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EXPLORING THE DILEMMAS AND INNOVATIVE PATHWAYS OF AI-EMPOWERED ETHNIC MUSIC EDUCATION IN HIGHER INSTITUTIONS UNDER THE "BUILDING A STRONG EDUCATION NATION" STRATEGY

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Abstract: The core of building a leading nation in education lies in implementing the fundamental mission of cultivating virtue and nurturing talent, and in fostering the deep integration of education, science and technology, and human resources. This entails constructing an educational system characterized by six key attributes—including ideological and political guidance, talent competitiveness, and technological support. A primary focus is placed on establishing eight major subsystems, encompassing the cultivation of character and spirit, basic education, vocational education, and higher education. Fundamentally, this approach is people-centered; within this context, ethnic music education in higher institutions serves not merely as a means of training specialized professionals, but more importantly, as a vital vehicle for fostering cultural confidence and preserving China's outstanding traditional culture. Artificial intelligence (AI) has opened new avenues for the preservation and innovation of ethnic music education; indeed, the integration of AI into higher education institutions represents a transformative pathway for revitalizing this field. However, the AI-enabled advancement of ethnic music education in higher institutions currently faces numerous challenges. Grounded in the strategic imperatives of building a leading nation in education, this paper explores the specific dilemmas confronting the integration of AI and ethnic music education in higher institutions. It identifies innovative pathways for their deep integration, leverages the value of AI empowerment, and aims to drive the high-quality development of ethnic music education in higher institutions—thereby ensuring the "living transmission" of ethnic music in the digital era and solidifying the foundations of cultural and aesthetic education.
Keywords: Ethnic music education in higher institutions; AI empowerment; Leading nation in education; Dilemmas and innovative pathways

1 INTRODUCTION

Building a leading nation in education constitutes the core strategic objective for constructing a high-quality education system in the new era, prioritizing people-centered education and the use of culture to shape the soul as its primary tasks. General Secretary Xi Jinping has pointed out that, in building a leading nation in education, it is essential not only to accelerate the construction of a high-quality education system but also to regard the cultivation and promotion of socialist core values—along with the inheritance of China's fine traditional culture—as fundamental tasks [1]. The *Outline for Building a Leading Nation in Education (2024–2035)* explicitly proposes comprehensively advancing the use of culture to shape the soul and nurture students, and promoting the integration of China's fine traditional culture into campuses and classrooms[2]. As a vital vehicle for carrying national historical memory and cultural spirit, ethnic music serves as a crucial foundation for universities to undertake the inheritance of traditional culture and to deepen aesthetic education. Guided by the strategy of building a leading nation in education, promoting the high-quality development of ethnic music education in universities stands as a key pillar for solidifying both cultural and aesthetic foundations. In the digital era, artificial intelligence (AI) provides significant momentum for the digital transformation of education, while also offering new pathways for resolving long-standing practical issues within university-level ethnic music education—such as the uneven distribution of faculty resources, insufficient "living inheritance," and limited channels for dissemination. Currently, technologies such as intelligent musical score recognition, AI accompaniment, and AI vocal backing are being gradually applied to classroom instruction; these applications facilitate the sharing of ethnic music resources across time and space, help ethnic music transcend the confines of specific cultural circles, and expand its social reach—thereby demonstrating the vast potential for technological empowerment.
At the same time, it must be acknowledged that the integration of AI with university-level ethnic music education remains in its nascent stages and faces numerous practical constraints. AI technologies currently lack sufficient adaptability to the unique modes, timbres, and regional cultural connotations inherent in ethnic music, making it difficult for them to effectively support the traditional pedagogical paradigm of "oral instruction and physical demonstration." Furthermore, the application of technology often remains at a purely instrumental level, failing to fully

manifest the humanistic connotations and spiritual values of ethnic music. Coupled with a shortage of interdisciplinary faculty and an underdeveloped support system for digital resources, the AI-enabled development of ethnic music education continues to face considerable challenges. Grounded in the overarching requirements for building a leading nation in education, this paper focuses on the core tensions inherent in the integration of artificial intelligence (AI) and ethnic music education. It explores innovative pathways wherein technology is rooted in culture and serves as a tool for holistic human development. The aim is to strike a balance between technological application and cultural heritage preservation, thereby enabling AI to serve as a digital medium for the transmission of ethnic music education. This endeavor seeks to facilitate the digital, living transmission of China's outstanding traditional culture and to inject cultural momentum into the construction of a leading nation in education for the new era.

2 BUILDING A LEADING NATION IN EDUCATION IS INSEPARABLE FROM ETHNIC MUSIC EDUCATION IN HIGHER INSTITUTIONS

2.1 Forging the Soul through Music: Consolidating the Foundations of Cultural Confidence

The construction of a leading nation in education is by no means confined solely to the cultivation and supply of specialized professional talent; rather, its deeper strategic significance lies in achieving an organic unity between holistic human development and the spiritual forging of the soul. It constitutes a systemic national strategic undertaking charged with the mission of ensuring the continuity of national culture and the innovative transmission of civilization. General Secretary Xi Jinping has pointed out: "Building a leading nation in education requires not only the cultivation of high-caliber professional talent but, more importantly, the fortification of the foundations of national cultural confidence"[3]. As a core living medium for the transmission of China's outstanding traditional culture, ethnic music embodies profound historical and cultural heritage, alongside unique functions in aesthetic education and value guidance. Within the realm of higher education, it serves as the central practical pillar for fulfilling the mission of preserving and innovating upon China's traditional culture, as well as for upholding the fundamental task of "cultivating virtue and nurturing talent." Consequently, it holds irreplaceable and vital value within the systemic strategic framework of building a leading nation in education. The core objective of this national educational endeavor is to cultivate a new generation of young talent—individuals who possess both solid professional competence and unwavering cultural confidence. Furthermore, the genesis and fortification of this cultural confidence rest fundamentally upon the individual's deep value-based identification with indigenous Chinese culture and their conscious engagement in its preservation and transmission. Ethnic music serves as a profound vessel for the collective historical memory, the emotional fabric of daily life, and the deep spiritual aspirations of the Chinese nation. From folk ballads to instrumental music, its ceaselessly flowing melodic lineage consistently enshrines and perpetuates the unique cultural genes and spiritual codes of the Chinese people. According to the Ministry of Education's 2025 statistics on the implementation of aesthetic education in national higher education institutions, 92.3% of undergraduate colleges and universities across the country have already established courses related to ethnic music[4]. By conducting ethnic music education, higher education institutions can guide students—through the processes of aesthetic listening and systematic study—to deeply perceive the living humanistic significance and historical resonance of ethnic culture. This enables students to systematically grasp the developmental trajectory and profound spiritual core of their culture, thereby fostering a deep sense of value identification, emotional belonging, and cultural pride regarding indigenous Chinese culture. Consequently, this serves as a crucial practical pathway for solidifying the foundations of cultural confidence within the broader endeavor of building a strong nation through education.

