ingegneria sismica
International Journal of Earthquake Engineering
Anno XLIII - Num. 3 - 2026

Research on the Application of "Blockchain+" in Music Education: A Case Study in China Education: A Case Study in China

Rendao Yu[1] *and Min Xu*[2,*]

[1] Instrumental Music Teaching and Research Department, Institute of Music and Dance, Jiangxi Institute of Science and Technology, Nanchang, Jiangxi, 330098, China
[2] Piano Department, School of Music, Jiangxi Normal University
No.99 Ziyang Avenue, Nanchang, Jiangxi 330022, China

SUMMARY: *This study is based on "blockchain+" technology, which collects shared resource information, optimizes the allocation of shared information resources, and constructs a matrix of factors related to the allocation of shared digital resources to establish a model for sharing digital music education resources. At the same time, the study analyzes the operational mechanisms of the education resource sharing model and the points-based incentive model, and develops a points-based incentive scheme to enhance the appeal of music education and students' initiative. The methods proposed in this paper are applied to Chinese music education, and their effectiveness is evaluated through case analysis. Results indicate: The shared incentive teaching model intervention significantly improved students' mastery of music singing techniques and related knowledge points by 26.04%-37.85% (P<0.05); increased their scores on blockchain-related knowledge points by 9.62-16.98 points; and under the shared incentive intervention teaching model, students reported a better teaching experience. Additionally, this paper designed an incentive mechanism application model for music learning under blockchain+ technology, providing a reference for the application of "blockchain+" technology in music education within China's educational system.*

KEYWORDS: *blockchain+; resource sharing model; points-based incentive model; music education*

1 Introduction

In recent years, with the rise of the digital age and the rapid development of information technology and internet technology, blockchain technology has gradually gained widespread attention and application [1, 2]. In terms of data operation and storage, blockchain technology has proven to have numerous advantages, and its application areas have expanded rapidly [3, 4]. In addition to digital currency transactions and the financial industry, blockchain technology also has broad application prospects in the field of music education [5, 6].

In the field of music education, copyright protection is a widely discussed issue [7]. In the traditional music industry, copyright protection primarily relies on central authorization institutions, such as music production companies, record companies, and copyright revenue management companies. However, this system has numerous drawbacks [8-11]. One of these is that the copyright protection mechanism is not sufficiently clear, and creators' hard-earned works are often infringed upon, yet it is difficult to provide conclusive evidence for legal action

*13811079027@126.com
https://doi.org/10.65102/is20261043 Published: 10 June, 2026

[12, 13]. The emergence of blockchain technology has provided a form of “insurance” for music copyright [14].

Blockchain is a distributed ledger and database characterized by decentralization, immutability, and transparency [15, 16]. The distributed ledger nature of blockchain enables precise recording of information across all stages of music creation, distribution, and dissemination [17, 18]. For example, when a song is completed by its creator at a specific time, that time is recorded on the blockchain, and all subsequent copyright transactions, licensing activities, and other operations are clearly traceable [19-21]. It establishes a unique “growth record” for each music work. In the event of a copyright dispute, by querying the records on the blockchain, one can clearly trace the origins of the work, with all actions taken by parties at specific times readily identifiable [22-25]. In addition, the application of blockchain and related technologies in music education also manifests in enhancing the accessibility of music creation, the protection and educational inheritance of traditional music, and transparent and efficient revenue and incentive mechanisms. This strengthens intellectual property protection while promoting the popularization and innovative development of music education [26-29].

Literature [30] analyzes the characteristics, development history, and application prospects of blockchain technology in higher education, proposing considerations for the development of “blockchain + education,” aiming to provide references for exploring the deep integration of modern information technology and education. Literature [31] addresses issues such as performance instability in online music teaching resource platforms based on blockchain technology, proposing a blockchain-based shared algorithm (PBFT) and an improved weighted Byzantine fault-tolerant mechanism for blockchain shared algorithms (WBFT). The study validated that the improved WBFT algorithm can meet the requirements for constructing an online music teaching resource sharing platform. Literature [32] proposes advanced methods and innovative models for ensuring the integrity of music education processes, along with an identification scheme based on an innovative zero-knowledge proof (ZNP) system, which allows one party to convince the other of its validity. Literature [33] examines the inheritance of folk music culture and the innovation of higher education music education under blockchain technology, and through the construction of a blockchain-based digital copyright protection application model, it elucidates the architectural design of this solution. Literature [34] explores music education and teaching based on blockchain technology and presents an overall perspective on blockchain technology and its importance for future development. Literature [35] examines the advantages and disadvantages of blockchain in online music copyright and related rights management, aiming to enhance awareness of the potential of blockchain in the music industry. The above studies analyze the application of blockchain technology in education, including its impact on music education and teaching, the inheritance of folk music, and other aspects, while also pointing out its shortcomings.

