The Role of Artificial Intelligence in Enhancing Music Teaching and Learning Practices

Poowaniy Diraksin
International College
Pathumthani University, Thailand

Qiqi Luo
International College
Pathumthani University, Thailand
qiqi@ptu.ac.th
(Corresponding Author)

Premwit Jirasanyansakul
International College
Pathumthani University, Thailand

Dong Wenxin
International College
Pathumthani University, Thailand

Wei Shang
International College
Pathumthani University, Thailand

Ruangchan Thetlek
International College
Pathumthani University, Thailand

Natworadee Chinnapakjarusiri
International College
Pathumthani University, Thailand

ABSTRACT

Objective: This study aims to explore the role of artificial intelligence (AI) in enhancing music teaching and learning practices, focusing on its applications in performance analysis, composition, personalized learning, and pedagogical innovation.

Methods: A systematic literature review was conducted, drawing on peer-reviewed journal articles, conference proceedings, and reputable academic sources published between 2021 and 2025. A qualitative content analysis approach was employed to analyze the data.

Results: The review reveals that AI significantly improves teaching efficiency, learner engagement, and personalization in music education. Intelligent tutoring systems and real-time feedback platforms enhance technical accuracy and self-directed learning. AI-assisted composition tools expand creative possibilities, while adaptive learning systems tailor instruction to individual student needs. Additionally, AI applications in education management streamline resource allocation and policy development. Challenges include data privacy concerns, unequal access to technology, and the need for teacher training to ensure effective adoption.

Conclusion: AI holds transformative potential to enrich music education by augmenting traditional methods with precision analytics, adaptive instruction, and creative support. However, responsible integration requires addressing ethical issues, ensuring equitable access, and maintaining the human-centered aspects of musical learning. Strategic implementation and professional development are critical to maximizing benefits while mitigating risks. Future research should focus on long-term impacts, cross-cultural applications, and the relationship between AI-assisted learning and artistic identity development.

Keywords: *Artificial Intelligence (AI), Music Education, Personalized Learning, Performance Analysis, AI Composition, Pedagogical Innovation*

INTRODUCTION

In the digital age, artificial intelligence (AI) has emerged as a transformative force across various sectors, including education, where it has demonstrated significant potential to enhance teaching methodologies, personalize learning, and improve assessment strategies (Cela et al., 2025; Limna, 2025; Merino-Campos, 2025; Rangsit Digital Economy, 2025; Shaengchart et al., 2025). Within the domain of music education, AI applications have begun to reshape how students acquire musical skills, how educators deliver instruction, and how performance is evaluated. Advancements in machine learning, natural language processing, and computer vision have enabled AI systems to analyze complex auditory patterns, provide real-time feedback, and simulate interactive learning environments. These developments present opportunities to augment traditional pedagogical approaches with data-driven insights and adaptive learning pathways tailored to individual student needs (Yu et al., 2023; Zhang et al., 2024; Zhao, 2024). Recent research highlights AI's capacity to support a wide range of music learning activities, from pitch detection, rhythm analysis, and sight-reading assistance to composition, improvisation, and music theory training. Intelligent tutoring systems, powered by AI algorithms, can deliver immediate corrective feedback, track learner progress over time, and recommend targeted exercises to address specific weaknesses. Moreover, AI-driven music composition tools offer students a collaborative creative partner, expanding possibilities for experimentation and fostering innovation. In formal education settings, these technologies can complement human instruction by reducing repetitive manual tasks, enabling educators to focus on higher-order teaching activities such as interpretive coaching, ensemble coordination, and artistic expression (Li & Wang, 2023; Mangum, 2024; Merchán Sánchez-Jara et al., 2024; Yue & Jing, 2025). However, the integration of AI into music education is not without challenges.

Ethical considerations related to data privacy, potential over-reliance on technology, and the risk of diminishing human creativity warrant careful examination. Furthermore, disparities in access to digital infrastructure and teacher readiness to adopt AI tools may influence the extent to which these innovations can be effectively implemented (Amini, 2025; Cheng, 2025; Limna, 2025; Liu & Guo, 2025; Wu, 2025). While existing studies provide promising evidence of AI's benefits, there is a need for a comprehensive synthesis of current applications, pedagogical implications, and future research directions in this field. This review article aims to critically examine the role of AI in enhancing music teaching and learning practices, mapping current trends, evaluating diverse applications, and highlighting gaps in the literature. By synthesizing insights from multiple domains, the review seeks to offer a nuanced understanding of how AI can be strategically leveraged to strengthen both the technical precision and expressive artistry of music education, while also proposing actionable directions for research, policy, and practice.

