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Impact of Online Music Teaching Platforms on Student Learning Outcomes

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Abstract: To address the widespread challenges of insufficient classroom participation, difficulty maintaining learning interest, and inaccurate learning outcome assessment in existing teaching models, this study introduces a hybrid and dual-teacher classroom model. Based on big data and online platforms, this study constructs a music teaching resource system that integrates online micro-lessons, real-time interaction, virtual choirs, collaborative composition, and learning behavior tracking to enhance the openness and personalization of teaching. Through comparative experiments, the study focuses on changes in student knowledge acquisition, musical skills, learning interest, and classroom engagement. Results show that the experimental group significantly outperforms the control group in terms of improvement in knowledge test scores, rhythm and pitch performance, task completion rate, and scores on the learning motivation questionnaire. Differences are particularly prominent in interaction frequency and the expressiveness of the work. The study shows that Group A demonstrates significant improvement in all three dimensions: interest increases from 3.1 to 4.2; autonomous learning motivation increases from 3.0 to 4.1; emotional engagement increases from 3.2 to 4.3, demonstrating strong positive effects. Experimental Group B shows the greatest improvement, with interest increasing from 3.0 to 4.5, autonomous learning motivation from 2.9 to 4.4, and emotional engagement from 3.1 to 4.6, indicating the most significant improvements in learning attitudes and emotions.

Keywords: Online music teaching platform; Student learning outcomes; Blended learning; Dual-teacher classroom; Network technology

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1. Introduction

With the rapid development of digital learning technologies, online and blended learning platforms are increasingly integrated into educational practices, providing diverse opportunities to enhance students' knowledge acquisition, skill development, and learning engagement. Previous research has shown that digital learning environments can promote personalized learning, enhance student motivation, and support collaborative learning experiences. However, there remains a gap in understanding how different teaching

methods, particularly the integration of platform-based activities, interactive tasks, and collaborative projects, influence cognitive and affective outcomes in music education.

This study aims to investigate the effects of different blended learning interventions on students' knowledge, skills, learning behaviors, motivation, emotional engagement, and performance on music tasks. By comparing a control group with two experimental groups, the study assesses not only objective learning outcomes but also students' engagement patterns, task completion, and subjective satisfaction with the learning platform. The research findings are expected to provide reference for effective strategies to enhance digital learning experiences and promote the overall development of music education.

2. Related works

In recent years, with the deep integration of information technology and education, scholars have conducted a lot of research on the design, application and effectiveness of online music teaching platforms. In response to the problems of slow response speed and poor security of traditional music teaching platforms, Luo proposed a remote online music teaching platform based on "Internet +". Experimental results showed that the platform's response time was only 290 ms, which significantly shortened the response delay and effectively improved the security and teaching efficiency of the system [1]. In response to the problems of long-time consumption and high resource integration error of traditional music teaching platforms, Zhu proposed an online teaching platform for college music courses based on the Internet of Things. Experimental results showed that the course resource upload time was always less than 4 seconds, and the lowest teaching resource integration error was about 0.01%, which significantly improved the efficiency and accuracy of the teaching platform [2]. Yu and Zou proposed the development idea of "blockchain + education" and demonstrated its application in the digital platform of music education. This study emphasized the importance of demand analysis in system design and implementation.

Based on the Fabric architecture, it explored the role of blockchain in digital education resource management and provided technical support and development direction for the construction of future education platforms [3]. Yang et al. explored the application of modern technology in the teaching of electroacoustic music, designed and implemented an interactive learning system based on OSC (Open Sound Control) to improve college students' rhythm perception and performance ability. The experimental results showed that the experimental group was significantly better than the control group in terms of rhythm perception and performance [4]. Beirnes and Randles used a co-autobiographical qualitative case method to record the first author's experience of teaching general music in a hybrid (offline and online synchronous) environment during the COVID-19 pandemic. The implications of this study for music education are that it is necessary to pay attention to teachers' teaching stories in the context of the pandemic and explore the profound changes brought about by technological intervention, learner-centered teaching methods and creative practices [5]. Cipta et al. used qualitative research and descriptive methods to collect data through focus group discussions and literature analysis, and analyzed them using the Miles and Huberman model.

