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Artificial Intelligence Reshapes Music Teaching: Application Scenarios and Practical Challenges

Huijuan Rao

School of college of Literature and Art, Shihezi University, Shihezi, 832000, China

Abstract: In the current digital transformation of education, music instruction, as a key component of quality-oriented education, is leveraging artificial intelligence to break through traditional limitations. Traditional music instruction relies on teacher experience, resulting in a lack of standardized content, insufficient personalized instruction, and limited interaction. However, AI, leveraging its strengths in data processing, adaptive learning, and human-computer interaction, can analyze learning data in real time, dynamically adjust instructional content, and construct diverse scenarios, injecting vitality into teaching innovation. This article, through literature research and inductive analysis, identifies diverse applications of AI in music instruction: personalized learning programs tailored to students' foundation, goals, and interests; interactive instruction leveraging gamification and real-time feedback to enhance engagement; immersive experiences using VR/AR technology to visualize abstract knowledge; creative assistance lowers the barrier to entry and stimulates innovation; and teaching evaluation leverages AI-based quantitative analysis for more scientific and efficient evaluation. However, there are also prominent problems with the application of technology: AI teaching tools are not sufficiently compatible with music subjects, making it difficult to meet artistic guidance needs such as emotional expression and timbre control; teachers' AI literacy varies, and some people's cognitive and application abilities lag behind; students' excessive reliance on AI may weaken their independent learning and innovation capabilities; in addition, issues such as unclear AI music copyrights, lack of student data privacy, and imbalanced teaching ethics also restrict the deep integration of the two. Based on these issues, this article proposes targeted solutions to provide practical references for educators, facilitate the deep integration of AI and music teaching, promote the quality improvement and sustainable development of music education, and provide support for the deepening of quality-oriented education.

Keywords: Artificial Intelligence Technology, Music Teaching, Application Scenarios, Practical Challenges, Educational Integration.

1. Introduction

With the widespread adoption of artificial intelligence (AI) technology in education, music instruction, as a crucial component of quality-oriented education, is transitioning from a traditional "experience-driven" model to a modern "technology-enabled" one. Traditional music instruction has always revolved around the teacher's personal experience. There's no unified approach to what to teach or how to teach, making individual tutoring difficult. Classroom interaction often follows the same old routine. Take instrument lessons, for example. Teachers have to manage multiple students, and it's difficult to spot incorrect fingerings or off-tempo rhythms all at once. By the time they do, students may have already developed a habit. Explaining music theory is even more challenging. The abstract concepts of notes and rhythms are simply incomprehensible to students simply by explaining them, making learning incredibly difficult.

Thankfully, artificial intelligence (AI) offers a new solution to these challenges. It can track students' progress, analyze data, and interact with them, unlike traditional classes that were restricted by time and location. Students can use AI to practice piano after class, helping them address specific issues. Abstract music theory can now be visualized, offering new insights into music instruction. Therefore, exploring how AI can be used in music instruction and what challenges it faces is highly beneficial, both in research and in practical teaching.In theory, this research can enrich the interdisciplinary research content of educational technology and music education, filling the research gap in the integration of artificial intelligence and music teaching. In practice, it can provide music educators with guidance on the application of technology, help solve practical teaching problems, and thus improve teaching quality and efficiency. Based on this, this article reviews relevant research results at home and abroad, combines the disciplinary characteristics of music teaching, systematically analyzes the application scenarios of artificial intelligence technology, deeply explores practical problems, and proposes feasible response strategies to provide support for the deep integration of the two.

2. Core Application Scenarios of AI Technology in Music Education

2.1. Personalized Learning Adaptation Scenarios

Artificial intelligence, powered by data, can tailor music instruction to individual students, creating personalized learning plans. At the beginning of learning, the system collects information about the student's musical foundation, learning goals, and interests through questionnaires and basic assessments, creating a personalized learning profile. For students with weak rhythmic sense, the system automatically promotes rhythmic training content and adjusts the difficulty based on errors in practice.For students taking exams, AI can break down repertoire and strengthen specialized skills. The data-supported arrangement avoids a "one-size-fits-all" approach and makes learning more targeted.