2.2 Cultivating Character through Aesthetics: The Core Vehicle for Deepening Aesthetic Education in Higher Institutions

Aesthetic education constitutes a core dimension and spiritual pillar in the construction of a strong nation through education; its fundamental objective lies in nurturing well-rounded individuals and achieving a dual enhancement of both spiritual richness and aesthetic literacy. General Secretary Xi Jinping has emphasized: "To effectively carry out aesthetic education, we must adhere to the principle of cultivating virtue and nurturing talent, remain rooted in the realities of contemporary life, respect the inherent characteristics of aesthetic education, and promote the spirit of Chinese aesthetic traditions"[5]. By virtue of its unique artistic attributes and cultural DNA, ethnic music serves as an irreplaceable core vehicle within the aesthetic education systems of higher institutions. Unlike forms of aesthetic education that necessitate complex textual interpretation, ethnic music utilizes the auditory medium to embed emotion and aesthetics within melody, rhythm, and timbre. It reaches directly into the human heart without the need for cumbersome theoretical exegesis, enabling students to experience emotional resonance through intuitive perception and to concretely internalize the concept of beauty—thereby effectively resolving the persistent challenge of aesthetic education becoming "detached" or abstract. Mr. Tao Xingzhi once posited: "Life itself is education; aesthetic education is, in essence, emotional education; and ethnic art represents the most authentic form of emotional education"[6]. By utilizing ethnic music as a unifying thread to construct a diversified pedagogical system for aesthetic education—incorporating methods such as classroom appreciation, practical performance, and cultural provenance studies—higher education institutions guide students to both perceive and create beauty. The patriotic sentiments, folk traditions, and humanistic spirit embodied in traditional ethnic music serve not only to enhance students' aesthetic judgment and creativity but also to nurture their moral character and bolster their cultural confidence. This fulfills the

educational objectives of "cultivating people through beauty and culture," precisely addressing the core requirement of building a "strong education nation"—namely, "cultivating well-rounded individuals"—and thereby laying a solid spiritual foundation for this national endeavor.

2.3 Conveying Culture Through Music: Facilitating the International Dissemination of Chinese Culture

Higher education in traditional ethnic music also provides vital practical support for the international dissemination of Chinese culture, serving as a key vehicle for demonstrating the global vision and broad international perspective inherent in the construction of a "strong education nation." As an artistic medium and cultural signifier capable of transcending cultural boundaries and linguistic barriers, traditional ethnic music can leverage diverse avenues—such as international academic exchanges, transnational educational collaborations, and integrated digital media platforms—to effectively propel China's outstanding traditional music onto the global artistic stage, thereby realizing the cross-cultural dissemination and value transmission of Chinese culture. According to 2024 data on overseas cultural dissemination released by China's Ministry of Culture and Tourism, cultural programs featuring traditional ethnic music enjoy an acceptance rate of 68.7% among young audiences abroad[7], thereby emerging as a core vehicle for the external dissemination of Chinese culture. Rooted in the developmental imperatives of the digital era, higher education institutions are cultivating a new generation of versatile talent—individuals who possess both a deep grounding in traditional ethnic culture and the requisite skills for international communication—thereby expanding the reach of traditional ethnic music and continuously enhancing the global influence of Chinese culture. In summary, higher education in traditional ethnic music serves as a pivotal pillar within the construction of a "strong education nation," underpinning cultural inheritance, aesthetic education, talent cultivation, and international dissemination; consequently, the high-quality development of this field represents an indispensable pathway toward realizing the vision of a strong education nation.

3 THE DILEMMAS OF AI EMPOWERMENT

3.1 The Complexity of Algorithms for Ethnic Music

The melodies, rhythms, and timbres of ethnic and folk music exhibit significant diversity and cultural specificity; traditional audio feature extraction methods are unable to fully uncover their underlying patterns, constituting a core technical bottleneck for the application of artificial intelligence in this field. In terms of melody, the eight-tone modal system and polyphonic improvisational variations characteristic of the Dong people's *Grand Songs* (Dongzu Dage) impose extremely high demands on the fault tolerance and generalization capabilities of algorithmic models. According to the 2025 *Experimental Report on AI Recognition Accuracy for Ethnic Vocal Music* published by the Sichuan Conservatory of Music, current mainstream AI models exhibit an error rate as high as 41.2% in recognizing the polyphonic parts of *Grand Songs*, rendering them incapable of accurately capturing the nuances of improvisational variations. Furthermore, the microtonal techniques employed in the performance of the Uyghur *Rawap* require pitch detection accuracy of ±5 cents; however, existing mainstream pitch detection methods possess limited resolution, making it difficult to precisely capture subtle pitch fluctuations such as glissandi and vocal embellishments [8]. Regarding rhythm, distinctive rhythmic patterns—such as the alternating fast and slow tempos of the Dai people or the long-and-short phrasing of the Mongol people—feature complex structures and flexible grooves; lacking regular meters or standardized notation conventions, they significantly increase the difficulty of precise algorithmic modeling. In terms of timbre, the harmonic structures and envelope characteristics of a single ethnic musical instrument vary significantly depending on the specific performance techniques and regional stylistic schools employed, thereby further complicating the process of feature extraction. Monitoring data from 2025, released by the Center for Educational Technology and Resources Development under the Ministry of Education, indicates that while mainstream AI models achieve a recognition accuracy rate of 92.3% for Western instruments such as the piano and violin, their accuracy rate for ethnic instruments—such as the *Suona*, *Guqin*, and *Rawap*—stands at a mere 58.7% [9]. Fundamentally, mainstream AI algorithms are developed based on the Western twelve-tone equal temperament system; consequently, they are inherently incompatible with the pentatonic, octatonic, and microtonal systems characteristic of my country's traditional ethnic music. Furthermore, Chinese traditional and folk music accounts for less than 3.2% of the training data used in mainstream commercial music AI models[10]. This structural imbalance in datasets within the field of ethnic music directly results in algorithmic models that suffer from poor adaptability and insufficient generalization capabilities when applied to this specific domain. Therefore, it is imperative to construct a sophisticated, intelligent, and innovative algorithmic framework tailored to the unique acoustic and cultural characteristics of ethnic music, thereby providing core support for the technological implementation and deepened application of AI within this field.