RELATED LITERATURE

Dai (2021) highlighted the transformative impact of advancing information technologies on music education, particularly within the context of educational modernization initiatives. The study emphasizes that the integration of AI into instructional design represents a deep convergence of information technology and music pedagogy. By leveraging AI's intelligent perception, learning analytics, and affective computing capabilities, an intelligent music teaching model can be established to enhance both teaching and learning outcomes. The proposed model, supported by big data intelligence, offers educators diverse instructional methods while providing students with personalized evaluations and adaptive learning services, thereby improving instructional efficiency. Dai further critiques the limitations of traditional teaching design, noting its inability to fully address the developmental needs of students in an AI-enhanced learning environment. To address this gap, the study presents a scientifically grounded intelligent music teaching design model built upon emerging technologies such as big data, the Internet of Things, mobile internet, and AI. This "wisdom teaching" framework supports the full instructional cycle—before, during, and after class—facilitating more targeted and effective teaching. It promotes cooperative and autonomous learning among students while enabling teachers to implement adaptive and data-driven strategies. Ultimately, the study underscores the significance of such innovations in cultivating intelligent music talents and advancing the modernization of music education.

Pan (2022) examined the crucial role of the modern music industry in the broader context of cultural and strategic industry development, emphasizing the necessity of integrating intelligent technologies to drive innovation and growth. The study highlights how AI and contemporary information technologies have created new opportunities for transforming the music industry, particularly in the domain of music education. With the rise of online education and virtual classrooms, traditional music teaching methods have undergone significant changes, ushering in a new era of intelligent, technology-enhanced pedagogy. The successful integration of AI into music education not only revitalizes instructional models but also supports the modernization and expansion of the music industry as a whole. Through practical case studies, the paper illustrates how AI applications are reshaping music education, facilitating more adaptive, scalable, and innovative learning experiences that align with evolving industry demands.

Limna et al. (2022) conducted a comprehensive review to examine the adoption of AI in education in the digital era. Employing a narrative synthesis and a systematic literature review, the study drew from books and peer-reviewed research articles indexed in major academic databases. The findings indicate that AI has become an integral component of modern education, functioning as a strategic driver of educational development and increasingly serving as a digital assistant to both teachers and students. AI facilitates personalized learning by providing access to diverse instructional resources tailored to individual needs and subject areas. Despite these benefits, the study underscores potential risks related to safety, security, and privacy, highlighting the dual nature of AI's impact on education. While AI offers considerable opportunities to enhance academic performance, its successful integration requires strategic planning, alignment with the needs of teachers and students, and careful mitigation of associated challenges.

Wei et al. (2022) explored the integration of AI into music education, focusing on its application across diverse teaching contexts, including primary and secondary schools, higher education institutions, and collaborative music programs. The study introduced the Music Education and Teaching based on AI (MET-AI) framework, which leverages modern science and technology to enhance instructional quality and learning outcomes. By incorporating AI-driven tools—particularly in electronic music instruction and innovative music software within private colleges—the MET-AI approach disrupts traditional pedagogical paradigms, fostering new models of music education that are more adaptive, interactive, and efficient. Experimental evaluations of the MET-AI platform demonstrated substantial improvements in teaching effectiveness, reporting a student learning outcome rate of 95.2%, an efficiency ratio of 98.1%, accuracy of 95.3%, a true positive rate of 95.7%, and high flexibility at 92.1%. Although certain performance metrics, such as a mean square error rate of 17.9% and a false-positive rate of 18.6%, indicate areas for refinement, the results affirm the potential of AI to optimize virtual learning environments, support professional music instruction, and improve overall teaching performance. Continuous enhancement of AI-enabled music platforms is essential for sustaining innovation in music education and ensuring long-term pedagogical benefits.

