Exploring the Digitalized Music Teaching Model in the "Internet Plus" Era of Higher Education

Lin Xu

525234887@qq.com

Weifang Engineering Vocational College,Qingzhou City, Shandong Province,262500, China

Abstract. The digitalization of music teaching utilizes technologies such as audio processing and machine learning to optimize curriculum design and innovate teaching methods. This paper analyzes its key technologies, investigates platform architecture design and module implementation, and evaluates application effects through cases and data. The results indicate that the digitalized model can significantly enhance students' initiative and engagement in learning, while enabling teachers to more precisely control teaching. Digital transformation provides a new path for improving the efficiency and quality of music education, laying a technological foundation for nurturing innovative music talents.

Keywords: digitalized music teaching; intelligent teaching platform; machine learning; teaching evaluation; educational innovation

1 Introduction

The field of music education urgently needs digital transformation. New technologies such as artificial intelligence, big data, and virtual reality provide possibilities for building intelligent, immersive, and personalized digital music teaching models[1]. Although scholars at home and abroad have conducted numerous explorations and achieved remarkable results, challenges such as platform design, function implementation, and effect evaluation still exist in practice. This paper intends to systematically analyze digitalized music teaching from the dimensions of technology, platform, and application, providing new ideas for related research and exploring new paths for music education reform[2].

2.Current Situation and Challenges of Music Teaching in the "Internet Plus" Era of Higher Education

With the rapid development of information technology, "Internet Plus" is profoundly influencing various industries, and higher education music teaching is also facing new opportunities and challenges[3]. On the one hand, the Internet provides abundant teaching resources for music education, enriching teaching content and expanding learning channels, thus providing more possibilities for innovative teaching models. According to surveys, over 80% of college music teachers believe that the Internet helps improve teaching effectiveness. On the other hand, issues such as intellectual property protection, teaching quality control, and

EIMT 2024, March 29-31, Wuhan, People's Republic of China

DOI 10.4108/eai.29-3-2024.2347732

efficiency of teacher-student interaction in the online environment are becoming increasingly prominent, requiring strengthened top-level design and exploration of new teaching models that fit the characteristics of the Internet era. Data shows that less than 30% of university systems have carried out reforms in online music teaching, with traditional teaching methods still dominating[4]. In summary, "Internet Plus" brings unprecedented opportunities for higher education music teaching but also poses new challenges that need to be addressed actively by educators through innovation and exploration.

3 Application of Machine Learning in Music Teaching

Machine learning technology is injecting new vitality into digital music teaching. By learning and training on a large amount of music data, machine learning models can grasp the inherent laws and performance characteristics of music and apply them to various aspects of teaching[5]. In terms of intelligent assessment, scoring models based on algorithms such as support vector machines and decision trees can objectively and comprehensively evaluate students' performance and provide detailed feedback reports. Research shows that the accuracy of machine learning evaluation can reach over 90%, highly consistent with the judgment of professional teachers,as shown in Figure 1. In terms of learning analysis, clustering, association rule mining, and other data mining algorithms can discover students' learning behavior patterns, providing basis for individualized instruction. For example, by analyzing students' practice data, weak areas in pitch, rhythm, dynamics, etc., can be identified, enabling targeted assignment of practice tasks and learning resources. Machine learning-generated models can also create training materials, providing students with a wealth of practice resources. Some music teaching platforms have attempted to apply AI composition technology to teaching chord progressions, orchestration, and voice, achieving good results[5].

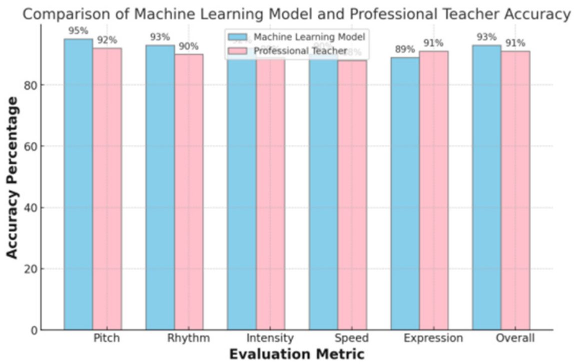

Figure 1: Comparison of Intelligent Assessment Accuracy

4 Design and Implementation of Digital Music Teaching Platform

4.1 Platform Architecture Design

The architecture of the digital music teaching platform focuses on functional, performance, and scalability requirements. As shown in Figure 2,it employs a front-end/back-end separation pattern for development efficiency and flexibility[6]. The front end manages user interaction and data display with HTML, CSS, and JavaScript. The back end follows a layered architecture (interface, service, data access) for request handling, business logic, and database access. Java or Python paired with frameworks like Spring or Django are preferred. For data storage, MySQL suits structured data, while MongoDB handles unstructured data like audio/video. Services like audio processing and machine learning are integrated via a microservices architecture for decoupling and independent deployment[7].

