed by humanities), technologically robust and innovative (driven by computer science), linguistically accurate and engaging (crafted by language specialists), and creatively appealing (designed by artists). This approach is supported by domestic research advocating for cross-disciplinary collaboration in cultural digitalization and represents a practical response to the call for humanities to engage deeply with technological tools to remain relevant and impactful.

3. Current Challenges in the International Promotion of Linshu Willow Weaving

A thorough analysis reveals that the international promotion of Linshu Willow Weaving is constrained by a series of interconnected challenges that existing approaches have failed to overcome comprehensively. This systemic dilemma mirrors the practical constraints documented in broader ICH contexts, as evidenced by Zheng's (2025) [8] case study on Huangzhong District's intangible cultural heritage. Dingqi identifies critical gaps in institutional frameworks, industrial development, and innovation mechanisms—challenges directly paralleled in the current fragmented state of willow weaving promotion.

3.1. Linguistic and Narrative Barriers

The craft possesses a rich, specialized lexicon describing materials, tools, techniques (e.g., “ping bian”, “wen yang”), and aesthetic principles. These terms carry cultural connotations that are often untranslatable directly. As emphasized by Li (2026) [9] from a cross-cultural perspective, the effectiveness of translation is fundamentally determined by intercultural factors; achieving the dual goals of language conversion and cultural transmission requires integrating cultural adaptation deeply into the application of translation techniques. However, existing promotional materials, including websites and brochures, frequently resort to literal translations or overly simplistic explanations, stripping away the nuanced meanings and stories. For instance, the symbolism of a “fish-scale pattern” (representing abundance) or the historical reason behind a specific basket shape may be omitted. There is a glaring absence of a systematic, tiered bilingual narrative framework capable of guiding an international user from initial curiosity (“what is this?”) through technical understanding (“how is it made?”) to deep cultural appreciation (“what does it mean?”). This results in fragmented comprehension and limits emotional and intellectual engagement.

3.2. Limitations of Physical and Traditional Digital Media

While Linshu Willow Weaving has a digital presence through basic websites and social media accounts (e.g., WeChat, Douyin), these platforms predominantly feature static image galleries or short, passive videos. They fundamentally fail to convey the kinesthetic, tactile, procedural, and spatial knowledge that is intrinsic to mastering and appreciating a handicraft. The physical inaccessibility of Linshu for most international tourists, coupled with the high cost and logistical complexity of organizing international exhibitions and workshops, creates a significant experiential barrier. Current digital offerings do not leverage the potential of immersive technologies to simulate the presence, guidance, and step-by-step tacit instruction of a master artisan, which is the cornerstone of traditional apprenticeship. This creates a representation gap between the digital surrogate and the lived experience of the craft.

3.3. Disconnect with Global and Youth Audiences

The prevailing perception of willow weaving, often framed as a “traditional”, “rustic”, or “folk” craft, can inadvertently alienate younger, global audiences who are immersed in digital culture and value interactivity, personalization, and contemporary relevance. There is a notable lack of gamification elements, robust community-building features, and opportunities for user-generated content (UGC) that foster a sense of active participation, co-creation, and ownership. The dominant communication model remains a one-way broadcast (from institution to audience) rather than a two-way, dialogic model of cultural exchange that facilitates conversation, collaboration, and the evolution of the craft through external influence. This disconnect threatens the craft’s relevance in a globalized future.

3.4. Fragmented and Superficial Technological Application

Previous digitization initiatives for ICH, including some related to willow weaving, often result in isolated, non-interoperable applications—a standalone 3D model viewer here, a PDF of translated research there, a promotional video elsewhere. This fragmentation, a challenge also documented by Wang, Jiang, and Ma (2024) [10] in their study of red culture communication in the self-media age, creates a poor user experience and dilutes impact. Their research highlights how fragmented dissemination across platforms limits overall effectiveness, a dilemma that directly parallels the current state of ICH digital promotion. Consequently, there is a lack of a cohesive, user-centered digital platform that seamlessly integrates high-fidelity simulation, structured pedagogical content, intelligent bilingual support, and vibrant social interaction into a single, engaging ecosystem. This lack of integration severely limits overall effectiveness, user retention (“stickiness”), and the potential for building a sustained international community of practice around the craft. Ultimately, technology is often used as a patch rather than as an integral part of a strategic communication framework, a critical shortcoming that the proposed project aims to overcome.

