

AIGC-Driven Language Learning Scenarios in Cross-Cultural TCM Communication

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Abstract:

Amid global cultural exchange and digital transformation, the international dissemination of Traditional Chinese Medicine (TCM) culture is confronted with challenges including language barriers, cultural differences, and inadequate communication effectiveness. The emergence of Artificial Intelligence Generated Content (AIGC) technology has opened up new avenues for cross-lingual communication and the development of TCM cultural language learning scenarios. Based on the project “Research on Digital Content Generation and Communication Strategies of Jingchu TCM Culture Based on AIGC”, this study explores how AIGC can enhance the construction of language learning environments for the international dissemination of TCM culture. By establishing a multimodal knowledge base, developing a cross-lingual intelligent optimization system, and designing immersive language learning scenarios, the research seeks to improve the accurate translation of TCM terminology, strengthen the effective transmission of cultural connotations, and promote the systematic enhancement of learners’ cross-cultural communication capabilities. Taking case studies such as the “Xiangsong” herbal incense tablet project and the “TCM Luban Workshop” as examples, this paper analyzes the application mechanisms, practical approaches, and practical significance of AIGC in constructing TCM culture-oriented language learning scenarios. The findings are anticipated to provide theoretical references and practical models for the international and digital dissemination of TCM culture.

Keywords:

AIGC; Traditional Chinese Medicine (TCM) Culture, International Dissemination, Language Learning Scenarios, Jingchu Culture, Cross-Cultural Communication

1. Linguistic Challenges in the International Dissemination of TCM Culture and Opportunities Enabled by AIGC

As an integral part of China’s outstanding traditional culture, the international dissemination of Traditional Chinese Medicine (TCM) culture not only embodies the country’s cultural soft power but also serves as an inherent requirement for building a

global health governance system. However, the international communication of TCM culture has long been plagued by multiple linguistic and cultural obstacles: First, TCM terminology is highly metaphorical and culturally specific. Concepts such as “Yin and Yang” (阴阳), “qi mechanism” (气机), and “meridians” (经络) are likely to suffer semantic loss or misinterpretation during cross-linguistic translation. Second, traditional communication models rely predominantly on one-way output, lacking interactivity and contextual adaptability. [1] This makes it hard to engage target audiences or cultivate their cultural identification. Third, the creation of digital content remains largely manual, leading to low efficiency, high costs, and difficulties in achieving personalized and scalable dissemination.

The maturation of Generative Artificial Intelligence (AIGC) technology offers a promising pathway to address the aforementioned challenges. By leveraging technologies such as natural language processing, multimodal content generation, and knowledge graph construction, AIGC enables the intelligent creation, semantic deconstruction, and cross-lingual adaptation of TCM cultural content. [2] This, in turn, facilitates the development of immersive, interactive, and personalized language learning environments for international audiences. Grounded in the research project “Digital Content Generation and Communication Strategies for Jingchu TCM Culture Based on AIGC,” conducted under the special research initiative “Studies on the International Communication of Jingchu Culture,” this paper draws upon the project team’s expertise in TCM cultural dissemination, language education, and technological development. It systematically examines the pathways, case implementations, and underlying logic of constructing language learning scenarios empowered by AIGC for the global promotion of TCM culture.

2. Theoretical Framework for AIGC-Empowered Construction of Language Learning Scenarios

2.1. The “Technology–Culture–Communication” Tripartite Synergistic Model

Traditional approaches to the international dissemination of TCM culture have predominantly focused on content translation and promotion, often lacking systematic consideration of technology-enabled mechanisms. This study proposes a “technology–culture–communication” tripartite synergistic model, which emphasizes that AIGC serves not only as a content generation tool but also as an intelligent medium connecting cultural symbols, language learning, and communicative contexts. [3]

Within this framework, the technology layer is responsible for digitizing, structuring, and semanticizing TCM cultural resources. This involves, for example, constructing a multimodal knowledge base that integrates texts such as the Compendium of Materia Medica, illustrated catalogs of Jingchu medicinal materials, and videos documenting intangible cultural heritage practices, while leveraging AIGC systems to automatically analyze and reorganize cultural information.

