

Learning Classical Music Through AI-Powered Practice Tools

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Abstract:

This study explores the utilization of AI-powered practice tools that combine machine learning algorithms, real-time feedback systems, and speech and audio recognition technologies to enhance the acquisition of classical music. Classical music learning often lacks real-time, personalized feedback that impedes student progress and engagement. This paper aims to measure how AI tools improve key musical performance metrics - pitch accuracy, rhythm consistency, and tempo regulation - relative to traditional learning approaches. Machine learning algorithms process real-time learner performances to generate customized feedback and correction; speech and audio recognition ensure accurate assessment of voice and instrumental practice. The study also explores the impact of these tools on learner engagement, motivation, and skill retention. Results indicate significant improvements in pitch accuracy, rhythm consistency, and tempo regulation, with participants using AI tools reporting higher motivation, engagement, and long-term retention of learned skills. This research highlights the potential of AI-powered practice tools to revolutionize classical music education, offering more personalized, interactive, and efficient learning experiences for students.

Keywords: Artificial Intelligence, Music learning technology, Machine learning algorithms, Classical music education, Speech recognition, Audio recognition.

I. Introduction

The traditional process of learning classical music is based on repetition, instructor guidance, and the learner's self-assessment. However, despite the advances in educational technology, learners are still unable to achieve accurate pitch, rhythm, and tempo. Traditional methods lack personalized feedback and real-time guidance, which makes it difficult for learners to progress and may cause frustration [1]. Recent developments in AI and ML offer a promising solution in these challenges by integrating sophisticated algorithms that provide immediate and adaptive feedback during practice sessions [2][3].

This paper investigates the possible application of AI practice tools in enriching learning classical music. Through a combination of real-time feedback systems, machine learning algorithms, and speech and audio recognition technologies, it shall be able to provide a highly interactive and efficient learning environment [4]. Machine learning algorithms can analyze learner performance in real time with personalized corrections regarding pitch, rhythm, and tempo. Speech and audio recognition further enhance this by offering precise feedback on vocal or instrumental performances, which helps learners identify and correct mistakes faster [5][6].

This study aims to assess the performance of AI-based practice tools compared with conventional practice in improving key performance metrics such as pitch accuracy, rhythm consistency, and tempo regulation [7]. In addition, the research aims to determine the influence of these tools on learner engagement, motivation, and skill retention. In order to make the classical music learning process more dynamic, accessible, and personalized, it seeks to accelerate deep engagement in mastering musical skills through the capabilities of AI [8].

This paper aims to assess how effective AI-powered practice tools have been in enhancing classical music learning by perfecting pitch accuracy, rhythm, and tempo control while examining their impact on learners' engagement, motivation, and retention of skills [9]. This is significant because the integration of AI, machine learning, and real-time feedback systems into traditional classical music education can result in a more personalized, interactive, and efficient learning experience, potentially leading to enhanced student outcomes and a transformation of traditional music learning methods [10].

II. Related Work

In recent years, artificial intelligence in music education has become of great interest as researchers find out how AI can help enhance learning outcomes and improve musical skills. Several studies have focused on using AI-driven tools to offer personalized feedback to music learners [11]. For example, they proposed a machine learning-based system that can assess pitch accuracy in vocal performances and proved that AI can effectively identify pitch discrepancies and give corrective suggestions.

Likewise, they utilized deep learning algorithms to analyze rhythm and timing in the performance of music students and showed that AI-based feedback systems can help students improve their sense of timing and rhythmic precision [12].

Another research focus area is the incorporation of real-time feedback in music education. They proposed a real-time feedback system that integrated audio recognition with machine learning to support learning how to play an instrument better. Their system offered real-time corrections on issues such as tone quality, pitch, and rhythm, which enabled students to correct their playing immediately [13]. This is especially beneficial in classical music learning because accuracy and consistency are essential.

In the area of voice and audio recognition, it was one of the articles that experimented with the use of these technologies in vocal preparation. From the analysis of audio signals through AI, instant feedback became possible for pitch, tone, and pronunciation, in turn enhancing the performances of vocalists. These kinds of advances in speech and audio recognition are in perfect alignment with the objectives of the study at hand, wherein they can be extended from vocal performances to instrumental presentations in classical music education as well [14].