Literature [36] highlights the transformative potential of blockchain for the creative industries and analyzes how blockchain technology can significantly impact the music industry. Literature [37] provides a literature review on the advantages and disadvantages of using non-fungible tokens (NFTs) in the music industry and discusses their initial applications, revealing that the widespread use of NFTs has the potential to bring significant advantages to the music industry. Literature [38] examines the potential impact of blockchain technology on the music industry based on the views of academic and industry experts, concluding that the music industry can only achieve positive impacts under detailed consideration of the industry and understanding of customer conditions. Literature [39] explores the impact of technological innovations such as blockchain in the music field, particularly how they can drive fundamental changes in business models and value creation processes, aiming to understand innovation adoption in specific contexts. Literature [40] examines the challenges faced by the music industry in its digital transformation and the role of blockchain, providing references for adopting blockchain in intellectual property exchange within the music industry. Literature [41] highlights the chaos in the music industry's copyright system, pointing out that intermediaries unreasonably charge transaction fees and that royalties are either delayed or paid to the wrong recipients, and illustrates this issue through case studies. The aforementioned studies explore the application of blockchain and related technologies in the music industry, emphasizing their positive impact on creating music business value and copyright protection.

This paper designs a framework for digital educational resource sharing and a model for digital educational resource sharing in higher education institutions, focusing on the application of "blockchain+" technology in music education. The study constructs an educational resource sharing incentive model and a points-based incentive mechanism model. Through the designed points-based incentive scheme, the authenticity and authority of educational resource information on the blockchain are ensured. The paper also provides application cases for the practical implementation of the methods discussed, offering solutions for the application of digital resource sharing models and incentive mechanisms in Chinese music education.

2 Building an incentive model for sharing educational resources based on "blockchain+" technology

2.1 Blockchain-based music digital educational resource sharing model

2.1.1 Collecting shared resource information

Collect shared resource information. Within the digital educational resource sharing system [42], there are many users who provide shared information. To ensure that shared digital resource information can be allocated reasonably, it is first necessary to collect and classify shared information resources according to different providers. The information resource sharing process for information providers is defined as follows:

$$\begin{cases} \frac{dn_A}{dt} = v_A n_A \left(1 - \frac{n_A}{N_A} - \frac{a_{AB} - b_{AB}}{N_B} n_B\right) \\ \frac{dn_B}{dt} = v_B n_B \left(1 - \frac{n_B}{N_B} - \frac{a_{BA} - b_{BA}}{N_B} n_A\right) \end{cases} \tag{1}$$

Among these, v_A and v_B represent the sharing speed of information uploaded by providers, a_{AB} and a_{BA} respectively represent the inhibition coefficients between different information providers resulting from information resource sharing, and b_{AB} and b_{BA} respectively represent the promotion effect coefficients generated between information providers. Due to the different ways in which digital resource information overlaps, the overlap of digital resource information is shown in Figure 1, where A and B represent the digital resource information uploaded by providers to the shared platform. It can be seen that the information resources shared by different providers can result in three scenarios: ① The information provided by different providers does not overlap at all; ② Different providers provide partially identical or overlapping information; ③ Different providers provide identical or similar information. Based on the representation in Figure 1, S_{AB} is defined as the overlap degree of information provided by providers A and B. Therefore, if S_{AB} takes a value of 0, the configuration factor can be directly defined; If the value of S_{AB} is not 0, then the collected shared digital resource information must undergo deduplication processing to remove duplicate digital resource information.