The culture layer delves deeply into the symbolic connotations and ethical logic of TCM to ensure the cultural accuracy of generated content. For instance, when designing bilingual course materials on “acupuncture therapy”, this layer not only provides terminology translation but also incorporates the philosophical background of “meridians and qi” in TCM and Li Shizhen’s Spirit of “Investigating Things to Understand Principles” in the Jingchu Region.

The communication layer closely aligns with the linguistic habits and cognitive needs of international audiences, designing interactive and emotionally resonant learning content. Examples include using AI to generate contextual dialogues, AR-based acupuncture simulations, and personalized cultural Q&A sessions in virtual teaching environments for overseas TCM enthusiasts, thereby facilitating a shift from passive reception to active participation.

This model moves beyond the limitations of traditional linear dissemination, advancing the international communication of TCM culture from mere “content delivery” toward “scenario construction.” It thereby provides sustainable and iterable intelligent support for cross-cultural language learning.

(2) AIGC Adaptation Mechanisms for TCM Language Learning Scenarios

The construction of TCM language learning scenarios requires the systematic resolution of three core challenges: terminology accuracy, cultural adaptation, and learning interactivity. AIGC technology enables efficient adaptation through the following multi-layered mechanisms:

In terms of semantic deconstruction and terminology alignment, AIGC leverages large language models to perform intelligent classical-to-modern translation and semantic annotation of ancient texts such as the Yellow Emperor’s Inner Canon and the Compendium of Materia Medica. This process establishes a structured association map linking herbal property, efficacy and cultural metaphor, thereby enabling context-aware intelligent alignment between Chinese and English terminology. For example, in a teaching case focusing on the core concept of “气血”, the AIGC system not only accurately translates it as “qi and blood” but also generates explanatory diagrams and annotations of TCM theory to illustrate its physiological and cultural connotations in Jingchu medicine, particularly the principle of “harmony as the key”.

In the area of multimodal content generation, AIGC integrates text, images, audio, video, and interactive modules to create immersive learning environments. For instance, in an international course on “acupuncture therapy”, the system can automatically generate 3D meridian animations, simulated needle manipulation videos, and real-world footage of intangible cultural heritage practices such as moxibustion from the Jingchu region. This allows learners to understand the practical application of specialized terms like “得气” (deqi, or needle sensation) through audiovisual interaction.

Regarding dynamic feedback and personalized recommendations, AIGC leverages learner behavior data to adjust content difficulty and presentation modes in real time. For instance, when an international student explores the compatibility principle of “君臣佐使” (sovereign, minister, assistant, and envoy) within the “Chinese Herbal Formulae” module, the system proactively recommends relevant herb-pairing examples, compatibility animations, and tailored quizzes. By continuously learning from user responses, it refines subsequent learning pathways, enabling truly adaptive, individualized language support—embodying a “one-learner, one-strategy” approach.

In summary, through the tightly integrated mechanisms of intelligent semantic analysis, multimodal content generation, and data-informed feedback, AIGC not only improves the precision of cross-cultural TCM terminology transfer but also promotes a more profound synthesis of cultural comprehension and language acquisition. This advancement supports the development of a new generation of TCM language

learning environments that are scientifically grounded, culturally enriched, and highly interactive.