2.2. Innovative Interactive Teaching Scenarios

With the help of AI, music instruction can break the one-way lecture model and build a multi-dimensional interactive environment. For example, music theory can be integrated into note-based level-breaking games. Students can receive timely feedback after completing tasks such as pitch recognition and beat matching[1]. This allows them to naturally retain knowledge points through fun interactions, making learning no longer a boring, one-way process.On the other hand, human-computer collaboration is emerging as a new direction in teaching. AI can serve as a teacher's "helper." For example, during choral instruction, the system can analyze each part in real time and display integration issues using an intuitive interface, helping teachers quickly identify key points and allowing students to clearly identify their shortcomings, thereby increasing their willingness to participate in class.

2.3. Teaching Evaluation and Feedback Scenarios

Artificial intelligence technology can automate and accurately evaluate music teaching. Traditional teaching evaluation often relies on subjective judgment by teachers, resulting in inconsistent evaluation criteria and delayed feedback. However, AI systems can use technologies such as audio analysis and motion capture to quantitatively assess students' performance metrics, such as pitch, rhythm, and dynamic control, and generate detailed feedback reports. For example, in piano instruction, the system can identify misnotes and rhythmic deviations during performance and mark specific measures to help students make targeted improvements. AI can also accumulate student learning data, creating long-term growth trajectories, providing data support for teachers to adjust their teaching strategies and improving the scientific and timely nature of assessments.

3. Technical Challenges of Applying AI Technology to Music Instruction

The primary challenge in applying AI technology to music instruction is the inadequate adaptation of technical tools to the specific characteristics of the discipline. Currently, most AI music instruction tools are limited to basic functional development, failing to fully consider the unique characteristics of music instruction and failing to meet practical needs. For example, common smart music notation tools only recognize notes and mark errors, but fail to analyze and guide core artistic elements such as emotional expression and timbre control during performance, making AI tools difficult to integrate into key aspects of music instruction. Furthermore, data interoperability between different AI tools is poor, creating "data silos." The application of artificial intelligence in music education still faces numerous practical challenges. For example, student practice data in smart piano practice apps cannot be directly synchronized with music theory learning platforms. Teachers must manually organize this scattered data, which not only adds additional workload but also makes it difficult to fully grasp students' overall learning status, thus hindering the scientific nature of teaching decisions[2].

Inadequate infrastructure further hinders the effective implementation of AI technology. For AI to be effective, it requires qualified hardware and stable network support, but many places, especially grassroots schools, still lack significant support in this area. Many schools lack high-performance computers that support AI teaching, VR/AR devices that enable immersive experiences, and smart instruments that can analyze performance details. This makes immersive teaching and real-time performance audio analysis impossible, and the advantages of AI are naturally limited.

Network issues are also prominent. In some areas, insufficient bandwidth and unstable signals result in slow data transmission and system lags. For example, in online AI music classes, network delays prevent students from receiving timely teacher instructions and AI feedback, disrupting the learning rhythm and affecting the learning experience and effectiveness. In addition, AI technology updates rapidly, algorithms and functions are frequently upgraded, and subsequent maintenance has become a problem, which is a considerable challenge for schools. However, many grassroots schools have limited funding and cannot consistently invest in technology upgrades. Consequently, the tools they use gradually become outdated and fail to meet teaching needs. Furthermore, most schools lack dedicated AI equipment repair personnel, forcing them to wait for outside personnel to come in when a tool breaks. This not only delays classes but can also undermine teachers' confidence in AI technology, hindering its long-term adoption.

4. Challenges of Applying AI Technology to Music Teaching

4.1. Lagging Teachers' AI Literacy and Role Adaptation Difficulties

Teachers are the primary drivers of instruction, and their AI literacy directly impacts the effectiveness of AI applications in music instruction. However, most current music teachers clearly lack this ability.

Cognitively, many teachers view AI as merely a supplementary tool, failing to see its potential to transform traditional teaching models—for example, using data to customize student learning plans and leveraging human-computer collaboration to enhance classroom interaction. Consequently, they either resist using AI or passively embrace it, failing to proactively consider how to integrate the technology into their teaching.