3.2 The Traditional Nature of Pedagogy

Currently, ethnic music education in higher institutions is predominantly guided by the traditional paradigm of "oral transmission and personal instruction"—a master-apprentice model wherein the teaching process is imbued with rich emotional expression, individual stylistic nuances, and distinct regional aesthetic sensibilities. AI-generated vocal assistance and musical accompaniment often exhibit mechanical, rigid, and standardized characteristics; they lack the unique charm inherent to ethnic music and fail to accurately replicate specific regional vocal styles and improvisational

qualities. A 2025 survey conducted by the China Association of Higher Education revealed that 82.1% of full-time ethnic music instructors believe that "AI cannot replicate the emotional conveyance and stylistic guidance provided by a teacher's demonstration"[11]. In classroom applications, AI currently serves only basic auxiliary functions and has yet to achieve a fundamental restructuring of pedagogical models or a significant enhancement of teaching efficiency. Within the instructional process, the teacher remains the sole central conveyor of knowledge and technical skills, while the role of AI is confined to tasks such as audio playback, intelligent music notation recognition, and simple audio effects processing; it has not yet been deeply integrated into the comprehensive pedagogical workflow—encompassing lesson preparation, instruction, post-class practice, and performance assessment. Data from the same survey indicates that in 76.3% of university ethnic music classrooms, AI is utilized solely for basic auxiliary functions; only 12.7% of classrooms have integrated AI into the entire teaching cycle. Consequently, there has been a complete failure to reconstruct or optimize the traditional "oral transmission and personal instruction" model, and the core empowering value of AI has not been effectively realized.

Secondly, the potential for personalized learning within AI-assisted instruction remains untapped, making it difficult to meet students' diverse learning needs. High-quality instruction typically requires accommodating individual student differences; however, the AI capabilities—such as learning behavior analysis, algorithmic adaptation, and personalized guidance—are not being fully leveraged in current ethnic music education. As a result, the shortcomings inherent in traditional teaching methods—which AI was intended to address—remain unmitigated. The root cause lies in the severe lack of specialized data accumulated within the specific context of ethnic music instruction; AI is currently unable to precisely identify and capture the subtle nuances involved in playing various ethnic instruments or executing specific vocal styles, making it difficult to generate personalized learning plans and instructional recommendations. Survey data reveals that 69% of surveyed instructors explicitly stated that "current AI tools are incapable of enabling individualized instruction (*teaching according to aptitude*) in ethnic music education," and that they must still rely on traditional teaching models to provide personalized guidance—demonstrating that the value of AI in facilitating differentiated instruction remains completely unrealized.

3.3 The Disconnect in Faculty Expertise

Faculty constitutes the core pillar of support for education in higher learning institutions. However, the current landscape of ethnic music education in universities is characterized by a pervasive structural disconnect: "instructors knowledgeable in ethnic music lack professional expertise in AI technology, while instructors proficient in AI lack professional knowledge of ethnic music." This disconnect between the two domains directly hinders the deep integration of AI into ethnic music education. The Ministry of Education's 2025 *Statistical Bulletin on the Faculty Structure of Art Education in National Higher Education Institutions* reveals that, among full-time faculty members specializing in ethnic music across the country's universities, 91.2% possess a background solely in the musical arts. Only 8.7% of these faculty members have received systematic training related to AI technology, and fewer than 4.5% are capable of proficiently operating specialized AI music software or independently designing AI-assisted instructional plans[12]. While the majority of ethnic music faculty members in higher education institutions have deeply cultivated their respective professional fields—possessing a solid foundation in ethnic music theory as well as performance and vocal skills—their professional backgrounds limit them; most lack even a basic understanding of AI technology. Consequently, they are unable to proficiently operate specialized digital tools, and find it even more difficult to integrate AI into ethnic music instruction—specifically in terms of designing instructional plans, organizing teaching activities, and evaluating learning outcomes—in a manner that aligns with pedagogical requirements.

Conversely, computer science faculty members who do possess AI technical expertise generally lack an understanding of the pedagogical principles, professional characteristics, and educational objectives inherent to ethnic music instruction. As a result, they are unable to develop AI tools and instructional models that are truly tailored to the specific needs of ethnic music education. Data from the China Association of Higher Education indicates that, currently, only 6.8% of full-time faculty members in the nation's universities possess the interdisciplinary competence to bridge both ethnic music expertise and AI technological literacy[13]. This professional barrier—characterized by the notion that "the arts do not understand technology, and technology does not understand the arts"—has directly resulted in a lack of "custom-tailored" design in the integration of AI with ethnic music education. Instead, current efforts often amount to little more than the simple transplantation of generic AI tools, making it difficult to establish practical implementation pathways that genuinely align with the realities of classroom instruction. At its root, this issue stems from pronounced disciplinary silos within higher education institutions, coupled with a lack of talent cultivation systems specifically designed for the interdisciplinary intersection of music and computer science. Furthermore, there is an absence of standardized, ongoing training mechanisms for ethnic music faculty regarding AI skills; likewise, existing systems for professional title evaluation and performance assessment do not sufficiently prioritize or reward interdisciplinary teaching achievements, thereby leaving faculty members without the necessary motivation or avenues to enhance their interdisciplinary capabilities.