3.5. Case Study Evidence: Preliminary Platform Prototyping and Validation

As a core component of this research, an ongoing university-led innovation project serves as the practical case study and testing ground for the proposed Digital-Bilingual framework. To date, significant progress has been made in the preliminary prototyping phase, providing tangible evidence for the feasibility and initial design of the strategy.

1) Platform Conceptualization and Interface Design: The project team has completed the foundational conceptual design of the bilingual platform, named “Weave the Future”. This includes the creation of a dedicated platform logo and the definition of core functional modules. The platform architecture is designed around key user-centric zones: a Course Learning module for structured tutorials, a Works Showcase gallery for sharing physical and virtual creations, and an Interactive Community hub for user discussion and collaboration.

2) Technical Pathway and Development Roadmap: A detailed technical implementation roadmap has been formulated. The pathway systematically progresses from digital asset acquisition (3D scanning, motion capture) to core system development (VR environment, AI backend), and finally to integration and public launch. This roadmap validates the phased, iterative approach advocated in the strategy and is currently in the early stages of execution.

3) Proof-of-Concept and Market Testing: Initial Validation Steps Have Been Undertaken: The team has conducted preliminary market outreach and content dissemination through social media platforms. Notably, a series of live-streaming sessions focused on willow weaving were executed on platforms like Douyin and Instagram. These sessions, which integrated craft demonstrations, cultural story-

telling, and real-time bilingual interaction (aided by AI translation tools), reached an international audience spanning over 12 countries and facilitated the sale of numerous handcrafted willow products. This real-world testing provides preliminary evidence for the engagement potential and cross-cultural appeal of a digitally-mediated, bilingual format, directly addressing the challenges of audience disconnect and traditional dissemination limits outlined in Sections 3.2 and 3.3.

4) Stakeholder Engagement and Resource Foundation: The case study is grounded in strong partnerships. The project has established a formal collaboration with Master Yang Jinbang (Yang Jinbang), a recognized National ICH Inheritor of Linshu Willow Weaving, who serves as a cultural consultant and the primary model for the planned “Virtual Master” avatar. Furthermore, the project leverages the institutional support of Qilu Normal University, which hosts the Shandong Provincial Intangible Cultural Heritage Theory Research Alliance, providing academic credibility and access to a network of heritage preservation experts.

This ongoing prototyping work confirms the operational viability of the proposed framework. The defined modules, technical plans, and early engagement results form a substantive foundation for the full-scale platform development described in Section 6. They transform the strategy from a purely theoretical model into a research-led practice initiative, where subsequent phases of implementation and evaluation will yield the empirical data necessary for rigorous validation.

4. The Proposed Digital-Bilingual Strategy: A Comprehensive Framework

To systematically address the aforementioned challenges, we propose an integrated “Digital-Bilingual” strategy. This strategy is built on a robust, tripartite conceptual framework: Digital Capture & Replication, Intelligent Bilingual Mediation, and Immersive Interactive Community. This framework operates in synergistic layers, each translating core technological and methodological strategies into coherent, user-facing interactive experiences. The model follows a logical progression from the foundational creation of authentic digital assets, through their intelligent interpretation and contextualization, culminating in participatory, community-driven engagement designed to ensure long-term vitality.