The results showed that teachers formed an understanding of the platform and a judgment of its advantages and disadvantages in technological interactions; in implementation, the platform helped to stimulate students' creativity at the cognitive, emotional and skill levels [6]. Kuebel and Haskett used a multi-case approach to examine the experiences of four elementary school general music teachers at different career stages during the COVID-19 pandemic. Teachers shared the technological resources they used, pointed out the inequality

between online and offline students, and reflected on the impact of the epidemic on their personal lives [7]. Sang and Dean conducted action research using the "Xiaoye Music Education" platform as a case study. They constructed an HCI (Human-Computer Interaction) course evaluation scale. The questionnaire results showed that the teaching was widely recognized, with both the homework submission rate and pass rate reaching 90%, and the high score rate for mock exams reaching 75% [8]. Gül explored the use and contribution of technology-supported educational tools in general music education. The results showed that teachers generally believed that they had limited ability to use technology-supported teaching materials, but showed a positive attitude and willingness to improve [9]. Løkke Jakobsen et al. explored cross-cultural learning in synchronous online Western classical instrumental music teaching, focusing on the learning experience of Chinese students.

The results showed that synchronous online teaching, despite the problem of technical delays, facilitated dialogue between teachers and students. However, research on cross-cultural interaction is still insufficient, and there is an urgent need to improve teachers' ability to cope with diverse music cultures [10]. Safian et al. developed software using 360-degree music performance videos and interactive modules, and used the m-ADDIE model to guide development, combining SUS (System Usability Scale) and PSSUQ (Post-Study System Usability Questionnaire) to evaluate usability. The results showed that e-MARZ had a user-friendly interface, was easy to use, and effectively solved teaching challenges. Although it had 3DOF (Three Degrees of Freedom) limitations, it provided a reference for the development of low-cost and operational VR (Virtual Reality) applications in education, significantly improving students' music appreciation and learning experience [11]. Jiang and Cheong observed 45 students in 13 remote music classes in Changsha County and interviewed two teaching assistants. The results showed that visual and audio support, music games, and progressive rhythm learning can effectively improve attention [12].

The bottleneck of existing research is that most of it focuses on platform function design and technical optimization, lacking long-term tracking of student learning outcomes and multi-dimensional empirical analysis.

3. Methods

3.1. Hybrid and dual-teacher classrooms: Innovative models for improving student music learning

3.1.1. Leveraging platform topics to develop students' deep thinking

Compared to traditional offline and online teaching methods, the most significant feature of hybrid teaching is openness. This openness applies not only to students' learning methods but also to their learning resources and thinking styles. For example, teachers can use Party history education content from the "Moral Education" section of the "National Smart Education Platform" to teach students about the revolutionary cultural background and creative context of the fifth-grade songs "Lugou Ballad" and the second-grade songs "Red Star Song" (People's Education Press edition). This allows students to learn together and deepen their understanding of the creative background and revolutionary culture of revolutionary songs. In this way, hybrid online and offline teaching can better promote students' understanding and mastery of knowledge, thereby improving music learning outcomes.

3.1.2. Implementing "dual-teacher classrooms" to improve classroom teaching quality

The dual-teacher classroom is an information technology-based teaching model that integrates online and offline teaching, offering a new concept for sharing educational resources. Through the "My Teaching" function of the "National Smart Education Platform for Primary and Secondary Schools", teachers can display national high-quality courses on the big screen and combine them with offline teaching. In the classroom, teachers can provide

students with a learning platform through multimedia courseware on the big screen, online learning task lists, after-class exercises, and so on. During the performance, teachers pause appropriately to interact and communicate with students. When there is a conflict of ideas, different teachers adopt different teaching strategies based on their own characteristics and choose teaching points and difficulties. Introducing the "dual-teacher classroom" into a situational and interactive teaching model can improve students' classroom enthusiasm.