3.4 The Erosion of Cultural Vitality

Compared to the superficial dilemmas surrounding technical compatibility and pedagogical integration, the issues of cultural cognitive bias and the dissolution of humanistic substance constitute the most critical and profound

contradictions inherent in the integration of AI with ethnic music education in higher education institutions. The core value of ethnic music lies not in the standardized presentation of melody or performance technique, but rather in the collective ethnic memories, regional characteristics, and spiritual essence it embodies. By relying on the fitting of standardized data and the execution of fixed algorithms, AI runs a significant risk of eroding the humanistic warmth and cultural core of ethnic music[14]. On one hand, the standardization-driven logic of AI tends to dissolve the unique artistic qualities of ethnic music. The true charm of ethnic music resides in the nuanced expression of non-standardized details; regional expressions—such as the ethereal resonance of Mongolian *Long Song* (*Urtin Duu*) or the uninhibited vigor of folk songs from Northern Shaanxi—are exceedingly difficult for standardized algorithms to replicate with precision. A 2025 survey conducted by the Chinese Academy of Arts revealed that 67.4% of AI-generated ethnic music works suffer from issues of cultural misinterpretation and homogenization; furthermore, 72.3% of Intangible Cultural Heritage (ICH) inheritors expressed the view that AI is capable only of replicating melodic forms, but incapable of conveying cultural substance[15]. For instance, while mainstream AI-generated renditions of the Mongolian *Long Song* may adhere to standard musical notation, they invariably lack the emotional depth and the cultural resonance of the grasslands embodied in the *Nogula* vibrato—a deficiency that has led industry experts to characterize such works as possessing "form without soul."

On the other hand, an over-reliance on AI threatens to undermine the logic of "living heritage" inherent in ethnic music—specifically, the tradition of "oral transmission and heart-to-heart instruction." The tacit knowledge embedded within ethnic music requires conversion through immersive, face-to-face human interaction; the formulaic replication offered by AI is simply incapable of bearing the full weight of this cultural depth. The *2024–2025 Academic Year Teaching Tracking and Survey Report on the "Long-Tune" Ethnic Vocal Music Course* by the Inner Mongolia Arts University reveals that students who rely heavily on AI assistance for vocal embellishment and pitch correction scored 32.6% lower—in terms of both vocal nuance and cultural understanding—than those who practiced exclusively using the traditional "oral transmission and heart-to-heart instruction" method. This reliance not only leads to a regression in technical proficiency but also severs the intrinsic link between ethnic music and ethnic culture, thereby stripping the living heritage of its humanistic foundations[16].

3.5 The Lag in Support Mechanisms

The deep integration of AI into ethnic music education within higher education institutions requires a foundation of robust hardware and software support systems, stable policy support mechanisms, and effective long-term collaborative operational frameworks. Currently, the development of these essential support and guarantee systems in my country lags significantly behind, emerging as a critical bottleneck that hinders the normalized and systematic advancement of integration practices. On one hand, the provision of digital hardware facilities is severely inadequate and fails to meet the demands of routine teaching activities. The Ministry of Education's *2025 Monitoring Report on Aesthetic Education Facility Configuration in National Higher Education Institutions* indicates that the configuration rate for specialized AI music teaching equipment in local universities and professional music conservatories stands at a mere 31.5%—with the rate in local universities in western China falling below 18%. Furthermore, the majority of institutions have not established dedicated spaces for AI-assisted ethnic music instruction, nor do they possess the specialized equipment required for the capture of ethnic musical timbres, professional audio analysis, or AI-driven musical composition[17]. According to the 2025 *Guiding Price List for Art Education Equipment Procurement in National Higher Education Institutions* published by the China Educational Equipment Industry Association, a standardized AI audio acquisition and analysis system—specifically tailored for ethnic music instruction in universities—typically comprises a dedicated pickup kit for ethnic instruments, a multi-track professional audio workstation, high-precision timbre sampling and analysis software, and an AI music modeling host. The average market procurement price for a single unit stands at 68,000 RMB. Furthermore, high-precision sampling equipment designed for the intangible cultural heritage instruments of ethnic minorities carries a procurement price exceeding 120,000 RMB per unit[18]. Constrained by limited annual budgets for specialized aesthetic education funds, most local universities struggle to implement such equipment on a large scale; indeed, many are unable to even fully equip their classrooms with basic digital teaching infrastructure. Consequently, both faculty and students are unable to engage in AI-integrated teaching and learning practices on a regular basis; the application of technology remains largely confined to theoretical discussions and sporadic pilot projects, failing to achieve comprehensive, practical implementation.

On the other hand, there is an insufficient supply of policy and resource support, and a lack of long-term operational mechanisms for collaboration between universities and enterprises. Currently, there is a severe shortage of specialized policies, financial subsidies, and construction projects specifically aimed at leveraging AI to empower ethnic music education within China. Although the Ministry of Education continues to advance the digital transformation of education, there remain significant gaps regarding specific implementation guidelines and targeted support for specialized aesthetic education fields such as ethnic music. Data from the 2024–2025 project approvals under the National Educational Science Planning program reveal that only three national-level projects—and fewer than 20 provincial-level projects—are specifically dedicated to AI-enabled ethnic music education. Furthermore, the funding gap for specialized support exceeds 80%[19], forcing universities to rely solely on their own institutional funds and limited internal resources to conduct relevant research and practice. Concurrently, collaborations between universities and technology enterprises are predominantly short-term pilot initiatives, lacking sustainable, long-term collaborative mechanisms: data from the China Association of Higher Education indicates that only 11.3% of universities have

established long-term partnerships with technology firms for AI-enabled ethnic music education, while 87% of such collaborations consist of short-term pilot projects lasting less than one year. Enterprises, unfamiliar with the specialized requirements and contextual nuances of traditional music education, struggle to develop highly adaptable AI tools; conversely, universities face difficulties in precisely articulating their pedagogical needs to enterprises and in providing specialized data and materials on traditional music. Consequently, collaborative efforts struggle to deepen sustainably, and the majority of integration initiatives stall almost as soon as they begin.