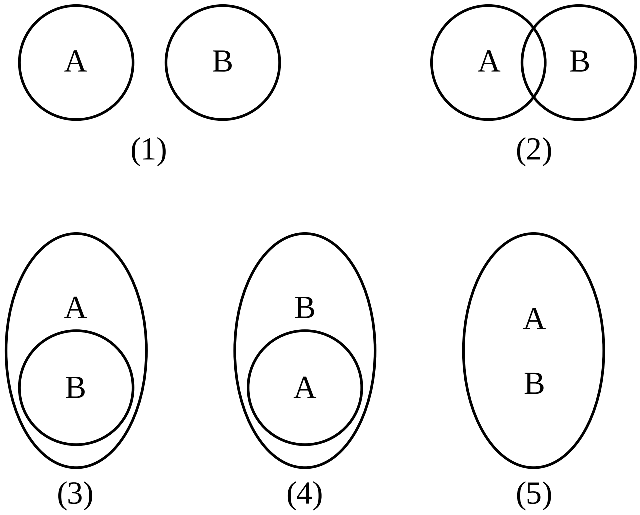

Figure 1: Schematic diagram of the overlap of shared information resources

2.1.2 Evolutionary Configuration of Shared Information Resources

When the degree of overlap between information uploaded by different information providers is 0, it indicates that information resource sharing has reached equilibrium, and information demanders' reception of information resources has reached saturation. In this case, the following equilibrium condition holds:

$$\begin{cases} \frac{n_A}{N_A} = v_{AB} \frac{n_B}{N_B} + 1 \\ \frac{n_B}{N_B} = v_{BA} \frac{n_A}{N_A} + 1 \end{cases} \tag{2}$$

Therefore, the equilibrium conditions for information resource sharing can be converted into variable form:

$$\begin{cases} p(n_A, n_B) = 1 + v_{AB} \frac{n_B}{N_B} - \frac{n_A}{N_A} \\ q(n_A, n_B) = 1 + v_{BA} \frac{n_A}{N_A} - \frac{n_B}{N_B} \end{cases} \tag{3}$$

Solving for equilibrium conditions yields coordinates that satisfy those conditions. When A and B have comparable levels of information resource sharing, both can achieve information resource sharing within a certain range.

2.1.3 Analysis of configuration factors for shared digital resources

Assume that the number of samples of shared digital resource information in the equilibrium state evolution configuration is m, and the configuration factor index is n. Define the j th configuration factor of the i th sample in the configuration information as s_{ij}, where i ranges from [1, m], and the range of j is [1, n], then the initial matrix formed by all sample values of the shared digital resource information is:

$$S = | s_{ij} |_{m \times n} \tag{4}$$

Before calculating the initial sample matrix, the data in the matrix needs to be standardized. The average value of the j th column data is calculated using the following formula:

$$\overline{s}_j = \sum_{j=1}^{m} \frac{s_{ij}}{m} \tag{5}$$

The data in the initial matrix is averaged to obtain a new matrix:

$$\overline{s}_{ij} = \frac{s_{ij}}{\overline{s}_i} \tag{6}$$

Then, normalize the results of the mean calculation using the following formula:

$$w_{ij} = \frac{\overline{s}_{ij} - \min(\overline{s}_{i1}, \overline{s}_{i2}, \cdots, \overline{s}_{in})}{\max(\overline{s}_{i1}, \overline{s}_{i2}, \cdots, \overline{s}_{in}) - \min(\overline{s}_{i1}, \overline{s}_{i2}, \cdots, \overline{s}_{in})} \tag{7}$$

The construction matrix obtained after a series of processing steps:

$$W = | w_{ij} |_{m \times n} \tag{8}$$

Substitute the relevant data of the collected shared digital resource information into the matrix, and calculate the relevant matrix, eigenvalues, and eigenvectors of the matrix to obtain a normalized eigenvector corresponding to the eigenvalues of the matrix configuration, where the characteristic polynomial constituting the eigenvector is marked as λ_j. Finally, the cumulative contribution rate of the configuration factors for shared digital resource information can be used to further determine the number of configuration factors. The cumulative factor contribution rate for the first k factors is:

$$q_k = \sum_{i=1}^{k} \left(\frac{\lambda_j}{\sum_{j=1}^{n} \lambda_j} \right) \tag{9}$$

When the eigenvalues of the eigenvector are not less than 1, the number of configuration factors can be determined.

2.2 Building a blockchain-based incentive model for sharing educational resources

2.2.1 Incentive model for sharing educational resources

The university music digital educational resource credit sharing incentive model [43] designed in this paper is shown in Figure 2. In this model, university teachers act as creators of high-quality music digital educational resources. When university teachers upload their own music resources, the platform will guarantee the intellectual property rights of these resources and also give the university teachers a certain amount of credit rewards. When the uploaded music resources are downloaded, collected, or commented on by students, the teachers can also obtain a certain amount of credit rewards. By prioritizing teachers' contributions to music education resource sharing as a key evaluation criterion and implementing dynamic management of teachers, this approach can significantly enhance teachers' motivation to create resources, thereby fully leveraging the important role of universities in the field of music digital education resource sharing.