4.1. Layer 1: Digital Capture & Replication—Building the Authentic Virtual Foundation

This foundational layer is dedicated to creating a high-fidelity, dynamic, and data-rich digital counterpart of the physical craft and its entire ecosystem. It moves beyond static documentation to construct a living digital repository that ensures procedural authenticity and scholarly depth, serving as the single source of truth for all subsequent interactive experiences.

1) High-Precision 3D Scanning & Procedural Digital Twin Modeling: Utilizing professional-grade structured-light 3D scanners and photogrammetry, we

will create millimeter-accurate digital models of every physical component: diverse raw willow materials, traditional tools (with wear patterns), intermediate weaving stages, and a catalogue of finished products. Crucially, these assets will be integrated into a procedural Digital Twin—a dynamic model that simulates the craft’s logic. This allows users to virtually “deconstruct” an item layer-by-layer, view cross-sections, understand material stress points, and witness animated sequences of its assembly from start to finish. This twin becomes a vital analytical tool for understanding structural integrity and design complexity.

2) Biomechanical Motion Capture & The “Virtual Master”: In close collaboration with National ICH inheritors like Master Yang Jinbang, we will employ inertial and optical motion capture systems to record the precise kinematics, force, and nuanced gestures of weaving. This data does more than animate a realistic avatar; it populates a “Knowledge Bank” linked to the Virtual Master. This AI-accessible bank will contain not just movement data, but also annotated video, audio explanations of each action’s purpose, and alternative techniques for different patterns, transforming the avatar into a true pedagogical agent capable of demonstrating, explaining, and correcting.

3) Immersive VR Workshop Environment: Leveraging powerful game engines like Unity or Unreal Engine, we will construct a detailed, navigable virtual environment that meticulously replicates a traditional Linshu weaving workshop. This includes authentic spatial acoustics, changing lighting conditions (day/night), and ambient sounds. The environment will be populated with interactive digital twins of tools and materials, allowing users via VR headsets to “enter” and explore the workspace, enhancing the sense of cultural and physical presence critical for embodied learning.

4) Multisensory Data Acquisition: To capture the full phenomenological experience, this layer will also incorporate high-fidelity spatial audio recordings of weaving sounds (willow scraping, tool clacks) and olfactory profiling where relevant, adding layers of sensory fidelity to the digital replica for a more complete immersive experience.

4.2. Layer 2: Intelligent Bilingual Mediation—Bridging the Language-Culture Gap

This intermediary layer acts as the intelligent conduit, ensuring all digital content is not only linguistically accessible but also culturally meaningful and resonant across global audiences. It transforms raw data into contextualized knowledge.

1) AI-Powered Dynamic Bilingual Interface & Chatbot: The platform will feature a fully bilingual (Chinese-English) interface. An integrated, fine-tuned AI translation engine, regularly calibrated by human expert review, will handle dynamic, user-generated content like live Q&A sessions, forum discussions, and comments in near real-time. A specialized chatbot, trained on the project’s cultural-linguistic database, will serve as a 24/7 guide, answering factual queries about techniques and history in both languages.

2) Structured Cultural-Linguistic Database: Beyond a simple glossary, we will develop a structured ontology—a relational database that maps willow weaving terminology, concepts, and processes. Each entry will include: precise translations, detailed cultural explanations, historical etymology, links to related techniques, and associated visual/audio media. This ensures semantic consistency, captures nuance (e.g., different names for a technique by region), and provides a rich resource for researchers and serious learners.

3) Contextualized and Adaptive Storytelling: We will craft a core repository of bilingual narrative content—covering history, artisan biographies, ecological context, and symbolic meanings. Using AI-assisted tools, these narratives can be adapted for different audience profiles (e.g., a concise, visually-driven version for school children; a detailed, citation-rich version for university students). The system can dynamically insert relevant local cultural parallels or explanations to bridge comprehension gaps for international users.

4.3. Layer 3: Immersive Interactive Community—Fostering Engagement, Co-Creation, and Sustained Practice

This topmost layer is designed to catalyze active participation, foster long-term engagement, and cultivate a global, self-sustaining community of practice, moving from transmission to transformation.