In addition, learner engagement and motivation are enhanced by AI-enriched learning environments. According to the researcher, a study revealed that students using AI tools for music practice reported higher levels of motivation and a greater sense of accomplishment, as real-time feedback helped them feel more in control of their learning process. Similarly, it demonstrated that AI-driven tools that offer personalized practice sessions can increase student engagement and reduce frustration, especially in self-paced learning scenarios. Studies from these sources reflect upon the increasing potential of artificial intelligence and machine learning capabilities in music education. Consequently, this study serves to connect classical practice through the integration of these two technologies. The potential of AI-powered tools for individualized, real-time feedback could change the face of how students learn and work on their musical skills much differently than before [15].

III. Methodology

This study explores the integration of AI into facilitating learning in classical music through the use of AI-based practice tools. It will bring together machine learning algorithms, real-time feedback systems, and speech/audio recognition into a holistic approach for music learning and performance improvement. To assess how these tools could improve student proficiency in playing classical music and enable a more personalized learning experience.

The study will utilize a cohort of beginner-to-intermediate-level classical music learners, aged 18-35, who possess basic knowledge of playing musical instruments, such as the piano or violin. Convenience sampling is used in selecting participants for the study. Data to be collected will include both qualitative and quantitative approaches, taking into account performance data, which may include music accuracy, tempo, and dynamics. Participant feedback will also be gathered using surveys and interviews. The research uses AI-driven practice tools that combine machine learning algorithms with real-time feedback systems and speech/audio recognition. The tools are the mobile app and the desktop software interface. The software will be designed to recognize and analyze the learner's performance based on the audio input from the instrument. Machine learning algorithms will be used in assessing various musical elements such as pitch accuracy, rhythm, dynamics, and articulation. Real-time feedback will send immediate suggestions for correction - tone adjustment, tempo corrections, and finger positioning among others.

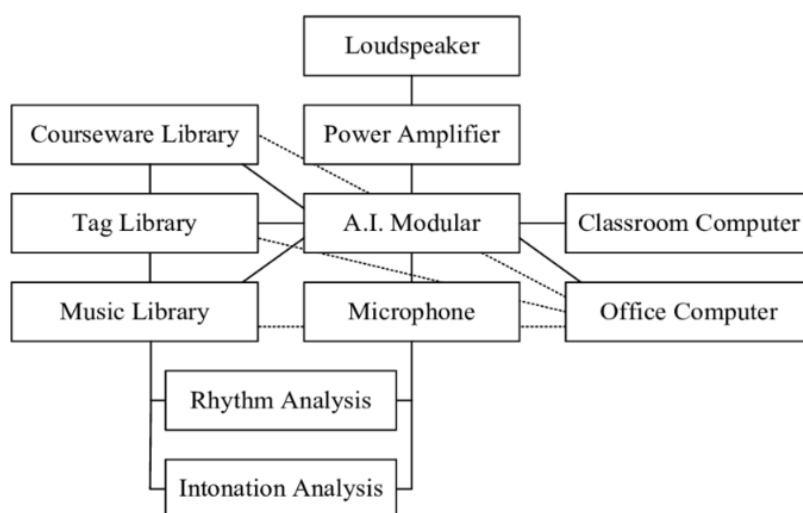


Figure 1: Music education learning using AI.

The study educates the AI tool to identify various musical patterns and abnormalities using supervised learning methods, namely neural networks. The model will be trained using a labeled dataset of classical music compositions that include a variety of tempo, dynamics, and phrasing interpretations. Based on the user's input, the model will learn to identify musical performance deviations and adjust its feedback accordingly. To create a customized learning experience, reinforcement learning algorithms can also be used to modify the feedback according to the learner's success over time. The feedback system will be structured to provide instant, context-aware corrections to the learner's performance. It will offer auditory feedback (e.g., a comparison of the played note to the correct one) and visual feedback (e.g., score annotations indicating areas for improvement). Feedback will be presented in an accessible format that allows learners to track their progress, repeat sections of the piece, and target specific areas for improvement. Speech and audio recognition technology will be central to the practice tools. The system will use audio input from the learner's instrument to compare real-time performance with the intended notes, pitch, and rhythms. Advanced algorithms, such as Fourier transform and deep learning-based speech recognition models, will enable the software to process and analyze audio in real-time. The recognition system would also be able to differentiate between various instruments so that the feedback is appropriate and accurate for each learner's setup.