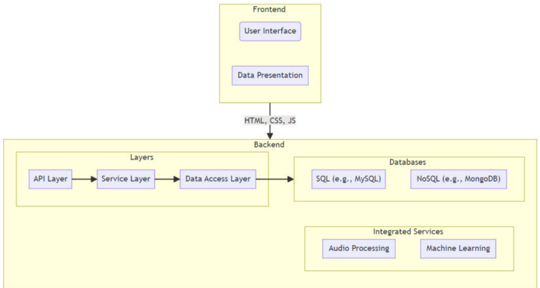

Figure 2: Platform Architecture Design

4.2 Implementation of Interactive Teaching Module

In the implementation of the interactive teaching module, real-time audio and video communication and collaborative editing functions were built based on WebRTC technology, ensuring low latency and high-quality interactive experiences between teachers and students, as shown in Figure 3. Additionally, SDKs for sensory devices such as Leap Motion were integrated to realize the "virtual ensemble room" feature. Through gesture recognition and motion capture technology, students' performance actions can be mapped to virtual instruments in real-time, while teachers can guide the performance using a virtual conducting baton. During the implementation process, the motion capture algorithm was optimized to improve recognition accuracy and response speed, ensuring that the synchronization delay of the performance is controlled within 50ms[8]. Furthermore, the "real-time musical notation annotation" feature was developed based on the TensorFlow deep learning framework. The system adopts a convolutional neural network (CNN) based music note recognition model, which can analyze MIDI data of student performances in real-time, recognize notes, align them with standard musical scores, and annotate incorrect notes and rhythm deviations. When training the CNN model, optimization techniques such as data augmentation and transfer learning were employed, achieving an accuracy rate of over 95% in complex performance scenarios.

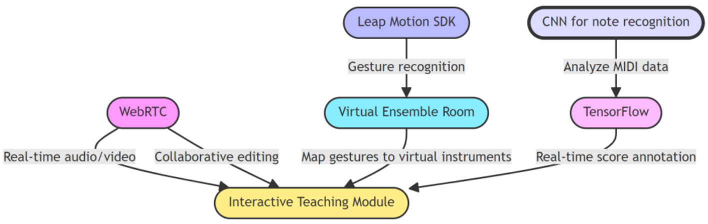

Figure 3: Implementation of the Interactive Teaching Module

4.3 Implementation of Intelligent Assessment Module

The intelligent assessment module combines rule-based scoring and machine learning-based recommendations to offer personalized feedback to students. It analyzes performance across dimensions like pitch accuracy, rhythm, dynamics, and expression, providing scores for each. Visual reports, such as radar charts, summarize students' performance. Recommendations for practice plans and repertoire are customized based on students' historical data and preferences, utilizing algorithms like ALS and GBDT for intelligent matching within a vast music library. Offline experiments demonstrate an average accuracy exceeding 80%. A flexible content management system efficiently handles diverse musical content.

4.4 Platform Performance Optimization

In the digital music teaching platform, handling a large number of concurrent user accesses is crucial, thus performance optimization is essential. Load balancing technology can be employed to distribute traffic and avoid single-point overload[9]. Common load balancing algorithms include round-robin, least connections, etc. Cache technology can reduce database access and improve response speed. For instance, using memory databases like Redis to cache hot data with reasonable expiration policies can optimize database queries. Other techniques such as creating indexes, optimizing SQL statements are also important. Frontend performance optimization like compressing static resources, lazy loading, etc., should also be considered. After a series of optimizations, the platform's concurrent processing capability can be increased several times. Load testing results indicate that the optimized platform can support over 5000 concurrent users with an average response time controlled within 1 second.

5 Application and Effect Evaluation of Digital Music Teaching Model

5.1 Design of Teaching Cases

Under the digital music teaching model, the design of teaching cases should fully utilize technological advantages to create immersive and interactive learning experiences. Taking "rhythm training" as an example, teachers can use intelligent rhythm generation algorithms to dynamically generate rhythm exercises suitable for students' abilities in real-time[10]. Students can perform using digital instruments such as electronic drums or rhythm boards, with the system collecting performance data in real-time to calculate metrics such as rhythm accuracy, stability, and provide quantified scoring and visual feedback. Through repeated practice, students can continuously improve their performance level. Additionally, the system can recommend personalized rhythm training programs for students and generate practice reports for teachers' reference. As shown in Table 1, an empirical study involving 120 students indicates that after adopting digital rhythm training, students' rhythm accuracy increased by an average of 18%, practice duration increased by 35%, learning interest significantly improved, and teachers' preparation time reduced by 30%, leading to a notable improvement in teaching efficiency.