Yu et al. (2023) examined the transformative influence of AI on music education, emphasizing its role as a product of rapid advancements in computer and information technologies. The study systematically reviewed the advantages and applications of AI in music education, highlighting its capacity to address limitations inherent in traditional teaching models, particularly the lack of individualized instruction. By integrating intelligent technologies with in-person teaching, AI fosters greater student engagement, personalizes learning experiences, and enhances instructional efficiency. The authors argue that the convergence of AI and music education represents an inevitable developmental trend, as intelligent tools, virtual technologies, and adaptive learning systems become increasingly prevalent in educational contexts. These technologies not only improve students' learning quality and efficiency but also serve as auxiliary tools for teachers, enabling more precise course planning and differentiated instruction. Yu et al. further stress the need for sustained innovation, deeper understanding of AI's pedagogical potential, and the cultivation of professional expertise in its application. They contend that aligning music education with ongoing technological developments is essential for promoting the long-term, sustainable growth of the sector and for ensuring that AI's integration into music teaching practices yields both immediate and enduring educational benefits.

Chen and Sun (2024) addressed emerging needs in the field of music generation by developing an advanced system grounded in a Transformer-based architecture. The model integrates an adaptive music feature encoder with a music emotion-driven multi-task learning framework, enabling it to capture diverse musical styles and emotional nuances with high precision. Drawing upon music theory knowledge and employing dynamic weight adjustment, the adaptive encoder effectively aligns generated outputs with stylistic and expressive requirements. The multi-task learning framework further enhances the emotional depth of generated music through the use of targeted emotion tags. Experimental validation using the Lakh MIDI Dataset (LMD) demonstrated notable performance gains, with the system achieving a BLEU score of 0.43, a ROUGE-L score of 0.63, and a METEOR score of 0.31—exceeding industry benchmarks. Beyond technical performance, pedagogical applications of such music generation models have shown measurable benefits in improving students' musical skills, emotional expressiveness, and learning satisfaction. These findings underscore not only the effectiveness of AI-driven music generation technologies but also their potential as powerful tools for both automated composition and enhancing music education practices.

Xu (2024) addressed the limitations of traditional music teaching, noting that students often face difficulties in receiving timely, personalized feedback and may lose interest due to the repetitive nature of conventional instructional methods. To overcome these challenges, the study proposed the design of an AI-based intelligent music education system aimed at enriching learning content and delivering individualized guidance to enhance student engagement. The system comprises five core modules: a basic information management module, a student music task management module, a personalized recommendation module, an interactive community module, and an AI algorithm module. Together, these components enable continuous monitoring of student performance, provide tailored feedback and instructional support, and create a more dynamic and stimulating learning environment. Experimental findings demonstrated a marked improvement in student interest: under traditional music education, only 21 students reported being highly interested in music, whereas with the AI-enhanced system, this number rose to 120. These results suggest that AI-driven intelligent music education systems can effectively address the shortcomings of traditional pedagogy, offering more personalized, efficient, and engaging learning experiences that foster both motivation and sustained participation in music learning.

Fang (2025) investigated the use of AI robots, powered by machine learning and visual algorithms, to enhance interactive experiences in music classrooms. The study emphasizes the role of mobile adaptive networks in improving robots' perceptual and decision-making capabilities, enabling them to dynamically learn and respond to changing classroom environments. By continuously adapting to students' needs, these AI robots offer precise and targeted assistance, facilitating more effective engagement in music lessons. A key feature highlighted is the use of the K-nearest neighbor algorithm for personalized music recommendation, which analyzes individual students' preferences and learning requirements to tailor suggestions that foster greater participation and enjoyment. Experimental applications of machine learning and visual algorithms in music classroom interactions demonstrate the promising potential of AI robots to support teaching optimization and enrich the overall educational experience. Fang's findings contribute to the growing body of research advocating for AI-driven tools as innovative agents in the transformation of music pedagogy.

Day et al. (2025) highlight the transformative impact of AI in reshaping music education, making it more creative, personalized, and inclusive. Advanced tools such as AIVA, MuseNet, and NaadSadhana provide tailored feedback, recommend individualized learning pathways, and assist with practice and improvisation, supporting a wide range of musical traditions from Indian ragas to Western harmonies. By simplifying complex theoretical and practical concepts, AI enhances learning experiences for both students and teachers. The chapter traces the evolution of AI in music from its early computer-generated compositions in the 1950s to contemporary deep learning systems capable of composing, analyzing, and accompanying live performances. These technologies facilitate genre blending, foster creative experimentation, and expand artistic possibilities. However, there are challenges related to creativity, authorship, costs, accessibility, and teacher readiness. Suggested solutions include the development of open-source platforms and inclusive AI systems to ensure equitable access. Looking toward the future, AI's potential includes virtual concert simulations and adaptive learning tools, but its integration must be balanced with the preservation of human creativity. By harmonizing tradition with technological innovation, AI offers the potential to enrich and democratize music education on a global scale.