3. AIGC-Driven Construction Pathways for TCM Culture Language Learning Scenarios

3.1. Building a Multimodal Knowledge Base: From Ancient Texts to a Cultural Semantic Network

The knowledge base forms the foundational layer for AIGC-generated content and constitutes a core resource for developing language learning scenarios. Concentrating on Jingchu TCM culture, the project team undertook a systematic integration of canonical texts such as the *Compendium of Materia Medica* and the *Yellow Emperor's Inner Canon*, medical artifacts from Chu tombs preserved in the Jingzhou Museum, and intangible cultural heritage practices like Qichun moxibustion. [4] This work resulted in the creation of a multimodal knowledge base encompassing text, image and video, which was realized through three principal dimensions:

In the digitization and semantic annotation of classical texts, the process encompassed not only transforming texts into digital format through OCR and manual verification, but also leveraging entity recognition and relation extraction technologies to label core semantic units. For instance, during the development of the bilingual teaching module titled “Authentic Medicinal Materials of Jingchu in the *Compendium of Materia Medica*,” the system automatically extracts the entry for “Qiai”, associates it with medicinal properties such as “warming the meridians and stopping bleeding”, connects it to cultural narratives related to Li Shizhen’s hometown, and constructs a bilingual semantic network. This approach allows students to intuitively grasp the Chinese herb’s multi-layered significance, spanning from its nomenclature and therapeutic attributes to its cultural symbolism.

In digitizing cultural relics and intangible heritage resources, interactive digital assets were produced using techniques such as 3D scanning of incense burners from Chu tombs and motion capture of moxibustion techniques. For example, in the English Training on Traditional Chinese Medicine Culture, students can examine a 3D model of a bronze incense burner from the Warring States period through VR equipment. At the same time, the system delivers bilingual narration in Chinese and English that clarifies the TCM principle of using fragrance to dispel impurities and relates it to Jingchu’s herbal fragrance culture. This method supports the integrated learning of artifact identification and cultural understanding.

In constructing the knowledge graph, an interconnected network was built around key nodes such as “medicinal materials—formulas—symptoms—cultural symbols”. To illustrate, when a student searches for “Shanghan” (Cold Damage disorders), the knowledge graph not only retrieves pertinent passages and their English translations from the *Treatise on Cold Damage*, but also connects them to Jingchu-region formulas like “Gegen Tang” (Kudzu Decoction), descriptions of characteristic symptoms, and related folk customs, such as hanging mugwort during the Dragon Boat Festival for disease prevention. This approach turns abstract medical concepts into a multidimensional, tangible cognitive map.

This transformation—from classical texts to a culturally enriched semantic network—not only supplies structured knowledge for AIGC-driven content generation but also establishes a digital teaching resource system that harmonizes

scholarly precision with cultural richness. By doing so, it moves language learning past the simple retention of terminology toward the deliberate and systematic building of cultural understanding.

3.2. Developing a Cross-lingual Intelligent Optimization System: Addressing the Challenge of Terminology Translation Distortion

The accurate and meaningful translation of TCM terminology across languages has long presented a dual challenge: ensuring not only linguistic precision but also the conveyance of its profound conceptual depth. To systematically overcome this issue, the project team designed and implemented a context-aware intelligent translation optimization system, which was then seamlessly embedded into international TCM teaching environments. [5] The specific workings and educational applications of this system are detailed below:

At the core of the system lies a systematically constructed bilingual terminology database. The foundation was built through the comprehensive gathering of key TCM terms and their official translations, with a particular focus on annotating terminology unique to the Jingchu region. For instance, during the instructional activity “Writing English Scripts on Jingchu Characteristic Therapies”, when an educator enters terms like “蕪艾灸疔” or “九蒸九晒”, the system delivers not just direct translations but also automatically links to detailed bilingual notes. These annotations explain the production methods, authenticate the geographical origin, and contextualize the cultural significance, thereby supplying precise and comprehensive terminology resources for developing teaching materials.

The Context-Aware Translation Algorithm enables terminology to adapt flexibly across diverse teaching contexts. By employing pre-trained language models enhanced with transfer learning, the system dynamically tailors its translations according to text genre and audience. For example, the term “荆楚膏方” is rendered precisely as “Jingchu Herbal Paste Formulation” in academic papers. In contrast, for introductory science videos aimed at a global audience, it is thoughtfully adapted as “Jingchu-style Medicinal Syrup”, accompanied by an automatically generated note such as “a traditional herbal preparation used to support wellness”.