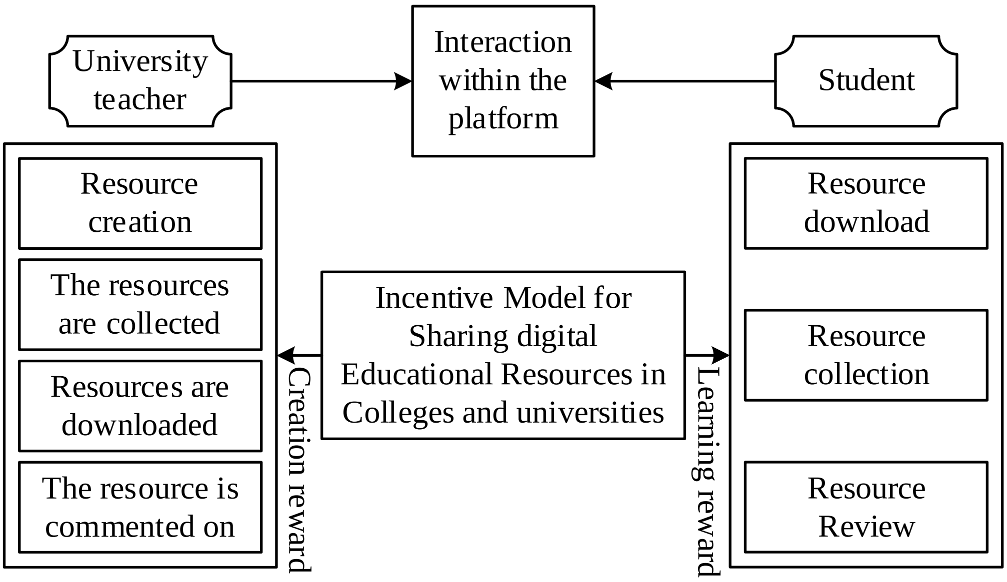

Figure 2: Digital education resources integral score sharing incentive model

2.2.2 Points Incentive Mechanism Model

The incentive mechanism for sharing digital educational resources in higher education institutions adopted in this paper [44] utilizes the FISCO BCOS underlying framework. University faculty members are evaluated based on the number of downloads of the music resources they upload and the total number of resources uploaded. A points-based incentive system is employed to reward users who upload resources. The process for faculty members to obtain rewards under the “blockchain+” technology is illustrated in Figure 3. To obtain points rewards on this platform, university faculty members must first create and upload music resources. Their contribution during the current cycle is calculated based on the number of resources uploaded, the number of downloads, comments, and bookmarks for those resources. Points are distributed to faculty members via smart contracts, and user points information is uploaded to the blockchain.