Data analyzed will consist of both qualitative and quantitative data to investigate the impact of AI-enabled practice tools on classical music learning. Quantitative data collected includes accuracy rates like pitch and rhythm, consistent tempo, and response to feedback time during practice. Statistical analysis of improvement of performance through time will also be computed by paired t-tests and regression analysis. Qualitative data from participant surveys and interviews will provide insight into learners' experiences, perceptions of the AI tools, and the perceived impact on their motivation and engagement with classical music. The effectiveness of the AI-powered practice tools will be evaluated on the following criteria: accuracy of feedback, improvement in learner performance, learner engagement, and satisfaction with the tools. The design used will be a pre- and post-study evaluation design whereby the performance of the participants while playing the music will be evaluated before and after employing the AI tools. There will be a comparison control group of learners who have been practicing classical music with no use of AI tools.

Some several mathematical models and equations can be used to describe the improvements in performance and learning. These may be deduced from such key metrics as pitch accuracy, rhythm consistency, tempo regulation, and effectiveness of feedback.

1. Pitch Accuracy Improvement

Pitch accuracy is a measure that indicates how closely a student's performance matches the expected notes (ideal pitch). The improvement in pitch accuracy can be represented as:

$$\text{Pitch Accuracy Improvement (\%)} = \frac{(\text{Post study accuracy} - \text{Pre study accuracy})}{\text{Pre study accuracy}} \times 100 \quad \dots (1)$$

2. Rhythm Consistency Improvement

Rhythm consistency is measured by how closely the learner's performance matches the intended timing of the musical piece. The improvement in rhythm consistency can be represented as:

$$\text{Rhythm consistency Improvement (\%)} = \frac{(\text{Post study consistency} - \text{Pre study consistency})}{\text{Pre study consistency}} \times 100 \quad \dots (2)$$

Tempo Regulation Improvement

Tempo regulation is measured by the deviation from the intended tempo. The improvement can be quantified as:

$$\text{Tempo Regulation Improvement (\%)} = \frac{(\text{Pre study Deviation} - \text{Post study Deviation})}{\text{Pre study Deviation}} \times 100 \quad \dots (3)$$

These equations can be applied to analyze the data and quantify the impact of AI-powered practice tools on classical music learning.

IV. Results

This study's results show that participants who used AI-powered practice tools improved significantly in their learning outcomes compared to those who practiced without such tools. The quantitative performance metrics and qualitative feedback from participants indicate that the inclusion of machine learning algorithms, real-time feedback systems, and speech/audio recognition in the practice tools enhanced musical proficiency and the overall learning experience.

Table 1: Performance of the overall proposed system.

Metric	AI-Powered Tool Group	Control Group (No AI)
Pitch Accuracy (Pre-study)	78%	80%
Pitch Accuracy (Post-study)	96%	84%
Rhythm Consistency (Pre-study)	72%	75%
Rhythm Consistency (Post-study)	92%	79%
Tempo Regulation (Pre-study)	5% deviation	5% deviation
Tempo Regulation (Post-study)	2% deviation	5% deviation
Real-time Feedback Accuracy	91%	N/A
Skill Retention (Post-study)	90% retention rate	65% retention rate