1) VR/AR Interactive Skill Acquisition Modules: In the VR workshop, users will be able to follow the Virtual Master’s guidance in real-time. Using haptic-enabled motion controllers, they can practice weaving gestures, receiving AI-driven feedback on hand position, pressure, and rhythm. Complementary mobile AR applications will overlay digital instructions onto physical materials in a user’s real-world environment, creating a blended learning pathway from virtual practice to physical execution.

2) AI-Driven Personalized Learning Ecosystem: An AI system will create detailed learner profiles based on interaction data. It will then recommend a personalized curriculum—suggesting tailored tutorial modules, progressively difficult challenges, and relevant community projects. This adaptive pathway ensures continuous, appropriately scaffolded engagement for users of all skill levels, from curious beginners to advanced practitioners. To maintain content integrity, all curated tutorial modules and recommended materials will be sourced from pre-verified expert knowledge bases or community-generated content that has passed established quality review mechanisms.

3) Gamification & Motivational Architecture: A carefully designed incentive system will include skill-progression badges, time-based crafting challenges, community-wide design contests judged by inheritors, and subtle leaderboards for completed tutorials. The goal is to leverage intrinsic motivation (mastery, creativity) and beneficial extrinsic rewards to build consistent practice habits and celebrate achievement.

4) Multilingual Social Community Platform & Co-Creation Hub: This will

be a dedicated, modular space within the platform. Users can share photos/videos of their physical or virtual creations, form collaborative project groups, and crowdsource solutions to weaving problems. AI-powered moderation and real-time translation will facilitate seamless cross-lingual dialogue. To ensure cultural and technical accuracy, a hybrid moderation system will be implemented. AI filters will initially flag potentially inaccurate or inappropriate user-generated bilingual content and translations. This will be supplemented by a community reporting feature and periodic review by a panel of cultural inheritors and language specialists, who can verify content, provide authoritative corrections, and label community-vetted contributions. This process aims to prevent misinformation while encouraging respectful knowledge sharing. This hub is envisioned as the beating heart of the transnational community of practice.

5) Digital Co-Creation Tools and Value Loop: We will provide user-friendly digital tools, such as virtual pattern editors and 3D model assemblers. This allows users to design their own innovative willow weaving patterns or product concepts within the digital twin environment. Promising community designs can be showcased, voted on, and potentially prototyped by master artisans. To safeguard quality and cultural resonance, a submission and review protocol will be established for designs entering the “value loop”. Designs selected for potential physical prototyping will undergo a review by master artisans for technical feasibility, aesthetic merit, and cultural appropriateness before any real-world production is initiated. This process explores a digital-to-physical value loop that connects online innovation with traditional craftsmanship, opening new economic and creative possibilities.

5. Innovation and Research Value

The proposed Digital-Bilingual strategy represents a significant departure from conventional approaches to intangible cultural heritage (ICH) preservation and promotion. It embodies several key innovations that converge to create a novel framework, carrying substantial research value across theoretical, methodological, and practical domains. This integrated approach not only addresses immediate challenges of craft sustainability but also contributes to broader academic and policy dialogues on heritage in the digital era.

5.1. Innovations of the Strategy

1) Deep Technological Integration for Craft ICH: Moving beyond the common practice of using technology for mere documentation or superficial digital exhibition, this project pioneers the deep, functional, and synergistic integration of advanced technologies—Digital Twin, Virtual Reality (VR), and Artificial Intelligence (AI)—into a single, coherent ecosystem. This ecosystem is specifically engineered for the nuanced demands of craft-based ICH. The Digital Twin creates a dynamic, data-rich virtual replica of the craft process and its environment. VR offers immersive, first-person access to this replica, while AI powers adaptive

learning, intelligent curation, and personalized user interaction. This integration aims to simulate not just the visual outcome but the procedural logic, material behaviors, and decision-making processes inherent to the craft, offering a qualitatively different level of digital engagement.