4 PATHWAYS FOR AI INNOVATION EXPLORATION

4.1 Specialization of Algorithms

Current mainstream AI audio models exhibit significant domain-specific adaptation biases; while they demonstrate strong processing capabilities for Western classical and popular music, they suffer from severe deficiencies in recognizing and adapting to the unique performance techniques, acoustic characteristics, and aesthetic systems of ethnic music. Consequently, they are unable to execute highly nuanced tasks—such as distinguishing specific breathing techniques in *Suona* performance, recognizing the emotional nuances within *Guzheng* vibrato, or matching the stylistic *Qi* (vital energy) and flow of *Kunqu* opera vocals. The core issue lies in the models' lack of a systematic, specialized knowledge base and training dataset dedicated to ethnic music, making it difficult to achieve a deep understanding and precise processing of this genre. According to monitoring data from 2025 released by the Center for Educational Technology and Resources Development under the Ministry of Education, the recognition accuracy of mainstream AI models for ethnic musical instruments stands at a mere 58.7%—significantly lower than the 92.3% accuracy achieved for Western musical instruments. To address this shortcoming, universities, enterprises, and cultural and tourism departments must collaborate to establish a specialized digital educational ecosystem for ethnic music. The primary objective is the joint construction of a specialized digital resource repository—a model already supported by established national-level pilot projects. For instance, the "Digital Resource Repository for Chinese Ethnic Music," spearheaded by the China Conservatory of Music, has systematically archived over 120,000 traditional musical pieces from China's 56 ethnic groups, acoustic and technical samples from over 300 types of ethnic instruments, and performance recordings and oral history materials from more than 2,000 Intangible Cultural Heritage inheritors[20]. This paradigm can serve as a blueprint for constructing a standardized, specialized resource repository for ethnic music—one that comprehensively covers the acoustic ontology of ethnic music, digitized historical musical scores, and vocal audio recordings—while prioritizing the urgent preservation and archiving of endangered, living heritage resources. This approach enables AI systems to engage in dual-track learning: simultaneously mastering both the acoustic ontology and the cultural connotations of ethnic music. Concurrently, a four-dimensional standardized annotation system—encompassing "Instrument–Genre–Technique–Culture"—should be established to provide the essential data infrastructure required for the training and deployment of AI models.

Merely possessing "textbooks" is insufficient; universities and enterprises must also collaborate to research, develop, and produce customized "teaching aids." The Inner Mongolia Arts University, in collaboration with technology enterprises, has developed a specialized AI recognition algorithm for Mongolian *Long Song* (Urtin Duu). This algorithm features customized optimizations specifically targeting *Long Song* techniques—such as the *Nogula* vibrato and microtonal nuances—thereby boosting the recognition accuracy of vocal techniques from 58.7% to 91.2%. This technology has already been successfully integrated into undergraduate curricula[21]. We can replicate this model: regarding instrumental instruction, we can develop specialized audio-visual recognition algorithms tailored to unique techniques—such as the *pipa's* continuous plucking (*lunzhi*) or the *guqin's* harmonics. In vocal instruction, we can customize intelligent assessment tools for pitch accuracy, breath control, and articulation, based on the distinct characteristics of various operatic genres and folk songs. Concurrently, we can develop specialized software for arranging and creating accompaniments for traditional music, thereby meeting students' needs for both practice and composition, while establishing a mechanism for continuous iteration to ensure these AI tools remain fully aligned with actual pedagogical requirements. Only by fully equipping AI with specialized "textbooks" and "teaching aids"—enabling it to thoroughly internalize the knowledge systems and cultural logic of traditional music, and to master the technical methodologies adapted for instruction—can this "intelligent student" truly gain a foothold in the field. This, in turn, will lay a solid foundation for its subsequent integration into the entire pedagogical process, allowing it to emerge as an invaluable partner to the human educator.

4.2 The Comprehensive Integration of AI into the Teaching Process

Many traditional music educators harbor misconceptions regarding AI; some fear that their own teaching positions will be supplanted, while others dismiss the technology as mere window dressing, lacking any tangible practical value. However, relevant academic research and pedagogical practice alike have confirmed that, within the realm of traditional music education, AI serves a strictly auxiliary function. It is incapable of displacing the educator's pivotal role in fostering emotional resonance, guiding aesthetic appreciation, and imparting practical, hands-on expertise[22]. Fundamentally, AI acts as a "highly capable collaborative partner" for the educator—a tool capable of deeply permeating the entire pedagogical cycle, encompassing teaching, learning, practice, and assessment—yet the human educator remains, at all times, the central guiding force within the classroom. In the pre-class phase, for instance, AI can assume the role of a personalized preparatory guide, thereby effectively remedying the inherent drawback of

"one-size-fits-all" uniformity often associated with traditional, purely human-led instruction. Students' musical foundations vary widely; some struggle with rhythmic stability, others with pitch accuracy, and some lack proficiency in fingering techniques. Based on each student's past learning trajectory, AI can precisely deliver customized preparatory resources: for those weak in rhythm, it provides audio breakdowns of traditional music beats; for students with pitch deficiencies, it offers exclusive sing-along materials; and for key challenges in upcoming lessons—such as breath control for the *dizi* (bamboo flute) or position shifting for the *erhu* (two-stringed fiddle)—the AI provides advance analysis through animated visuals accompanied by voice-over explanations. A teaching pilot launched by the Zhejiang Conservatory of Music in 2024 demonstrated that this personalized preparatory model boosted the class-wide lesson preparation completion rate from 62% to 94%, while reducing the time spent explaining foundational content during class by 40%, thereby significantly enhancing teaching efficiency[23].