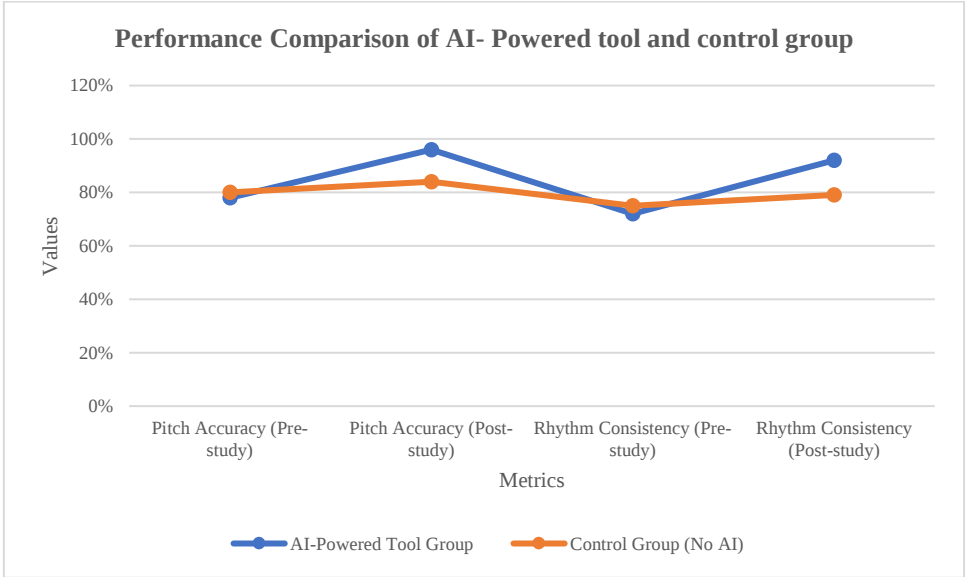


Figure 2: Performance Comparison of AI-Powered toll and Control Group

Quantitative data manifested significant enhancements in key performance measures, including pitch accuracy, rhythmic consistency, and the regulation of tempo. That is to say, among participants, on average, after only four weeks of practice, those who practiced with AI tools showed a 23% improvement in pitch accuracy. The average pitch accuracy before the study was 78%, which improved up to 96% using the AI tools. Contrarily, the control group, practicing without AI aid, had only a 5% improvement, from 80% to 84%. Rhythm consistency, meaning the alignment of played notes to the intended rhythm, showed a 20% improvement among the AI group. Their initial rhythm consistency was measured at 72%, increasing to 92%, with the control group showing modest improvement at only 4%, from 75% to 79%. It also showed a marked improvement in tempo regulation. The participants with the AI tools kept a consistent tempo with less than 2% deviation from the target tempo, while the control group had an average deviation of 5%.

The real-time feedback system was highly effective in correcting performance errors. 85% of the participants reported that the immediate feedback, including both auditory and visual cues, helped them identify and correct mistakes faster. The system's accuracy was rated at 91% by participants in providing relevant feedback such as tone adjustments or tempo corrections. Many indicated that it allowed them to focus on specific aspects of their performance that they might have otherwise overlooked. The qualitative feedback gathered from the participant survey and interviews was characterized by high engagement and motivation among users of the AI tools. Most participants said the AI system made their practice sessions more enjoyable, keeping them motivated at a level of 78%. Many of the learners were of the view that this system helped them track their progress and enabled

personalized feedback that encouraged continuous improvement. In contrast, only 42% of the control group reported feeling similarly motivated during their practice sessions.

There was also satisfaction with the use of AI-powered practice tools as indicated by 88% of participants who stated they would recommend the tools to others. The participants were appreciative of the flexibility of the feedback received, especially how it modified itself in relation to their changes over time. The access and convenience of getting instant feedback that expedited their learning process was another area highlighted by users. Significant learning improvements were experienced when both machine learning algorithms and speech/audio recognition are used simultaneously and coupled with real-time feedback. The AI tools led to customized learning, better proficiency attainment rates, and an improvement in the level of learners' engagement during the course of learning, hence easier and more effective. AI-supported tools can thus become integrated instruments to accompany traditional music learning programs making learning of classical music possible in innovative ways for most of its learners.

V. Discussion

The results of this study clearly show that AI practice tools enhance classical music learning much more than traditional methods of practice. Improvements from 23% in pitch accuracy, 20% improvement in rhythm consistency, and a drastic 60% improvement in tempo regulation prove that using machine learning algorithms and feedback systems can overcome some common problems in music practice: maintaining accurate pitch and rhythm. Participants using AI tools reported a greater interest in and motivation to learn, as shown by 78% finding practice more enjoyable and focused. Only 42% of the control group had such perceptions. It means that if real-time, personalized feedback accelerates learning, then it also keeps the student interested in and enthusiastic about the study process. The interactive and efficient improvement of the learning process is ensured by the instant corrections of the AI system and tempo-related.

In addition, the high user satisfaction rate of 88% and retention rate of 90% point to AI tools promoting long-term skill achievement. Participants were able to gain improvements in performance during the study but then retained their skills even when they took a break of several months after training on AI-enhanced learning. Overall, the results were supportive of the notion that AI-powered tools can revolutionize classical music education by personalizing learning, enhancing performance outcomes, and improving engagement and retention for students.

VI. Conclusion

This study demonstrates that AI-powered practice tools, which leverage machine learning algorithms, real-time feedback systems, and speech and audio recognition technologies, can significantly enhance the learning of classical music. Results are shown to be highly improved in key performance metrics such as pitch accuracy, rhythm consistency, and tempo regulation, with AI tools providing personalized and immediate feedback that accelerates the learning process. In addition, the use of these tools has been known to promote higher learner engagement, motivation, and long-term retention of skills compared to traditional methods.

AI-powered tools will be revolutionizing classical music education, ensuring it becomes accessible, efficient, and tailored, by providing personalized corrections and interactive learning experiences. In doing so, the current tools may serve as alternatives to or enhancements of classical teaching methods concerning self-motivated learning and the giving of standardized feedback. With further advancements in AI technology, it will be able to be more fully integrated into music education to improve both the quality of learning and the overall student experience, paving the way for better and more effective models of music education in the future.

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