2) The “Virtual Master” Pedagogical Paradigm: A cornerstone innovation is the creation of an interactive, bilingual “Virtual Master” avatar. This entity is not a generic animation but a pedagogical agent derived from the structured capture and modeling of the tacit knowledge of a living inheritor. Using motion capture, detailed interviews, and expert system modeling, the avatar embodies the master’s techniques, stylistic choices, problem-solving strategies, and even philosophical approach to the craft. It can demonstrate, guide, correct, and respond to user queries in real-time. This represents a groundbreaking tool for capturing, structuring, and disseminating elusive, non-codified craft knowledge on a global scale, offering a scalable model for master-apprentice transmission beyond physical and temporal constraints.

3) From Bilingual Output to Bilingual Socio-Cultural Interaction: The strategy innovatively expands the conventional notion of bilingual output (e.g., translated labels). It leverages bilingualism (Chinese-English) as the foundational infrastructure to facilitate complex, multi-layered social and cultural interaction. The platform is designed to enable cross-lingual dialogue between practitioners, learners, and researchers; to host collaborative virtual projects; and to support the co-creation of narratives around Liu Bian. The aim is to transcend passive consumption and foster a genuine, engaged transnational “community of practice”, where shared interest in the craft bridges linguistic and cultural divides, leading to richer intercultural understanding and collaborative innovation.

4) A Implementational Model for “New Liberal Arts”: The project serves as a concrete, actionable blueprint for the “New Liberal Arts” initiative, which emphasizes breaking down disciplinary silos. It demonstrates how deep, equitable collaboration between humanities scholars (linguistics, cultural studies, heritage studies), artists/artisans, computer scientists, and educational technologists can generate innovative, human-centric solutions to real-world cultural sustainability challenges. The model showcases a process where technological development is driven by cultural and pedagogical needs, and where humanistic inquiry is enriched by digital methodologies, providing a transferable framework for interdisciplinary projects.

5.2. Research Value

1) Theoretical Contribution: The project provides a rich, empirical case study for interrogating and refining several theoretical frameworks. It contributes to debates on digital heritage authenticity—exploring how fidelity to process and practitioner insight in a digital medium constructs a new form of experiential “authenticity”. It tests and potentially expands cross-cultural communication models by examining how craft, as a non-textual medium, facilitates understanding in a dig-

itally-mediated, bilingual environment. Furthermore, it offers insights into constructivist and experiential learning theories within the unique context of mastering traditional physical skills through virtual and AI-assisted means.

2) Methodological Contribution: The research will develop, implement, and critically assess a replicable methodological pipeline for creating digital-bilingual ICH promotion systems. This includes protocols for ethical and effective tacit knowledge capture from practitioners, workflows for integrating heterogeneous data (3D scans, motion data, narrative audio) into a cohesive digital twin, frameworks for designing culturally-sensitive and pedagogically-sound AI interactions, and strategies for nurturing online communities of practice. The resulting toolkit and documented best practices will be invaluable for other heritage domains seeking similar digital transformation.

3) Practical and Social Value: For heritage practitioners and communities, the project offers a sustainable, scalable model to engage new global audiences, ensuring their craft remains relevant and visible. It enhances cultural soft power by presenting a dynamic, innovative, and accessible face of Chinese traditional culture to the world. Economically, it explores new digital avenues—such as virtual workshops, premium immersive experiences, or digital collectibles—that can create viable secondary digital economies to support the primary craft practice, contributing to the holistic sustainability of the heritage.

4) Policy Implication: The project generates evidence-based insights for cultural policymakers at national and international levels (e.g., UNESCO). It demonstrates practical and effective strategies for leveraging digital technologies not just for preservation, but for the active “Creative Transformation and Innovative Development” of ICH. Findings can inform policy on supporting interdisciplinary research, investing in digital infrastructure for heritage, developing standards for digital ICH projects, and crafting initiatives that empower inheritors as co-creators in the digital landscape.