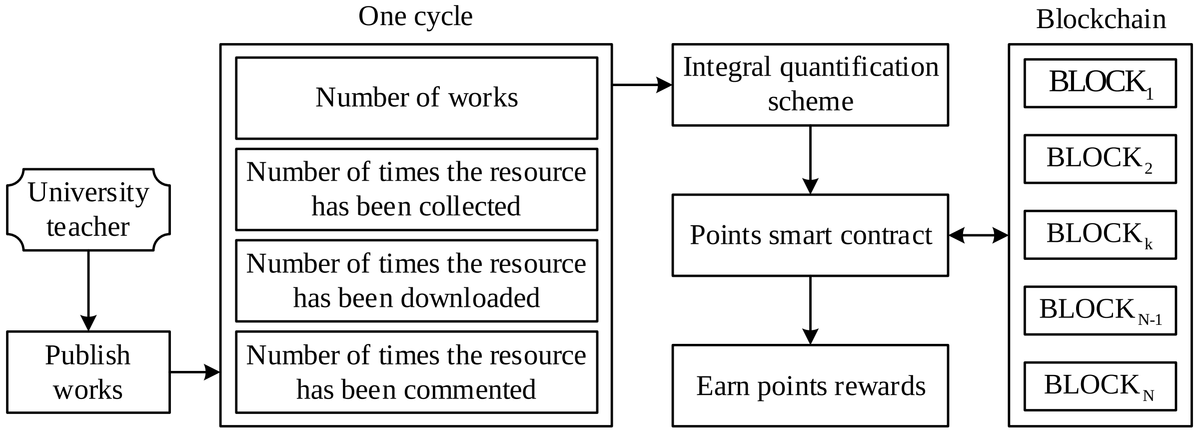

Figure 3: The process of obtaining teacher rewards under blockchain technology

The reward process for students to earn points is shown in Figure 4, which is basically the same as the way university teachers obtain resources. The points a student earns within a cycle are related to their interactions with digital educational resources on the platform during that cycle. When students comment on, download, or bookmark resources, they can earn corresponding points. To prevent malicious point accumulation, students cannot bookmark more than 30 resources within a single cycle, and they cannot comment on a single resource more than six times within a cycle. When backend administrators detect users engaging in malicious bookmarking or commenting activities, they may impose certain penalty measures on the user's points.

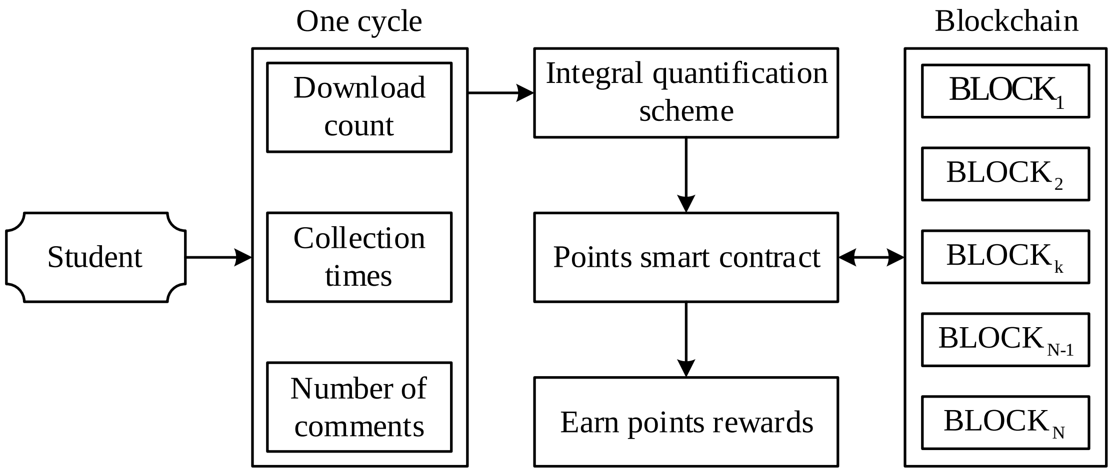

Figure 4: Student learning points reward process

2.2.3 Setting up a points-based incentive scheme

The quantitative scheme allocated by the platform to university teachers and students is the key factor in determining whether the above incentive model is effective. The following is a detailed quantitative scheme formulated for this platform.

(1) Point allocation ratio for university teachers and students

The point settlement cycle is set to one month. During each cycle, the system will distribute a certain number of points S. This contribution reward is divided into university teachers T1 and students T2, with the calculation formula as follows:

$$T_1 = S \times (1-\alpha) T_2 = S \times \alpha \tag{10}$$

Among them, α is the proportion of learning rewards in the total rewards.

(2) Points acquisition calculation method

The creative contribution values vl and v2 obtained by T1 and T2 in each cycle are distributed to university teachers and students according to the corresponding proportions. The formulas for calculating vl and v2 are as follows:

$$V_1 = (l + d + n) / p \tag{11}$$

$$V_2 = (i + e + u) / q \tag{12}$$

Among them, l represents the number of content downloads, d represents the number of resource comments, n represents the number of bookmarks, i represents the number of comments within the current cycle, e represents the number of downloads within the current cycle, and u represents the number of bookmarked resources within the current cycle.