Technically, most teachers lack systematic AI training and are often at a loss when faced with intelligent data analysis platforms and AI teaching software. For example, they struggle to understand student practice data reports, identify weaknesses, or adjust their instruction based on AI feedback. Ultimately, these technological tools become useless.

More critically, the role transition is difficult. AI requires teachers to transition from being "lecturers" to "learning guides," teaching students how to effectively use AI and fostering independent learning. However, some teachers are used to the old model of "I talk and you listen" and cannot adapt to the new role, resulting in technology and teaching being unable to be combined and unable to play a role[3].

4.2. Risk of Dependence and Differences in Individual Adaptation at the Student Level

While AI facilitates students' music learning, it also presents the problems of overdependence and insufficient individual adaptation.

The most obvious consequence of overdependence is that it weakens students' autonomy and innovative thinking. When practicing an instrument, students often rely on AI to correct

notes and rhythmic errors in real time. Gradually, they lose the ability to listen and identify problems on their own. Without AI's assistance, they can't even detect minor flaws in their performance. When composing music, they constantly rely on AI-generated melodies and chordal frameworks, losing their own style and desired emotions, resulting in compositions that lack distinctiveness and appeal. Furthermore, many students, due to their overreliance on AI, are less willing to actively seek guidance from teachers or study with classmates. Over time, this impacts their ability to collaborate and interact with others.

Insufficient individual adaptation also prevents AI from truly "teaching students in accordance with their aptitude." On the one hand, AI only focuses on surface data such as practice time and number of mistakes, but cannot see the students' motivation for learning, current emotions and other hidden factors. For example, if a student likes classical music, but AI promotes pop music practice, the student will naturally have no interest in learning. On the other hand, each student has different learning habits. Some students prefer face-to-face teaching and are not used to AI's digital interaction. Even if they use it, they cannot truly devote themselves to learning, and the technology has no effect at all.

5. Copyright and Ethical Challenges of AI-Based Music Teaching

5.1. Ambiguous Definitions of Music Copyright and Risks to Student Data Privacy

The integration of AI into music education raises particular concerns about unclear copyright ownership and data privacy. Regarding copyright, there's currently no clear legal definition of ownership for AI-generated music. Teachers using these AI-generated compositions in class or having students create based on them often struggle to determine whether they are infringing copyright. If someone were to seek legal action, both the school and the teacher could be embroiled in legal disputes.

Further complicating matters, some AI teaching tools utilize unauthorized music as training material. This "data feeding" is inherently illegal and, if it triggers copyright disputes, can significantly disrupt normal teaching.

Data privacy is also a concern. AI tools rely on vast amounts of student data to function, and the risk of data leakage persists during the collection and analysis process. Students submit personal information, practice records, and even emotionally charged performance audio. If schools and technology providers fail to implement data encryption and access control measures, this data could be misused or leaked. Worse still, some tools collect unnecessary information, exceeding actual teaching needs, further complicating privacy protection and complicating student data security[4].

5.2. Hidden Ethical Imbalances in Teaching

The use of artificial intelligence in music instruction may also disrupt pedagogical ethics and deviate from the original goals of music education. For one thing, the "black box" algorithms of AI instruction can easily lead to unfair teaching practices. The logic behind the algorithms is invisible and intangible, and hidden biases are inevitable when recommending instructional content. Some students are limited to low-quality resources. Over time, this widens the learning gap between students, eroding the fundamental principle of educational equity.

On the other hand, over-reliance on AI can diminish the humanistic nature of music instruction. Music instruction isn't just about imparting knowledge and practicing skills; it's also about cultivating students' emotional perceptions and nurturing their humanistic qualities through music. However, AI lacks the ability to perceive emotions and empathize, making it incapable of replacing the teacher's emotional guidance. If instruction overemphasizes technology and reduces music learning to rote skill training, it loses its warmth and deviates from the core goal of music education: to cultivate well-rounded individuals and enhance humanistic qualities.