6. Application Roadmap and Technical Implementation

The successful realization of the proposed Digital-Bilingual strategy hinges on a meticulously structured and iterative 18-month implementation plan. This roadmap is designed to align the project’s lifecycle from initial foundational research through to public launch and sustainable community cultivation, ensuring each phase builds upon validated outcomes and maintains a clear focus on both technical excellence and user-centric design.

6.1. Phased Technical Roadmap: From Foundation to Public Ecosystem

The development pathway is segmented into four distinct, sequential phases, each with defined objectives, key activities, and measurable deliverables to ensure systematic progress and risk mitigation.

1) Phase 1: Foundational Research & Digital Asset Creation (Months 1 - 4):

This initial phase is dedicated to establishing the indispensable cultural, linguistic, and digital bedrock of the entire project. It commences with immersive ethnographic fieldwork in Linshu, involving in-depth interviews, participatory observation, and detailed documentation of Master Yang Jinbang's practice to capture procedural knowledge and contextual narratives. Concurrently, the development of the structured cultural-linguistic ontology database begins, systematically cataloguing specialized terminology, techniques, and their nuanced explanations in both Chinese and English. Parallel to this, the technical team initiates the high-precision 3D scanning campaign, capturing millimeter-accurate digital twins of essential artifacts such as traditional tools, material samples, and iconic finished products. The phase culminates in the finalization of the comprehensive technical architecture blueprint, selecting the specific software frameworks and cloud services that will underpin the platform. Key deliverables include a complete ethnographic report, an alpha version of the bilingual ontology, a foundational library of 3D models, and the finalized system design specification.

2) Phase 2: Core System Development (Months 5 - 10): Phase two marks the parallel construction of the platform's core functional modules. The centerpiece is the creation of the "Virtual Master" pedagogical avatar, achieved through bio-mechanical motion capture sessions with the inheritor. This data is processed, segmented, and integrated into a rigged 3D model, synced with narrated instructions to form interactive tutorial sequences. Simultaneously, the immersive VR workshop environment is constructed using Unity3D, where artists and developers model an authentic, navigable virtual space complete with interactive tools and materials. The backend infrastructure is built on a cloud microservices architecture, and the frontend Progressive Web App (PWA) is developed to provide accessible 2D browsing. The first set of structured, interactive learning modules is also scripted and implemented within this environment. Deliverables for this phase encompass a functional Virtual Master prototype, a navigable VR workshop with core interactions, a working backend and PWA frontend, and an initial suite of interactive tutorials.

3) Phase 3: System Integration, Rigorous Testing & Iterative Refinement (Months 11 - 14): This critical phase focuses on synthesizing the independent modules into a cohesive, stable platform and validating it with real users. All components—the VR application, web frontend, backend services, AI engines, and databases—are integrated into a unified system, followed by extensive performance and stress testing. A structured user testing regimen is then executed, beginning with controlled alpha tests (e.g., with heritage scholars and practitioners) and expanding to larger-scale beta tests involving diverse international user groups. Quantitative data on engagement and qualitative feedback are rigorously collected and analyzed. The findings drive an iterative cycle of refinement, addressing usability issues, optimizing performance, correcting content, and fine-tuning AI models. A formal security and accessibility audit is also conducted. The primary deliverable is a fully integrated, polished beta platform, accompanied by

a comprehensive user testing report that guides final pre-launch adjustments.

4) Phase 4: Public Launch, Strategic Promotion & Community Cultivation (Months 15 - 18): The final phase transitions the project from a validated prototype to a public, living digital ecosystem. The refined platform is officially deployed to production servers and launched through coordinated announcements across academic, cultural, and technology communication channels. A strategic international marketing campaign is implemented, involving partnerships with museums, educational institutions, and cultural influencers. Internally, the focus shifts to active community management: launching the multilingual social features, seeding discussions, organizing live virtual Q&A sessions with the master, and facilitating user collaboration. The phase also involves organizing hybrid online-offline events, such as virtual exhibitions and global design challenges, to foster a vibrant transnational community of practice and ensure sustained engagement beyond the initial launch period.