Wu (2025) explored the transformative role of AI in music education management, highlighting its potential to enhance the quality and efficiency of administrative processes. The study contextualizes AI's application within music education by discussing opportunities and challenges related to teaching quality assessment, resource allocation, and educational policy development. Despite the promising prospects, Wu identifies current limitations in AI's capacity to handle complex data, generalize algorithms, and adapt to specific scenarios within music education management. To address these gaps, the paper proposes two innovative solutions: an intelligent decision support system based on an improved actor-critic framework designed to simulate complex decision-making processes, thereby improving management accuracy and efficiency; and a convolutional neural network (CNN)-based time series prediction model aimed at forecasting technological trends to inform future policy and resource distribution. Wu's research offers both theoretical insights and practical frameworks that support the advancement of personalized and precise management approaches in music education, underscoring AI's expanding role beyond classroom instruction into strategic educational governance.

RESEARCH METHODOLOGY

This review employed a systematic approach to synthesizing the empirical and theoretical evidence on the role of AI in enhancing music teaching and learning practices. Systematic reviews provide a comprehensive and methodologically rigorous means of integrating diverse findings while ensuring objectivity, replicability, and transparency in the research process. A qualitative approach was adopted, comprising four sequential stages: research design, data collection, data analysis, and report writing. At the design stage, the review parameters were defined, including the focus on AI-assisted tools for music instruction, learning, performance assessment, and creative engagement. Data collection involved a systematic search of peer-reviewed journal articles, conference proceedings, and reputable academic sources published between 2021 and 2025, using databases such as Scopus and Google Scholar.

The principal analytical technique employed was qualitative content analysis, a widely recognized method in systematic reviews that enables the systematic and objective interpretation of verbal, visual, and textual data to generate valid insights into the phenomena under study. This method was used to categorize findings into thematic domains, such as AI for performance analysis, composition and creativity, personalized learning, and pedagogical innovation. Through iterative coding and synthesis, the analysis distilled patterns, highlighted best practices, and revealed challenges associated with integrating AI into music education. This methodological framework ensured that the review not only synthesized current knowledge but also provided an evidence-based foundation for understanding how AI can support, enhance, and transform music teaching and learning in contemporary educational contexts.

RESULTS AND DISCUSSIONS

The synthesis of the reviewed literature reveals that AI integration in music education has led to significant advancements in instructional design, personalized learning, performance assessment, and creative engagement. Across studies, there is a consistent pattern showing that AI tools can substantially improve teaching efficiency, learner engagement, and the adaptability of instructional methods. One of the most prominent contributions of AI in music education lies in real-time performance analysis and corrective feedback. Machine learning algorithms, computer vision, and audio signal processing enable precise evaluation of pitch accuracy, rhythm consistency, and tonal quality. Wei et al. (2022) reported that the MET-AI platform achieved teaching effectiveness rates above 95%, supported by high accuracy and efficiency metrics. Such systems reduce reliance on subjective human assessment, providing learners with immediate, objective, and data-driven feedback. The evidence suggests that this immediacy not only accelerates skill acquisition but also fosters a more self-directed approach to practice. However, performance metrics also indicate areas for refinement, particularly in reducing error rates and enhancing sensitivity to nuanced musical expression—an element where human interpretive expertise remains essential. Furthermore, the reviewed studies underscore AI's growing role as a collaborative creative partner. Chen and Sun (2024) demonstrated that Transformer-based music generation systems, enhanced by adaptive encoders and emotion-tagging frameworks, can generate compositions that align closely with stylistic and expressive parameters. Students engaging with these tools reported improved creativity, emotional expression, and overall satisfaction in their learning experiences. By enabling exploration of diverse musical styles, AI composition tools broaden students' creative horizons and encourage experimentation beyond traditional repertoire. Nevertheless, discussions in the literature caution against over-reliance on automated composition, emphasizing the importance of integrating such tools as supplements to, rather than replacements for, foundational musical training.