3.2. Core design ideas of the online music teaching platform

The purpose of the online platform for university music education established based on the big data environment is to combine the Internet with information technology and transform music education into a networked and interactive one. On this basis, an open, flexible and personalized music education ecosystem is constructed to lay the foundation for the cultivation of high-quality music talents in the new era.

3.2.1. Platform characteristics

The platform should have online and interactive characteristics. Faced with the rapid development of information technology and the advent of the big data era, the online music education platform must have interactive characteristics. Online learning transcends the constraints of time and space, enabling students to access and share music education resources anytime, anywhere. Through high-definition video instruction, real-time teaching, and cloud resource sharing, a seamless connection between theoretical knowledge and practical application is achieved. Interactive teaching requires the integration of multimedia technologies to strengthen communication and collaboration between teachers and students, and between students themselves. Through features like virtual choirs and collaborative composition, real-time musical feedback and online Q&A are enabled. Through big data analysis, user interaction behavior can be accurately identified, enhancing the adaptability and appeal of teaching content.

3.2.2. Establishment of resource platforms

In the new round of information technology revolution, digitalization, networking and intelligence have become the trend of all walks of life, and education is no exception. Building a digital music teaching resource platform is an important part of the construction of university music teaching resources and an important means to support the reform of university music teaching. The digital music teaching resource platform consists of two parts, hardware and software. It is driven by the reform of university music courses and combines the regional characteristics of local music education majors. The platform includes functional modules such as online classroom, library, audio-visual library, digital examination, and platform management. The online teaching module includes online teaching, sight-singing and ear training, music theory, vocal teaching, instrumental teaching, and composition teaching. The library module includes bibliographic query, book borrowing, e-books, and literature query. The audio-visual library module includes audio retrieval, video retrieval, multimedia, virtual reality, etc. The system realizes the networking of online examination rooms, question management, multi-channel transmission and intelligent scoring. The platform also includes basic data, operation interface, log management, user management, permission configuration, workflow, access control, integrated interface, code debugging, upgrade and maintenance.

3.3. Role of network technology in music teaching

3.3.1. Improving learning efficiency and quality

Network technology can improve students' learning interest through auditory and visual stimulation, promote

students' active learning of music, fully understand the connection between knowledge, and enhance their absorption and comprehension abilities.

3.3.2. Stimulating students' interest and motivation in learning music

Through various methods such as objects, pictures, and sounds, network technology helps students understand music knowledge and makes music classes livelier. Interest is the source of all activities, and mobilizing students' learning enthusiasm is the key to improving the quality of education.

3.3.3. Improving the information value-added rate

There are many types of information on the Internet. In teaching, information should be scientifically selected in combination with teaching content and methods. The openness of the Internet has led to a continuous increase in the information value-added rate.

4. Results and discussion

4.1. Subjects and grouping

Subjects: N = 72 to 120 students in grade X of a certain school, such as fifth grade/university general music class.

4.1.1. Stratified randomization (stratified by class or pre-test score)

(1) Control group (C): traditional teaching (offline routine).
(2) Experimental group A (BL): hybrid teaching (online platform + offline).
(3) Experimental Group B (DT): Dual-teacher classroom (online live/recorded instruction by a renowned teacher + offline instruction by a local teacher + platform support).

If the sample size is small, two groups can also be used: C vs. (BL + DT).

4.2. Teaching content and duration

The same unit, for example, the revolutionary song unit includes "Lugou Ballad" and "Red Star Song" was selected, covering music history background, rhythm and meter, melody recognition, and singing/instrumental/choral practice. Duration is around 6 to 8 weeks, 2 class hours per week to ensure consistent teaching intensity. The experimental process consists of four phases: pre-test, intervention implementation, post-test, and delayed test. The entire process fully integrates the functions of the online music teaching platform.

(1) Pre-test phase (Week 0)

Students first complete a knowledge test consisting of 20–30 questions covering music theory and background of the works. The skills assessment covers sight-singing, rhythmic imitation, and singing excerpts, evaluated using a standardized scoring scale. Students then complete an interest and learning motivation scale (5-point Likert scale, self-developed, reliability $\alpha > 0.8$). Baseline behavioral data, such as study time and grades over the past month, are also collected to provide a reference for evaluating the effectiveness of the intervention.