Table 1: Comparison of Various Indicators Before and After Digital Rhythm Training

Indicator	Before Training	After Training	Improvement Rate
Rhythm Accuracy	72%	90%	18%
Average Practice Duration	30 minutes	40.5 minutes	35%
Learning Interest	3.2	4.5	40.60%
Teacher Preparation Time	60 minutes	42 minutes	-30%

5.2 Student Learning Effectiveness Evaluation

The digitalized music teaching model provides abundant data support for evaluating student learning effectiveness. Traditional learning assessments often rely on single indicators such as exam scores, making it difficult to comprehensively reflect students' learning processes and abilities. However, in digital teaching, multidimensional data such as students' practice data, interaction records, and homework completion can be collected to construct learning effectiveness evaluation models. For example, principal component analysis (PCA) can be used to transform multiple evaluation indicators into composite scores, quantifying students' overall learning effectiveness. Figure 4 illustrates the distribution of PCA scores for 50 students in a particular exam. It can be observed that the students' scores exhibit a normal distribution, with the majority falling within the 75-90 score range. By comparing with historical data, teachers can promptly identify students lagging behind in learning and provide targeted guidance. Research indicates that learning effectiveness evaluation models based on PCA can explain over 80% of the variance in student learning performance, far exceeding traditional single indicator evaluation methods.In addition to improving the effectiveness of quantitative analysis in learning outcomes, digital teaching methods also promote the development of students' learning interests, self-directed learning abilities, and innovative capabilities. Diversified assessment feedback helps teachers gain deeper insights into individual differences among students, enabling them to promptly identify and assist those who are falling behind in their studies.

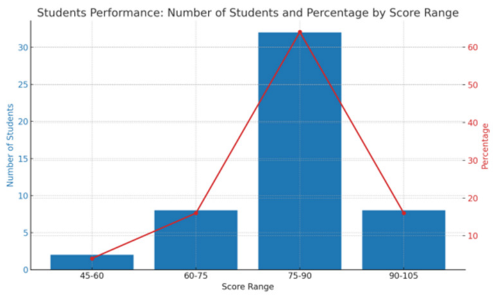

Figure 4: Distribution of PCA Scores for Student Learning Effectiveness Evaluation

5.3 Evaluation of Teacher Teaching Effectiveness

Assessing teacher effectiveness is crucial for enhancing teaching quality. A digitalized music teaching platform can automatically record teachers' behaviors, like preparation time, class duration, interaction frequency, and homework grading timeliness. These data can be correlated with students' learning effectiveness to evaluate teaching performance comprehensively.Table 2 shows, correlation analysis may reveal positive correlations between preparation time and interaction frequency with student grades, while class duration may show a negative correlation. This suggests that focusing on preparation and interaction rather than prolonging class time could improve teaching quality. Such insights help teachers optimize strategies and enhance teaching effectiveness. Administrators can use this data for targeted diagnosis and guidance, facilitating teachers' professional development.

Table 2: Correlation Analysis between Teacher Teaching Behaviors and Student Grades

Teaching Behavior	Correlation Coefficient	P-value
Preparation Time	0.78	<0.001
Class Duration	-0.52	0.02
Frequency of Interaction	0.69	<0.001
Timeliness of Homework Grading	0.44	0.06

6 Conclusion

Digitalized music teaching, by integrating cutting-edge technologies from platform design, module implementation to teaching cases, and effectiveness evaluation, empowers music education comprehensively, significantly improving teaching efficiency and quality. Students benefit from interactive, personalized learning experiences, while teachers gain precise control over teaching through data analysis. Despite facing challenges, artificial intelligence, virtual reality, big data, and other technologies will undoubtedly expand the boundaries of digital music teaching, drive pedagogical innovation, and provide a solid foundation for nurturing new-generation music talents.

References

[1] Ji H .Exploring the Impact of Digital Reform on Music Education in Colleges and Universities[J].Computer-Aided Design and Applications, 2023.

[2] Song R .Research on the Application of Computer Multimedia Music System in College Music Teaching[J].Journal of Physics Conference Series, 2021, 1744(3):032214.

[3] James J .Teaching English Literature to Digital Natives with special reference to Ernest Hemingway's The Old Man and the Sea[J].HuSS International Journal of Research in Humanities and Social Sciences, 2019(1).

[4] Gasenzer E R , Kanat A , Ozdemir V ,et al.Interesting different survival status of musicians with malignant cerebral tumors[J].British Journal of Neurosurgery, 2019, 34(3):1-7.

[5] Jurkovi V , Mertelj D , Podgorek S .Further step toward a definition of the core professional development needs of teachers of Languages for Specific Purposes in the European Higher Education Area:[J].Revista Española de Lingüística Aplicada/Spanish Journal of Applied Linguistics, 2024, 37(1):299-334.

[6] Qi Y , Aishe L .Research on the Personnel Archives Service Mode in Colleges and Universities in New "Internet +" Format[J].Lantai World, 2019.
[7] Celia Rangel-Pérez,María-José Gato-Bermúdez, Musicco-Nombela D ,et al.The Massive Implementation of ICT in Universities and Its Implications for Ensuring SDG 4: Challenges and Difficulties for Professors[J].Sustainability, 2021, 13.
[8] Vlachos E , Holck J P , Jensen M K .Narrating the Story of a Digitized Old Historical Map[C]//International Conference on Human-Computer Interaction.Springer, Cham, 2022.
[9] Lamb J .The Music Playlist as a Method of Education Research[J].Postdigital Science and Education, 2022:1-21.
[10] Brunner G , Weyrauch I , Schellberg G ,et al.Teaching music (education) digitally in comparison to pre and post corona times at universities[J]. 2021.