AI's adaptive learning capabilities have been particularly impactful in delivering personalized instruction. Intelligent tutoring systems can track learner progress, identify weaknesses, and recommend targeted exercises—functions that address the limitations of one-size-fits-all teaching models. Dai (2021) and Yu et al. (2023) highlight that AI-supported personalization not only enhances engagement but also promotes autonomy and self-paced learning. Fang (2025) illustrates how AI-powered classroom robots can further personalize learning by offering tailored music recommendations based on individual preferences and skill levels. This personalization

aligns with broader educational trends toward learner-centered pedagogy, though it also raises questions about equitable access, as students in resource-limited contexts may face barriers to utilizing such advanced technologies. Beyond the classroom, AI is increasingly influencing the strategic and managerial dimensions of music education. Wu (2025) presents frameworks for AI-driven decision support systems and predictive analytics that enhance resource allocation, curriculum planning, and policy development. Such tools hold potential to streamline administrative processes, improve quality assurance, and align institutional offerings with emerging technological and industry trends. In teaching contexts, AI enables educators to shift focus from routine evaluative tasks to higher-order pedagogical activities, such as interpretive coaching and ensemble coordination. This shift reflects a broader redefinition of the teacher's role in AI-enhanced educational ecosystems. While the findings affirm AI's transformative potential, they also highlight critical challenges, including ethical concerns over data privacy, potential erosion of human creativity, and disparities in access to necessary infrastructure. The literature stresses the need for sustained teacher training and professional development to ensure effective adoption of AI tools. The risk of technological determinism—where tools are implemented without adequate pedagogical integration—remains a concern, underscoring the necessity for careful alignment between technology and curriculum objectives.

The reviewed evidence collectively indicates that AI can significantly enrich music education by augmenting, rather than replacing, traditional pedagogical methods. Effective integration requires a balanced approach that leverages AI's analytical precision and adaptive capabilities while preserving the interpretive, emotional, and human-centered aspects of music. Policymakers and educational leaders should consider strategies to expand equitable access, provide comprehensive teacher training, and establish ethical guidelines for AI use in music education. Future research should focus on longitudinal studies to assess the sustained impact of AI on both technical proficiency and artistic development, as well as comparative studies to evaluate AI's effectiveness across diverse cultural and institutional contexts.

CONCLUSIONS

The findings of this review demonstrate that AI has emerged as a powerful catalyst for innovation in music education, offering transformative possibilities for teaching, learning, assessment, and administration. AI-enabled tools—ranging from intelligent performance analysis systems and adaptive composition platforms to personalized tutoring applications and strategic decision-support models—are reshaping the educational landscape by enhancing efficiency, accuracy, and learner engagement. The evidence consistently points to AI's capacity to complement traditional pedagogical methods, enabling more individualized instruction, fostering creativity, and supporting the development of both technical proficiency and expressive artistry. However, the integration of AI into music education is not without its complexities. Challenges such as data privacy concerns, unequal access to technological resources, potential over-reliance on automated systems, and the need for sustained teacher training must be addressed to ensure responsible and equitable adoption. Ethical considerations are particularly salient in safeguarding the human dimensions of musical learning—interpretation, emotional connection, and artistic expression—that cannot be replicated by machines.

The implications for educators, policymakers, and institutions, as well as other stakeholders, are clear. It is critical to note that AI should be viewed as a collaborative partner rather than a replacement for human expertise. Strategic implementation requires aligning AI tools with curricular goals, investing in digital infrastructure, and providing continuous professional development to build educators' capacity for effective use. Moreover, the advancement of AI in music education must be guided by inclusive policies that bridge technological divides and ensure that all learners, regardless of context, can benefit from these innovations.

Future research should adopt longitudinal and comparative approaches to assess the sustained impact of AI across diverse educational settings and cultural contexts. Investigating the interplay between AI-assisted learning and the cultivation of artistic identity will be particularly important for maintaining the balance between technological innovation and the human essence of music. By addressing these considerations, AI can be harnessed to not only modernize music education but also to deepen its capacity to inspire, connect, and transform learners in the digital age.

DECLARATION

During the preparation of this work, the authors used AI, specifically ChatGPT and Claude.ai, to check for spelling and grammar errors. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

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