In summary, the formulas for calculating the reward points X earned by teachers who upload digital educational resources and the reward points Y earned by students within a single cycle are as follows:

$$X = V_1 \times T_1 \tag{13}$$

$$Y = V_2 \times T_2 \tag{14}$$

3 Analysis of the effectiveness and application cases of "blockchain+" technology in music education

3.1 Analysis of the Effectiveness of Blockchain-based Digital Resource Sharing in Music Education

The statistical analysis of the measurement data primarily employs mean and standard deviation for description, with statistical inference primarily utilizing Z-tests, t-tests, and chi-square χ^2 tests to analyze different needs and causes. In terms of evaluating the effectiveness of the intervention, based on the theory of the difference-in-differences (DID) model, the basic DID model was set as follows: $y_{it} = \beta_0 + \beta_1 group_i \cdot time_i + \beta_2 group_i + \beta_3 time_i + \beta_4 X_{it} + E_{it}$. In this study, Group refers to the two experimental groups, with variable values assigned as $Group_1$ = control group, $Group_2$ = experimental group; time refers to before and after the intervention, with variable assignments of $time_{Aftert\ heintervention} = 1$ and $time_{Before\ intervention} = 0$. y_{it} represents the change in the outcome variable before and after the intervention for the two experimental groups under the intervention measures. X_{it} is the known control variable affecting the intervention effect between groups, E_{it} is the random error term, and E_{it} represents other unknown control variables. The significance level is $\alpha = 0.05$.

This teaching assessment is analyzed from five dimensions: breath support, resonance placement, articulation clarity, rhythm and pitch accuracy, and emotional expression, with a total score of 32 points. The teaching experience study analyzes four dimensions: students' self-directed learning ability, participation satisfaction, skill development satisfaction, and learning resource satisfaction. Self-directed learning ability includes 2 items, participation satisfaction includes 5 items, and learning resource satisfaction includes 6 items, totaling 13 items. The scoring principle is: each item is worth a maximum of 7.5 points, with a total maximum score of 97.5 points; the higher the score, the better the teaching model experience.

3.1.1 Research subjects and teaching intervention model

Research subjects: This study selected students from four classes of the 2019 double degree program at the Music College of BJ University as research subjects. Using random sampling, the students in the four classes were divided into two groups: classes 1-2 were the control group with 98 students, and classes 3-4 were the experimental group with 103 students.

Teaching Intervention Methods: The control group was taught using conventional teaching methods, content, and curricula. The experimental group was taught using a “blockchain + virtual simulation” shared incentive teaching method, specifically combining offline “singing technique blockchain knowledge” with online “singing and playing virtual simulation training.” Music education resources processed using “blockchain+” technology were uploaded to an online MOOC for resource sharing. The shared singing technique blockchain knowledge includes a series of knowledge points such as breath support, vocal principles, resonance position, clear articulation, rhythm and pitch accuracy, and emotional expression, which are combined into a blockchain and named M1-M6 respectively. The digital singing and playing practice blockchain knowledge includes: practice traces on the blockchain; learning outcomes converted into blockchain tokens; and automatic rewards from the system upon meeting practice requirements, respectively named Q1-Q3. The teaching period is from September 2022 to July 2023, with each teaching plan consisting of 12 class hours.

3.1.2 Comparison of students' mastery of relevant knowledge before and after the intervention

The comparison of students' mastery of relevant knowledge before and after the intervention is shown in Table 1. The results indicate that in the control group, the final mastery rate of singing technique knowledge points M1-M6 increased by 1.69%–9.37% compared to the baseline mastery rate; the mastery rate of digital singing and playing practical training knowledge points Q1-Q3 increased by 0.29%–9.16%. In the experimental group, the final mastery rate of singing technique knowledge points M1-M6 increased by 26.04%-37.85% compared to the baseline mastery rate; the mastery rate of digital singing and playing training knowledge points Q1-Q3 increased by up to 28.19%.

In this study, the final mastery rate of knowledge related to vocal principles and emotional expression in the control group improved, but the teaching intervention effect of blockchain knowledge was generally moderate; In the experimental group, the final mastery rates for knowledge points related to vocal principles, rhythm and pitch accuracy, clear articulation, and emotional expression showed significant improvements. The blockchain and virtual simulation incentive-based teaching intervention had a good effect. Students may have systematized music-related knowledge through blockchain learning, integrated knowledge from various music disciplines, and learned music-related knowledge and skills more vividly through the virtual group music training process involving visual, auditory, and tactile experiences in a three-dimensional spatial environment.