During the lesson itself, AI serves as a highly efficient "interactive assistive tool." When teachers explain techniques for expressing musical emotion, the AI can simultaneously retrieve audio recordings from various schools of thought and renowned masters (for instance, different interpretations of *Reflections of the Moon in the Erquan Spring*), thereby providing a visual demonstration of stylistic differences across performances. During group practice sessions, the AI can identify performance errors in real time, clearly flagging the specific students and musical passages where mistakes occurred, which facilitates targeted coaching by the teacher. Furthermore, a 3D virtual demonstration feature allows for the magnification of intricate details—such as fingering and embouchure—ensuring that even students in the back rows can observe clearly; this proves even more intuitive and comprehensible than a teacher's live, unassisted demonstration. This model has since been implemented across 106 university-based "Inheritance Bases for Excellent Traditional Chinese Culture and Arts" designated by the Ministry of Education[24]. In the post-lesson period, AI transforms into an "independent practice platform" available around the clock. Lacking professional guidance after class, students are prone to developing incorrect playing habits. AI-powered online platforms address this issue by rapidly analyzing student-uploaded performance recordings, precisely identifying problems such as pitch deviations and rhythmic irregularities, and offering concrete, actionable suggestions for improvement (for instance: "In bar 8 of the Suona performance, breath control is unstable; practice this section slowly and in segments while following a metronome set to 60 BPM"). Furthermore, these platforms automatically track students' practice progress and performance outcomes, allowing instructors to monitor their development at any time without the need to query each student individually—thereby significantly reducing communication overhead. Pilot data from higher education institutions within Jiangsu Province's Smart Education Demonstration Zones indicate that the implementation of AI-assisted after-class practice platforms has resulted in a 57% increase in effective after-class practice time for students, alongside a 31% improvement in the pass rate for professional skills assessments[25].

4.3 Fostering "Dual Competence" Among Faculty

No matter how sophisticated AI technology becomes, its ultimate effectiveness in education depends entirely on how instructors integrate it into their teaching practices. Currently, many traditional Chinese music instructors remain stymied by a persistent triad of challenges: "fear of using it," "lack of know-how," and "ineffective application." Some feel completely bewildered by AI—perceiving code and algorithms as overly complex—and harbor a deep-seated reluctance to even attempt using the technology. Others, having forced themselves to acquire a rudimentary grasp of basic operations, fail to apply the technology strategically; for instance, by using generic AI software to evaluate students' traditional music assignments. Such tools are incapable of detecting the subtle technical flaws within intricate ornamentation passages on instruments like the Suona, nor can they generate targeted, instrument-specific recommendations for improvement—thereby squandering the inherent advantages of AI. According to 2025 statistical data from the Ministry of Education, among full-time traditional Chinese music instructors at higher education institutions nationwide, 91.2% possess a purely artistic professional background. Conversely, only 8.7% have received systematic training in AI-related technologies, and fewer than 4.5% are proficient in operating specialized AI software designed for professional music applications[26]. Resolving this issue hinges on a core objective: cultivating a new generation of "dual-competent" instructors—educators who not only possess a deep mastery of the pedagogical nuances of traditional Chinese music but also demonstrate proficiency in utilizing AI tools—thereby ensuring that technology truly serves to enhance the educational process. Higher education institutions should take the lead in establishing a specialized training system for AI application capabilities tailored to instructors in ethnic music disciplines. Training for ethnic music teachers regarding AI-assisted instruction must be guided by core principles of de-emphasizing theoretical underpinnings, prioritizing hands-on practice, and ensuring contextual relevance. This approach minimizes lectures on technical principles—and waives requirements for mastering the technical implementation pathways—to focus squarely on the practical pedagogical application of mature AI tools. The training curriculum should be closely aligned with the full spectrum of daily teaching scenarios in ethnic music, covering core practical modules such as intelligent instructional feedback via AI tools, personalized resource curation, and the pedagogical application of databases. Supported by illustrative case studies and hands-on exercises, the program should adopt a "learn-by-doing" model to dismantle technical learning barriers and ensure the immediate translation of training outcomes into actual classroom practice. The specialized training initiative launched by the Guangdong Provincial Department of Education in 2025 exemplifies this practice-oriented model; following the training, the utilization rate of AI tools among ethnic music teachers across the province surged from 17% to 79%, demonstrating remarkable effectiveness[27]. Concurrently, higher education institutions must establish interdisciplinary collaborative mechanisms for teaching and research. This

entails fostering the formation of collaborative communities where ethnic music faculty work alongside instructors from fields such as computer science and educational technology. By creating a closed-loop system of mutual empowerment, these communities can drive the deep integration of AI into ethnic music pedagogy. Within this framework, ethnic music teachers articulate precise, context-specific requirements based on their pedagogical practice, while technical specialists undertake the selection, adaptation, and optimization of AI tools. Simultaneously, ethnic music teachers provide expert guidance and content oversight to the technical team, ensuring that the AI tools remain true to the pedagogical essence of the discipline and avoid the pitfalls of mere technical formalism. The interdisciplinary team jointly established by the Shanghai Conservatory of Music and Shanghai Jiao Tong University serves as a prime example of this model; they have successfully developed 12 specialized AI tools tailored to ethnic music instruction, which have since been implemented in over 20 higher education institutions nationwide[28].

Furthermore, higher education institutions may judiciously recruit multidisciplinary talent to enrich their faculty ranks—for instance, graduates who possess not only mastery of ethnic instrumental performance and familiarity with ethnic music pedagogy but also expertise in digital technologies and AI applications; or professionals who combine practical experience in AI-assisted instruction with deep expertise in the field of ethnic music. These individuals serve as "technological bridges"; not only can they directly establish integrated "AI + Ethnic Music" courses, but they can also organize on-campus practical training workshops for AI tools and compile user-friendly guides to help other ethnic music instructors quickly master their usage. Furthermore, leveraging their dual expertise, they can identify additional practical scenarios closely aligned with pedagogy, thereby fostering a more seamless integration between AI and ethnic music instruction. Concurrently, higher education institutions must prioritize interdisciplinary achievements in "AI + Ethnic Music" education during academic title reviews and teaching performance evaluations, thereby stimulating the intrinsic motivation of faculty members to engage in this integrated teaching approach.