(2) Intervention implementation phase (Weeks 1–6/8)

The control group (C) maintains regular classroom instruction; the platform learning group (BL) watches micro-lessons and completes assignments on the platform, followed by offline discussions and practice, and submits assignments and self-assessments on the platform. The mixed dual-teacher group (DT) introduces renowned teachers' lessons and demonstrations on a large screen, with secondary

explanations and differentiated tutoring by local teachers. Students also participated in virtual choral singing, collaborative composition, and online Q&A via the platform. The platform's standardized configuration includes video micro-lessons, interactive practice exercises, virtual choral singing/ collaborative composition, and post-class self-assessments. It also provides a learning analytics dashboard to track logins, learning time, task completion rate, discussion participation, and timely feedback.

(3) Post-test phase (final week)

Students complete a knowledge and skills assessment with the same structure as the pre-test, but with different questions. Class performance and final project/performance are assessed. Students complete a Satisfaction and System Usability Questionnaire (SUS or self-written questionnaire). Some students participate in semi-structured interviews or focus groups to obtain qualitative feedback.

(4) Extended testing phase (optional, + 4 weeks)

Retention testing of key knowledge points and a brief retest of skills are conducted to assess the sustainability of learning outcomes.

4.3. Data analysis

Figure 1 shows that the knowledge and skills scores of the three groups are generally similar in the pre-test phase, with no significant differences with mean differences were controlled within 5 points. However, in the post-test results, the experimental group shows significantly greater improvement than the control group. Specifically, the control group has an average improvement of approximately 6 points in knowledge and 4 points in skills, demonstrating limited progress. In contrast, Group A achieves an average improvement of 15 points in knowledge and 14 points in skills, respectively. Group B shows the most significant improvement, with an average increase of 19 points in knowledge and 19 points in skills. The results indicate that the online music teaching platform, which incorporates a hybrid and dual-teacher classroom approach, has a positive impact on student learning outcomes. Not only do students significantly outperform the traditional teaching group in theoretical knowledge, but they also achieve greater progress in musical performance, demonstrating that the platform can significantly enhance students' music learning outcomes within a limited timeframe.

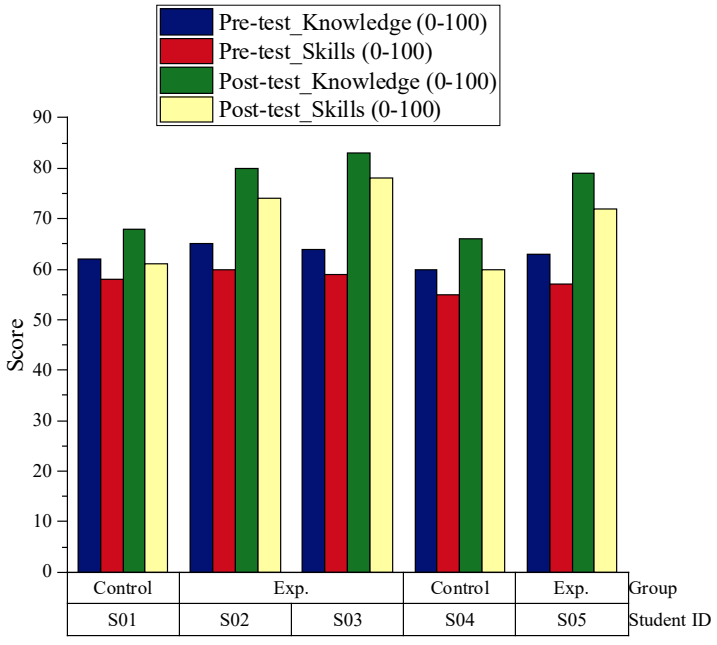

Figure 1. Pre-test and post-test student score table.