Table 1: The students' mastery of relevant knowledge before and after the intervention

Related knowledge points	Control group (n = 98)				Experimental group (n = 103)			
	Baseline mastery rate (%)	Terminal capture rate (%)	χ^2	P	Baseline mastery rate (%)	Terminal capture rate (%)	χ^2	P
M1	68.02	70.69	2.9535	0.0861	68.52	95.02	0.3173	0.000***
M2	68.92	78.27	--	0.000***	67.85	94.08	0.2325	0.000***
M3	67.97	69.66	0.2825	0.5796	67.73	95.48	1.6889	0.000***
M4	66.47	69.13	0.2108	0.6388	65.4	93.77	0.6002	0.000***
M5	69.01	74.84	0.4368	0.4979	58.03	95.88	0.0504	0.000***
M6	69.04	78.41	--	0.000***	69.03	95.07	--	0.000***
Q1	68.67	77.83	--	0.000***	69.15	97.11	--	0.000***
Q2	64.41	69.36	5.9043	0.0148	65.17	91.87	3.7234	0.000***
Q3	67.24	67.53	0.2664	0.573	67.44	95.63	2.5413	0.000***

3.1.3 Comparison of scores for blockchain-related knowledge points

The comparison of scores for blockchain-related knowledge points is shown in Table 2. The results indicate that the experimental group students improved their scores for blockchain-related knowledge points related to singing techniques by 9.62–16.98 points, with particularly significant improvements of over 15 points in the final scores for knowledge points related to vocal principles and rhythm and pitch accuracy. The final scores for blockchain-related knowledge points in the digital singing and playing practical training were up to 18.29 points higher than the baseline scores. Overall, the final scores of the control group students were higher than the baseline scores, but the difference between the two was not significant. The difference between the baseline scores and final scores of the experimental group students was extremely significant (P=0.000<0.001).

This incentive-based teaching method combines blockchain knowledge with virtual simulation teaching. Based on blockchain knowledge, students conduct digital singing and playing visualization exercises through virtual simulation experiments. Additionally, the virtual simulation teaching projects expand the breadth and depth of knowledge content, allowing students to gain insights into details that may be overlooked in traditional blockchain teaching. Furthermore, after using virtual simulation teaching, students' understanding of music knowledge points becomes more vivid, deepening their comprehension and mastery of these concepts.

Table 2: Score comparison of knowledge points related to blockchain

Related knowledge points	Control group (n = 98)				Experimental group (n = 103)			
	Baseline scores (100)	Final score (100)	Z	P	Baseline scores (100)	Final score (100)	Z	P
M1	75.85	78.26	1.692	0.472	75.55	87.18	9.201	0.000***
M2	72.3	77.29	2.724	0.302	73.53	90.51	15.99	0.000***
M3	72.16	76.46	2.125	0.551	71.48	86.38	14.215	0.000***
M4	76.49	79.61	1.952	0.513	78.79	89.75	13.279	0.000***
M5	72.52	76.46	2.056	0.464	72.82	89.62	15.423	0.000***
M6	73.05	75.77	1.702	0.705	78.57	88.19	13.174	0.000***
Q1	75.83	75.94	0.436	0.998	77.17	83.22	9.881	0.000***
Q2	72.84	76.39	1.847	0.536	74.92	88.21	13.662	0.000***
Q3	73.63	76.52	1.723	0.585	72.27	90.56	17.517	0.000***

3.1.4 Analysis of differences in teaching experiences between the two groups of students

The differences in teaching experiences between the two groups of students are shown in Table 3. This study found that the scores for self-directed learning ability in the experimental group were significantly higher than those in the control group (all $P < 0.01$). In terms of participation recognition, the scores for enthusiasm in participating in teaching and willingness to continue learning in the experimental group were significantly higher than those in the control group (all $P < 0.05$). In terms of learning resource recognition, the experimental group scored higher than the control group in evaluations of the effectiveness of technical training, overall satisfaction, and total scores, with statistically significant differences ($P < 0.01$). The total score of the experimental group (89.09) was higher than that of the control group (57.29), with a statistically significant difference ($P < 0.01$).

The experimental group scored higher than the control group in terms of perceptions of self-directed learning ability, confidence in self-directed learning, and total self-directed learning ability scores, indicating that students in the shared incentive-based teaching group demonstrated superior self-directed learning ability compared to those in the blockchain teaching group. This may be attributed to the incentive-based teaching approach, which integrates online and offline education to enhance students' self-directed learning ability and confidence.

The experimental group scored higher than the control group in terms of teaching participation enthusiasm and willingness to continue learning, indicating that students in the incentive-based teaching group exhibited higher levels of enthusiasm and willingness to continue learning compared to the control group. Compared to the traditional educational model, students in the incentive-based teaching group demonstrated a significant increase in initial learning enthusiasm. In this shared incentive-based teaching group, students participated in virtual learning scenarios based on blockchain theory, immersing themselves in music performance techniques. Under the cultivation of an immersive music environment, this approach effectively enhances students' enthusiasm and willingness to learn.