4.4 Upholding Cultural Integrity

Put simply, AI is merely a tool designed to assist in the education and dissemination of ethnic music; it is by no means the core of its cultural transmission. The true "soul" of ethnic music lies in emotions and cultural nuances that AI can neither learn nor replicate. The *erhu* conveys the homesickness of a wanderer; the *guqin* evokes a state of spiritual harmony between humanity and nature; folk songs articulate the joys and sorrows of everyday human life. These sentiments and sensibilities—deeply rooted in the soil of ethnic culture—are something that even the most advanced digital technologies cannot replicate. If we rely solely on AI, ethnic music risks devolving into nothing more than cold, digital sounds, stripped of its inherent vitality and cultural roots. In the realm of creative practice, AI can provide technical assistance, but it can never assume the role of the "soul" of the work. When a student wishes to compose a piece in an ethnic style, AI can offer technical suggestions—such as melody harmonization, instrumentation design, and accompaniment arrangement—and can even construct a foundational creative framework. However, the core emotional expression, cultural significance, and distinct ethnic character of the work must ultimately be determined by the creator themselves: to convey homesickness, one must infuse the melodic essence of folk songs from one's homeland; to depict the festive atmosphere of a harvest, one must incorporate the rhythmic characteristics of traditional folk gongs and drums. These expressions—steeped in personal sentiment, cultural memory, and ethnic spirit—can only be imbued with true emotion by human beings; at best, AI can merely lend a technical hand. In the pilot program for the creation and instruction of the Yi ethnic group's *Haicaiqiang* folk singing style at Yunnan Arts University, students utilized AI for compositional assistance; however, the core creative process was grounded entirely in traditional intangible cultural heritage and folk customs. Ultimately, all 28 student compositions received professional certification from national-level inheritors of intangible cultural heritage, thereby achieving both innovative artistic expression and the preservation of cultural essence[29].

In pedagogical practice, the time-honored traditions passed down by our ancestors—specifically the principles of "oral transmission and intuitive absorption" and "master-apprentice instruction"—must not be abandoned. Ethnic music contains many nuances that can only be grasped through personal realization and cannot be fully articulated through text alone: the "spiritual resonance" of a *guzheng* performance lies hidden within the intensity and emotion applied during string-pressing techniques; similarly, the "distinctive flavor" of a folk song is inextricably woven into the specific articulation and rhyming conventions of the local dialect. These subtle, non-standardized elements can only be gradually internalized by students through the teacher's face-to-face demonstrations, hands-on corrections, and immersive explanations. While AI can assist teachers by monitoring pitch accuracy, curating preparatory materials, and grading basic assignments, it cannot replace the teacher's role in imparting experiential wisdom, sharing cultural insights, and conveying emotional depth. Teachers must allocate ample time to thoroughly explain to students the folk narratives, historical contexts, and ethnic spirit underpinning each musical piece, ensuring that students not only acquire the technical skills to "play" and "sing" but also understand *why* the music is performed in that specific manner. Data from the pilot program for teaching the Dong ethnic group's *Grand Songs* at Guizhou University indicates that in classes where "oral transmission and intuitive absorption" served as the core pedagogical method—with AI utilized solely as an auxiliary tool—students achieved scores for vocal stylistic authenticity and cultural comprehension that were 38.7% higher than those in classes relying exclusively on AI-assisted instruction[30]. In the realm of dissemination and promotion, while AI can broaden the audience for ethnic music, it cannot replicate the profound impact of immersive, in-person cultural experiences. While AI can disseminate traditional ethnic music across the country—reaching even students in remote regions—through online platforms, digital exhibition halls, and short-form

videos, fostering a genuine love for and understanding of this music requires a more tactile and immersive approach. Students must have the opportunity to physically handle musical instruments, attend live performances, and participate in folk cultural activities. The profound impact and emotional resonance derived from such immersive, real-world experiences are qualities that online AI can never replicate.

4.5 Establishing a Comprehensive Safety Net for Support

The AI-empowered education of ethnic music is not a task that universities can undertake in isolation; rather, it requires the government, enterprises, universities, and cultural and tourism departments to each fulfill their respective duties and exert concerted efforts. Only through such collaboration can a stable synergy be forged, enabling AI technology to be truly integrated into pedagogical practice and thereby facilitating the living heritage of ethnic music. The government should assume a leading and guiding role by formulating specific support policies for the digital development of ethnic music, focusing on resolving the practical dilemmas—such as funding shortages and insufficient policy backing—currently confronting local universities. At present, while many local universities possess an urgent desire to advance the digitalization of ethnic music, their efforts are often stymied by a scarcity of funds and a lack of policy safeguards, making it difficult to effectively implement relevant initiatives. In this regard, the proven experience of Jiangsu Province serves as a valuable model: In 2024, the Jiangsu Provincial Department of Education introduced a specialized plan establishing an annual support fund of 50 million RMB specifically for the digitalization of ethnic music. This fund was earmarked for purposes such as the construction of digital resource repositories in universities, the procurement of AI-enabled teaching equipment, and specialized faculty training. Concurrently, tax incentive policies were enacted to encourage corporate participation in university-enterprise collaborations. By the end of 2025, these initiatives had facilitated the establishment of AI-enabled ethnic music teaching laboratories in 37 universities across the province and resulted in the successful implementation of 21 university-enterprise collaborative projects[31]. The national government, as well as various provincial and municipal authorities, could adopt this model by establishing dedicated support funds for the digitalization of ethnic music to provide targeted assistance for relevant university-level construction and research projects. Simultaneously, they should formulate targeted incentive policies to encourage enterprises and universities to engage in industry-academia-research collaborations, jointly developing specialized AI tools tailored specifically to the needs of ethnic music.