The Cultural Annotation Embedding Mechanism plays a crucial role in promoting deeper understanding. As the system delivers translations, it concurrently generates explanations of a term’s cultural background. For example, when teaching the classic term “扶正祛邪”, the system not only supplies the standard translation—“strengthening the body’s resistance to eliminate pathogenic factors”—but also automatically inserts a cultural note: “This concept originates from *The Yellow Emperor’s Inner Canon*, reflecting the TCM preventive principle that when healthy qi is sufficient, pathogenic factors cannot invade. It also echoes the folk belief in Chu culture of the “tiger totem” as a symbol for repelling epidemics. This embedded annotation can be seamlessly integrated into group discussions, helping students connect TCM theory with its regional cultural roots.

Through this system, terminology translation moves beyond mere word-for-word substitution. It evolves into an integrated pedagogical tool that seamlessly combines language learning, theoretical understanding, and cultural interpretation, thereby effectively mitigating semantic distortion in cross-cultural communication.

3.3. Designing Immersive Language Learning Scenarios: From Virtual Diagnosis to Cultural and Creative Interaction

By leveraging AIGC, highly immersive and interactive language learning environments can be created, offering a powerful means to enhance learner engagement and cultural identification. Informed by practical teaching needs, the project team has designed and implemented the following three representative scenarios:

Developed using the Unity engine and AIGC technology, the Virtual TCM Diagnosis Scenario enables learners to assume the roles of either doctor or patient and engage in interactive dialogue with an AI assistant. For instance, students act as the “doctor” and conduct virtual consultations. During the tongue diagnosis segment, when a student describes symptoms such as “loss of appetite and a bitter taste in the mouth”, the system dynamically generates a corresponding image of a yellow, greasy tongue coating. At the same time, the AI assistant says that a yellow and greasy tongue coating aligns with the TCM syndrome pattern of internal dampness-heat accumulation. In the Jingchu region, a modified version of *Huoxiang Zhengqi San* is often prescribed for this condition. Whenever terms like “dampness-heat” arise in the student’s dialogue, the system automatically supplies bilingual explanations of the associated pathological mechanisms and treatment principles. This integrated approach allows for the concurrent development of language skills and specialized medical knowledge.

The Bilingual Explanation System for TCM Cultural and Creative Products converts physical artifacts into portable learning tools. In one teaching application, during a cultural immersion session, international students scan the “Jingchu Liuxiang” incense tablet with their smartphones, instantly activating an AI-generated AR explanatory video. A voiceover explains “This incense tablet combines authentic Jingchu medicinal ingredients such as Qizhou mugwort and Chuanxiong. Mugwort is traditionally associated with protecting against pathogens, while Chuanxiong helps promote blood circulation. Together, they reflect the Jingchu medical principle of integrating medicine with diet and uniting prevention with treatment. The narration is supported by visuals of the herbs and animated sequences illustrating the crafting process. This allows students to explore cultural meaning through direct interaction with the physical object while engaging with its digital representation.

The Cross-Border TCM Culture Short Video Lesson Series enables the creation of learning scenarios that are both scalable and socially engaging. [6] For example, the “Legend of Acupuncture” short video series, developed for the international course of Introduction to Acupuncture, uses AIGC to generate well-structured and engaging English narratives. These scripts are then complemented by detailed animations of needle insertion and manipulation, produced using motion-capture technology. After the videos are released on overseas platforms, an integrated interactive Q&A module responds in real time to viewer comments. For instance, if a viewer asks, “Does acupuncture hurt?” the system automatically generates a clear and engaging response that explains the sensation by integrating neuroscientific principles with the traditional concept of “deqi”, while also recommending related learning resources to the viewer. Together, these elements create an immersive learning ecosystem that combines in-depth simulation, hands-on interaction, and wide-reaching dissemination, allowing language skills and cultural understanding to develop naturally through the blending of virtual and physical experiences.