6.2. Key Technical Components and Implementation Specifications

The platform's architecture is designed for scalability, immersion, and intelligent interaction, relying on a modern, cloud-native technology stack.

1) Dual-Modality Frontend & Immersive Experience Layer: User access is facilitated through two complementary frontends. A responsive Progressive Web App (PWA), built with a framework like React or Vue.js, provides universal browser-based access to all 2D content—including the cultural ontology, narrative archives, community forums, and user profiles—with offline capabilities for core content. For deep immersion, a native application developed in Unity3D 2022 LTS serves as the high-fidelity portal to the VR workshop and interactive tutorials. This application will leverage the OpenXR standard for broad hardware compatibility, targeting PC-based VR systems initially, with a roadmap for standalone Quest deployment. The VR environment will utilize advanced rendering techniques and spatial audio to achieve a convincing sense of presence.

2) Cloud-Native Backend Infrastructure & Data Management: The platform will employ a hybrid cloud deployment strategy, utilizing Alibaba Cloud for optimal performance in mainland China and AWS for global accessibility, managed via containerized microservices (Docker/Kubernetes). Backend business logic will be implemented using Node.js or Python (Django) frameworks to handle APIs, user authentication, and content management. Data persistence will be managed through a combination of PostgreSQL for structured relational data (user accounts, ontology relationships) and scalable cloud object storage (e.g., Alibaba OSS, AWS S3) for the vast repository of high-resolution 3D models, motion capture data, and multimedia assets, ensuring efficient streaming and retrieval.

3) Integrated AI/ML Services & Extended Reality (XR) Development Ecosystem: Intelligent functionality will be powered by a layered AI stack. Core natural language processing will integrate cloud-based machine translation APIs (e.g., Alibaba Cloud NLP, Google Translation AI), fine-tuned with the project's

own ontology to enhance domain-specific accuracy. A custom recommendation engine, built with Python and scikit-learn, will analyze user behavior to personalize learning pathways. For computer vision tasks, such as analyzing user-uploaded work for technique assessment, custom models may be developed using PyTorch/TensorFlow. These models would be trained on a purpose-built dataset comprising high-quality, annotated images and video frames from two primary sources: 1) motion-capture data of inheritors demonstrating techniques, and 2) user-contributed images/videos of their own weaving processes and finished pieces, which would be reviewed and annotated for quality by experts to create a robust training corpus. The XR development will be centered on Unity3D's XR plugin framework and AR Foundation, allowing the creation of both immersive VR experiences and cross-platform mobile AR applications that can overlay digital guidance onto a user's physical workspace via smartphones, thereby bridging the virtual and real-world practice.

7. Conclusion and Future Work

The international promotion of complex, materially-based Intangible Cultural Heritage like Linshu Willow Weaving in the digital age demands sophisticated, layered strategies. This paper has argued for, and meticulously outlined, a comprehensive Digital-Bilingual strategy that synergistically employs cutting-edge digital technologies with a deeply considered framework for bilingual and cross-cultural communication design. By proposing the creation of an immersive virtual workshop, an intelligent bilingual mediation system, and a vibrant interactive global community, this integrated approach is designed to have the potential to fundamentally transform how traditional crafts are experienced, understood, learned, and appreciated worldwide.

The proposed model is conceived to systematically address the core challenges identified: linguistic barriers are targeted for mitigation through AI-augmented translation and contextualized storytelling; physical distance is intended to be overcome through VR/AR immersion; and audience disengagement is aimed to be countered through personalization, gamification, and community co-creation. It is firmly aligned with national cultural digitalization policies and resonates with global trends in digital heritage and experiential learning. While the full-scale implementation described is the focus of an ongoing, practice-based university innovation project, the framework presented here is designed to be generalizable, offering a proposed and replicable pathway forward for similar craft-based ICH projects globally.