6. Optimizing Strategies for the Integration of AI Technology and Music Teaching

6.1. Strengthening Technical Adaptation and Infrastructure Development

Meeting technical challenges requires focusing on both tools and infrastructure. Regarding tools, to make AI teaching tools more tailored to music instructional needs, developers must collaborate with music teachers to optimize functionality based on practical teaching needs. For example, adding modules that analyze the emotion and timbre of performances can make the tools more adaptable to music disciplines. Furthermore, we should promote data interoperability among different AI tools, establish unified music teaching data standards, and break down data silos. On the other hand, the government will increase infrastructure investment. Special funding will be provided to support grassroots schools in equipping them with AI teaching hardware, such as VR equipment and intelligent performance analysis instruments. Campus network upgrades will be promoted to ensure the network environment meets technical requirements. Furthermore, businesses are encouraged to collaborate with schools to establish AI music teaching experimental bases to provide practical support for technology application.

6.2. Improving Teachers' AI Literacy and Role Transformation

Improving teachers' AI literacy is key to promoting technological integration, and a comprehensive training and incentive system is necessary. Education departments should develop AI training plans for music teachers, designing tiered and categorized training content. For example, tool operation training should be provided for novice teachers, while innovative teaching models should be offered to key teachers. Training should be conducted through a "online + offline" and "theory + practice" approach, with workshops and case studies to enhance the effectiveness of training. At the same time, schools should establish incentive mechanisms, incorporate AI technology application capabilities into teacher evaluation systems, establish AI teaching innovation projects, and encourage teachers to proactively explore technology integration models. They should also guide teachers to shift their roles from "knowledge transmitters" to "learning guides," fully leveraging the auxiliary role of AI tools to achieve human-computer collaborative teaching.

6.3. Standardizing Copyright Management and Ethical Development

To address copyright and ethical challenges, it is necessary to strengthen institutional norms and educational guidance. In terms of copyright management, relevant departments should accelerate the improvement of AI music copyright laws and regulations, clarifying the copyright ownership of AI-generated content and secondary creations; strengthen supervision of the development of AI teaching tools, requiring developers to use legally licensed music materials and clarify copyright responsibilities in tool usage agreements. In terms of ethical development, data privacy protection standards for AI music teaching should be established, requiring schools and technology providers to implement data encryption, access control, and other measures to ensure student data security; and establish a review mechanism for AI teaching algorithms. Evaluate the fairness and transparency of algorithms to avoid algorithmic bias[5]. Furthermore, through classroom instruction and special lectures, educate teachers and students about copyright knowledge and ethical standards, raising their awareness of copyright and privacy protection.

7. Conclusion

This study explores how artificial intelligence (AI) technology is reshaping music instruction. By analyzing its application scenarios and practical challenges, the study concludes that AI technology can play a significant role in personalized learning adaptation, interactive teaching innovation, and teaching evaluation and feedback. Leveraging data-driven and technological innovation, AI technology can overcome the limitations of traditional music instruction and provide new avenues for optimizing teaching models. These scenarios address the diverse needs for personalization, interactivity, and precision in music instruction, highlighting the enormous potential for integrating the two.

However, the application of AI technology still faces multiple challenges: technically, there are insufficient tool adaptation, weak infrastructure, and the pressure of updating and maintenance; at the subjective level, there are lagging AI literacy among teachers, the risk of overreliance among students, and individual differences in adaptation; and at the copyright and ethical level, there are hidden dangers such as ambiguous copyright definitions, data privacy risks, and imbalances in teaching ethics. To address this, the study proposes optimization strategies such as strengthening technical adaptation and infrastructure development, improving teacher AI literacy and role transformation, and standardizing copyright management and ethical development, providing practical references for promoting the deep integration of technology and instruction.

It is important to emphasize that AI technology is not a "replacer" for music instruction, but rather an "enabler." Its application must adhere to the essential principles of music education and balance technological application with humanistic care. In the future, with the continued development of AI technology, new scenarios such as personalized teaching based on brain science and immersive music learning in the metaverse will gradually emerge, bringing more innovative possibilities to music instruction. At the same time, how to further enhance the artistic perception capabilities of AI tools and how to build a more equitable and efficient AI music teaching ecosystem requires continued exploration by both academics and practitioners. Future research could focus on the long-term effectiveness evaluation of the integration of AI technology and music instruction, combining empirical research with optimized strategies to promote higher-quality development of music education empowered by technology.

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