Figure 2 shows significant differences in platform usage between different groups. Students in the control group log in infrequently (an average of nine times), study for less than six hours, and achieve a task completion rate of only 65%-70%. Participation in discussions and interactions is low, and their timely feedback rate is less than 50%. In contrast, students in Experimental Group A log in an average of nearly 20 times, study for over 13 hours, achieve a task completion rate exceeding 92%, and significantly outperform the control group in both the number of discussion posts and replies, with a timely feedback rate exceeding 85%. Experimental Group B performs the best, with students logging in an average of over 22 times, studying for nearly 15 hours, achieving a task completion rate of 95%, ranking first in the number of discussion posts and replies, and a timely feedback rate of nearly 90%. Overall, these results demonstrate that the improved teaching platform effectively enhances student engagement and interactive motivation, outperforming traditional teaching models in both task execution and learning feedback. Experimental Group B particularly demonstrates significant advantages in the quality and quantity of learning behaviors.

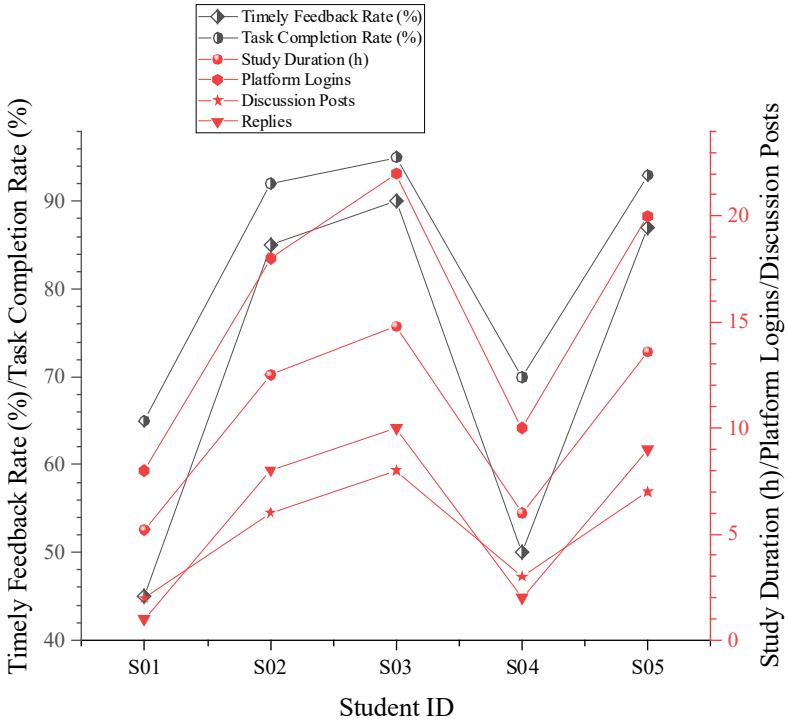

Figure 2. Platform learning behavior.

Figure 3 shows significant differences between the different groups in the pre-test and post-test comparisons of interest, autonomous learning motivation, and emotional engagement. The control group shows limited improvement in all three indicators: interest rises slightly from 3.0 to 3.2, autonomous learning motivation increases slightly from 2.8 to 3.0, and emotional engagement increases by only 0.2 points, representing little overall change. In contrast, Experimental Group A shows significant improvement in all three dimensions: interest increases from 3.1 to 4.2, autonomous learning motivation from 3.0 to 4.1, and emotional engagement from 3.2 to 4.3, demonstrating strong positive effects. Experimental Group B shows the greatest improvement, with interest increasing from 3.0 to 4.5, autonomous learning motivation from 2.9 to 4.4, and emotional engagement from 3.1 to 4.6, indicating the most significant improvements in learning attitudes and emotions. Overall results indicate that the improved teaching platform, particularly Experiment B, effectively stimulates students' learning interest,

enhances their independent learning motivation, and improves their emotional engagement, whereas the traditional model has limited effectiveness in cultivating learning motivation and interest.