4. Analysis of Typical Cases: The Application of AIGC in TCM Culture Language Learning Scenarios

4.1. Case One: AIGC-Enhanced Language Learning Practice in the “Scent Ode” Chinese Herbal Incense Tablet Project

The “Scent Ode” Chinese Herbal Incense Tablet is a cultural product grounded in Jingchu traditional Chinese medicine culture, developed by Hubei College of Chinese Medicine. Winner of the first prize in the 2024 Hubei University Student Cultural and Creative Works Competition, this project lends itself to AIGC-supported international promotion and language-learning scenario development in several key ways:

(1) Multilingual Interpretation and Generation of Cultural Symbols

By applying AIGC, the symbolic patterns on the incense tablet—such as Chu-style cloud designs and phoenix motifs—undergo cultural semantic analysis to produce bilingual Chinese–English explanatory texts. For example, for the “phoenix holding mugwort” motif, the system generates an interpretation such as: “The phoenix, an ancient Chu symbol of renewal, carries mugwort in its beak, illustrating how herbal medicine is woven into the fabric of local cultural identity.”

(2) Multilingual Generation of Interactive Production Tutorials

An AI-powered system generates illustrated, bilingual (Chinese–English) tutorials from user-inputted incense tablet production steps. With audio narration also available for playback, these tutorials integrate the names of medicinal ingredients, their therapeutic effects, and relevant cultural context, allowing learners to naturally pick up TCM terms and concepts through hands-on creation.

4.2. Case Two: AIGC-Driven Restructuring of the “TCM Luban Workshop” Language Curriculum

The “TCM Luban Workshop” is an international TCM cooperation initiative led by Hubei College of Chinese Medicine in countries including Belarus and the Philippines. The integration of AIGC technology offers significant potential to reshape its language training curriculum through the following key approaches:

(1) Personalized Courseware Generation

Drawing on learner profiles that include native language background, foundational TCM knowledge, and learning goals, AIGC automatically produces bilingual training materials. For instance, courseware created for nursing students in the Philippines highlights bilingual terminology for practical skills such as acupuncture and massage, and embeds simulated case-based dialogues.

(2) Virtual Training Scenario Development

A VR-based TCM training environment has been designed, enabling learners to enter simulated settings—such as a pharmacy or clinic—through VR headsets, where they can practice consultations with AI-generated patients. The platform assesses in real time the learner’s linguistic accuracy, cultural appropriateness, and adherence to clinical protocols, while offering corrective feedback on speech and contextual knowledge prompts.

(3) Intelligent Enrichment of the Cross-Cultural Case Library

Communication examples gathered from the “Luban Workshop” field practice are processed by AIGC to ensure privacy, organize thematically, and transcribe into

multiple languages, thereby compiling a cross-cultural case library. Instructors can readily access these cases to prepare classroom teaching materials, helping instructors create classroom materials that are both practical and culturally relevant.

5. Conclusion and Prospects

Looking ahead, advances in multimodal large models, affective computing, and extended reality (XR) are set to make AIGC-supported TCM language learning environments more intelligent, immersive, and learner-sensitive. Future iterations of a “virtual clinic,” for example, could incorporate emotion-sensitive interfaces that detect a learner’s confusion and adjust instructional delivery in response. To address emerging challenges and harness such possibilities, we call for deeper interdisciplinary collaboration—forming a cross-domain community that connects TCM studies, linguistics, computer science, communication, and cognitive psychology. Only through sustained, integrated effort can we shape a smart learning ecosystem that is technologically robust, culturally attuned, scalable, and human-centered. Ultimately, this pathway can foster richer global engagement with TCM culture—shifting from superficial awareness to meaningful comprehension, and from passive reception to active international co-creation.

Notes on Contributors

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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