Universities must prioritize the enhancement of hardware infrastructure and the refinement of their digital teaching support systems. This entails establishing dedicated digital teaching laboratories for ethnic music—equipped with core hardware and software components such as high-quality recording equipment, systems for capturing the timbres of ethnic musical instruments, AI teaching terminals, 3D virtual demonstration systems, and immersive audio systems—thereby providing both faculty and students with a professionalized space for pedagogical practice. For instance, by synergistically integrating multi-camera real-time video capture with AI-driven intelligent analysis technologies, a laboratory can achieve high-precision recognition, real-time analysis, and standardized instructional correction of core technical movements—such as fingering and hand posture—during students' performance of traditional ethnic musical instruments. Furthermore, by configuring high-fidelity, immersive surround sound systems to construct immersive acoustic environments, the laboratory facilitates students' precise perception and discernment of the timbral qualities and acoustic characteristics of various traditional instruments, thereby systematically optimizing the teaching experience and educational effectiveness within traditional music classrooms. As of 2025, all 106 university-based centers for the preservation and transmission of China's excellent traditional culture and arts—designated by the Ministry of Education—have successfully established their own dedicated digital teaching laboratories, providing a replicable construction model for higher education institutions nationwide. Moreover, it is imperative to establish a long-term, stable, and multi-stakeholder collaborative mechanism—encompassing government, industry, academia, and research sectors—to foster a closed-loop partnership among universities, technology enterprises, and cultural and tourism departments, wherein each party’s strengths are mutually complementary. Leveraging their technological expertise, enterprises undertake the development and operational maintenance of AI tools; drawing upon their pedagogical strengths, universities drive the practical application of these technologies and the cultivation of interdisciplinary talent; and capitalizing on their resource advantages, cultural and tourism departments provide essential resources and practical settings for application—collectively driving the deep integration of AI with traditional ethnic music education. The laboratory jointly established by the Central Conservatory of Music, Tencent Music, and the Center for the Development of Folk and Ethnic Arts under the Ministry of Culture and Tourism exemplifies this collaborative model: the cultural and tourism sector provides Intangible Cultural Heritage (ICH) resources; the university offers professional guidance and pedagogical settings; and the enterprise supplies technical support. Through this tripartite collaboration, over ten AI tools for ethnic music have been developed and made available free of charge to more than 200 universities across the country[32]. For instance, the cultural and tourism sector organizes ICH inheritors to visit university campuses to record instructional materials, thereby enriching the AI training datasets; the enterprise continuously refines the functionalities of the AI tools based on pedagogical feedback from the university; and the university mobilizes students to participate in the cultural and tourism sector’s ethnic music promotion campaigns, utilizing AI tools to facilitate dissemination—ultimately achieving a win-win outcome for all parties involved.

In summary, the five major dilemmas facing the integration of AI and ethnic music education are not mutually independent; rather, they are interconnected and mutually constraining. A mismatch in technology constitutes the most fundamental, root-level problem; without specialized AI tools, it is impossible to precisely align with pedagogical

requirements, and consequently, the technology fails to yield any practical results. A lack of depth in pedagogical application prevents the full realization of AI's value, instead creating an impression that the technology is disconnected from classroom practice. A mismatch in faculty capabilities means there is no one to spearhead the implementation of this integration; worse yet, AI tools may be misused, thereby diluting the cultural core of the ethnic music itself. Furthermore, when supporting safeguards—such as policies, funding, and hardware infrastructure—fail to keep pace, these internal dilemmas are further exacerbated, rendering the path toward integrated development all the more arduous. To resolve this dilemma, we must exert concerted effort and pursue a systematic approach across five dimensions: technological adaptation, pedagogical innovation, faculty development, cultural preservation, and robust institutional support. Only in this way can AI truly facilitate the inheritance and development of ethnic music education—serving as a digital torchbearer for ethnic music rather than a stumbling block to its transmission.

5 CONCLUSION

Building a leading nation in education requires not only keeping pace with the technological advancements of the digital era but, more importantly, firmly safeguarding the roots of China's outstanding traditional culture. The empowerment of ethnic music education in higher institutions through artificial intelligence is never about using technology to fundamentally alter traditional art forms; rather, it represents a process of mutual empowerment and reciprocal achievement between traditional cultural heritage and modern technology. Only by allowing technology to take deep root in the soil of ethnic culture—consistently preserving the artistic soul of ethnic music and aligning with the core educational mission of cultivating moral character and nurturing talent—can ethnic music retain its vibrant vitality in the digital age. Furthermore, the high-quality development of ethnic music education in higher institutions will continue to fortify the cultural foundations and infuse profound cultural confidence into the construction of a leading educational nation, thereby ensuring that China's outstanding traditional culture is passed down from generation to generation. AI serves strictly as an auxiliary aid in ethnic music education, not as the central protagonist in the process of cultural transmission and talent cultivation. It can assist students in refining performance techniques and organizing historical materials on ethnic music, and help teachers liberate themselves from tedious foundational tasks, thereby freeing up more energy to convey the cultural connotations and spiritual essence embedded within musical compositions; however, technological logic must never be allowed to override the fundamental educational mission. While AI is capable of executing standardized tasks such as melodic composition, pitch annotation, and accompaniment adaptation, it can never replicate the nostalgic sentiments evoked by an *erhu* melody or the authentic, down-to-earth charm of a folk ditty. Moreover, it can never replace the artistic nuance, emotional expression, and aesthetic guidance conveyed by a teacher through the traditional method of "oral instruction and heart-to-heart transmission."

To foster a deep integration between these two realms, we must exert systematic effort and ensure practical implementation. This entails developing AI tools specifically tailored to ethnic music—thereby facilitating AI's deep integration into the entire pedagogical process and preventing its application from becoming merely superficial or perfunctory. It also requires cultivating a faculty team with dual expertise—proficient in both ethnic music and technology—to ensure that technology truly serves the practical needs of teaching. Furthermore, it is imperative to refine policy support, secure financial guarantees, and establish diversified collaborative mechanisms to construct a robust support framework for the deep integration of these two domains. Only in this way can we enable more young people to connect with their cultural roots and strengthen their cultural confidence through traditional ethnic music. This will drive the evolution of ethnic music in the digital age—ensuring it simultaneously preserves its authentic, time-honored essence while radiating a dynamic vitality that keeps pace with the times. Through aesthetic education that is imbued with warmth, depth, and power, we can inject enduring cultural momentum into the national endeavor to build a leading educational power, allowing China's outstanding traditional culture to shine with even greater brilliance in this new era.

COMPETING INTERESTS

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