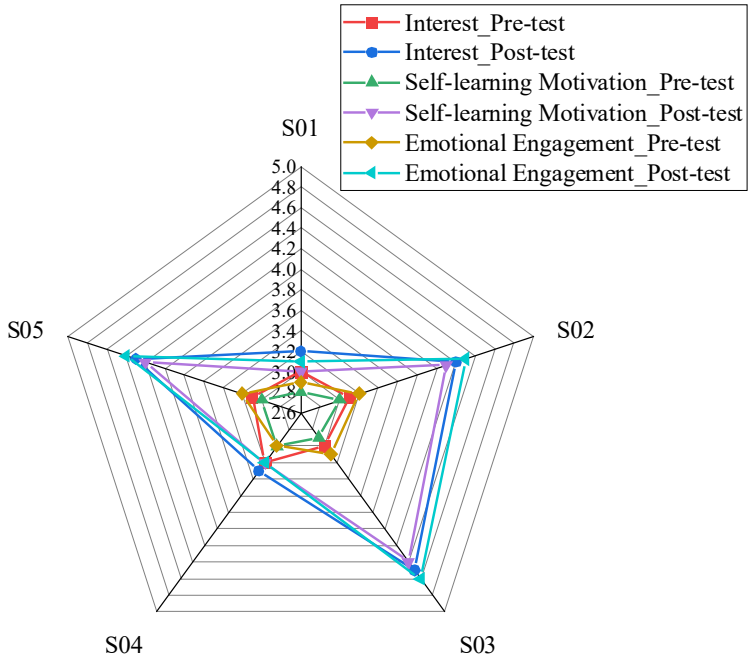

Figure 3. Student interest and motivation questionnaire (Likert 1–5).

Students in the control group maintain scores around 3 in all five dimensions, including pitch, rhythm, expression, technique, and collaboration, for a total score of approximately 60–62%. Their SUS usability ranges from 62–65, and their overall satisfaction rating is only 3. In contrast, Group A achieves significant overall improvement, reaching 4 in all five dimensions, for a total score of 80–84%. Their SUS usability improves to 82–85, and their overall satisfaction rating remains stable at 4. Group B performs the best, achieving 5 in all five dimensions, with only expression reaching 4, for a total score of 92%. Their SUS usability is 90, and their overall satisfaction rating is 5. These results indicate that compared to the control group, the experimental groups show significant improvements in both performance and learning experience, with Group B showing the strongest overall performance (see **Table 1**).

Table 1. Final project scores and satisfaction

Student ID	**S01**	**S02**	**S03**	**S04**	**S05**
Group	**Control**	**Exp. A**	**Exp. B**	**Control**	**Exp. A**
Score_Pitch (1–5)	3	4	5	3	4
Rhythm (1–5)	3	4	5	3	4
Expressiveness (1–5)	3	4	4	3	5
Technique (1–5)	3	4	5	3	4
Collaboration (1–5)	3	4	5	3	4
Total Score (%)	60	80	92	62	84
SUS Usability (0–100)	62	82	90	65	85
Overall Satisfaction (1–5)	3	4	5	3	4

5. Conclusions

This study explored the effects of a blended learning intervention on students' knowledge acquisition, skill development, learning behavior, motivation, emotional engagement, and musical performance. The results showed that students in the experimental groups (Experiments A and B) scored higher on post-tests of knowledge and skills than those in the control group, demonstrating the effectiveness of the platform-based interactive learning approach. Furthermore, students in the experimental groups demonstrated greater engagement on the learning platform, including more frequent logins, longer study sessions, higher task completion rates, and increased participation in discussions and feedback. Psychological indicators such as learning interest, autonomous learning motivation, and emotional engagement also significantly improved in the experimental group. Regarding musical performance, students in the experimental group scored higher on dimensions such as pitch, rhythm, expressiveness, technique, and collaboration, and also reported higher overall satisfaction and platform usability. Despite these positive results, the study also has limitations. The relatively small sample size and short intervention period may limit the generalizability of the findings.

Future research can include larger and more diverse student groups, extend the intervention period, and further explore the mechanisms by which blended learning platforms influence cognitive, behavioral, and emotional outcomes. Such research can further inform the design of effective, engaging, and personalized learning environments.

Disclosure statement

The author declares no conflict of interest.

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