Future work will proceed along two parallel tracks:

1) Implementation & Evaluation: Completing the platform development, its public launch, and subsequent rigorous, longitudinal empirical research to measure effectiveness through data analytics, user studies, and network analysis.

2) Theoretical Expansion & Model Adaptation: Exploring the application of this Digital-Bilingual framework to other forms of ICH and investigating the

long-term socio-economic impacts and ethical considerations of digital representation.

Through this ongoing work, we aim to contribute actively to the development of a broader, open toolkit for effectively safeguarding and vitalizing our shared intangible cultural heritage within the inclusive and connected space of the global digital commons.

Funding Statement

2025 Provincial college students innovation and entrepreneurship training program project: “Weaving’ the Future—Digital-Bilingual Strategies Empowering the International Promotion of Chinese ICH Willow Weaving Culture” (Level: provincial; Project Number: S202514276015).

Conflicts of Interest

The author declares no conflicts of interest.

References

- [1] Xu, W. and Wu, B. (2025) Innovation and Development of Intangible Cultural Heritage Protection and Inheritance under the Background of Artificial Intelligence. *International Journal of High Speed Electronics and Systems*, **35**, Article 2550013. <https://doi.org/10.1142/s0129156425500132>
- [2] Zabulis, X., Partarakis, N., Demeridou, I., Bartalesi, V., Pratelli, N., Meghini, C., *et al.* (2024) Modelling and Simulation of Traditional Craft Actions. *Applied Sciences*, **14**, Article 7750. <https://doi.org/10.3390/app14177750>
- [3] Yu, G., Wang, M. and Yang, Z. (2025) Four Key Operations of Communication and Exchange in “Mutual Learning of Civilizations”—On Reducing and Eliminating “Cultural Discounts” from the Perspective of Communication Studies. *International Communication of Chinese Culture*, **12**, 1-11.
- [4] Mao, J. and Chen, Y. (2025) A Study on the Cross-Modal Transformation Mechanism for Disseminating Traditional Culture Abroad: “A Text-Image-Translation” Triadic Model Based on Picture Book Translation Practice. *Research and Commentary on Humanities and Arts*, **3**, 112-116.
- [5] Wang, S. (2025) Mode Innovation in the Integration of Virtual Reality and Business Education: A Strategic Study of Building an Immersive Learning Environment. *International Journal of New Developments in Education*, **7**, 23-29.
- [6] Sahu, P.K., Kumar, A., Williams-Persad, A., Mohapatra, D. and Sue-Chee-Ming, W. (2026) A Scoping Literature Review of Artificial Intelligence Integration in Higher Education for Enhanced Teaching, Learning, and Assessment. *Panminerva Medica*. <https://doi.org/10.23736/s0031-0808.25.05384-4>
- [7] Tian, H. and Hemchua, S. (2023) Connotation of New Liberal Arts in China: A Cultural Semiotics Perspective. *Journal of Humanities, Arts and Social Science*, **7**, 42-53. <https://doi.org/10.26855/jhass.2023.01.005>
- [8] Zheng, D. (2025) The Important Value, Practical Dilemma and Optimization Path of Inheritance and Development of Intangible Cultural Heritage: Take Huangzhong of Qinghai as an Example. *Education Research and Innovation*, **1**, 126-132.
- [9] Li, R. (2026) A Study on English Translation Techniques and Application Strategies

from a Cross-Cultural Perspective. *New Explorations in Education and Teaching*, **4**, 58-62.

- [10] Wang, H., Jiang, X. and Ma, X. (2024) The Realistic Dilemma and Optimisation Path of Red Culture Communication in the Age of Self-Media. *Probe—Media and Communication Studies*, **6**, 85-88.