Table 3: Analysis of differences in teaching experience between the two groups

Evaluation dimension of teaching effect	Evaluating indicator	Experimental group		Control group		t	P
		Average value	Error	Average value	Error		
Independent learning ability	Views on autonomous learning ability	3.08	0.72	5.92	2.837	2.837	0.000 ***
	Confidence in self-learning	3.79	0.418	6.15	2.355	2.355	0.000 ***
	Subtotal	6.87	—	12.07	—	3.084	0.000 ***
Participation recognition	The enthusiasm to participate in teaching	4.57	0.395	6.37	1.874	1.874	0.000 ***
	The necessity of teaching mode construction	4.35	0.373	6.18	1.621	1.621	0.000 ***
	Interest in learning related knowledge	3.94	0.697	6.3	2.446	2.446	0.000 ***
	Help with learning relevant knowledge	4.06	0.585	6.37	2.043	2.043	0.000 ***
	Continue to participate in learning and be willing	3.88	0.682	6.33	2.527	2.527	0.000 ***
	Subtotal	20.8	—	31.55	—	4.686	0.000 ***
Recognition of learning resources	Recognition of learning resources	4.47	0.563	6.61	2.095	2.095	0.000 ***
	Content richness evaluation	3.91	0.394	6.48	2.489	2.489	0.000 ***
	Content scientific evaluation	4.53	0.243	6.68	2.042	2.042	0.000 ***
	Process rationality evaluation	4.04	0.348	6.41	2.226	2.226	0.000 ***
	Design hierarchy evaluation	4.51	0.396	6.27	1.982	1.982	0.000 ***
	Technical training effectiveness evaluation	3.93	0.419	6.56	2.502	2.502	0.000 ***
	Overall satisfaction evaluation	4.23	0.458	6.45	2.443	2.443	0.000 ***
	Subtotal	29.62	—	45.46	—	4.927	0.000 ***
Amount to		57.29	—	89.09	—	4.893	0.000 ***

3.2 Application of Incentive Mechanism Models in Blockchain Music Education

This paper introduces user incentive points and integrates them into various blockchain knowledge points, such as user registration, user evaluation, and evaluation information on the blockchain. It aims to solve the problem of inconsistent evaluation information of music education resources in the user evaluation systems of major MOOC platforms under the incentive-based teaching model of music education resource sharing.

3.2.1 Resource Evaluation System

MOOC resource users provide comprehensive star ratings based on their learning experiences with digital music education resources, using a rating scale of 1 to 5 stars, corresponding to unsatisfactory, satisfactory, average, good, and excellent, respectively. Based on the resource evaluation criteria, users can provide textual evaluations of the resources from the above evaluation criteria to better supplement their impressions of the resources, thereby providing more references for other users when selecting resources. The evaluation criteria for this platform are shown in Table 4.

Table 4: Evaluation criteria of this platform

Evaluation category	First-level indicators	Secondary indicators	Content introduction
Category comprehensive internal evaluation	Instruction design and instructional resources	Instructional design	Teaching objectives, content, strategies, etc.
		Teaching materials	Content richness, blackboard layout, etc.
	Course content	Teaching process	Completeness of teaching process, clarity of teaching process, use of media technology, etc.
		Teaching efficiency teaching efficiency	Achievement of teaching objectives, teacher-student interaction, etc.
		Teacher quality	Teachers' knowledge level, expression ability and so on.
		MOOC performance	MOOC performance
Text evaluation	Users can evaluate the resources in terms of the above evaluation criteria, and better supplement their feelings about the resources, so as to provide other users with information Households choose resources to provide more reference		
Malicious evaluation criteria: Malicious bad reviews, meaningless symbols and words, and the repetition rate of evaluations and previous evaluations is higher than a certain threshold.			

3.2.2 Earning Incentive Points

User incentive points are categorized into five levels from lowest to highest: 0–5. Level 0 is the initial level granted to each user upon registration (before completing personal information). After users complete their identity information, their incentive points are assessed based on the completeness and reliability of the information provided, as well as their identity, to determine their corresponding level.

Users can earn incentive points by participating in evaluations. However, if the system detects, consensus on the blockchain identifies, or reports malicious evaluations, appropriate penalties will be imposed based on the severity of the situation, ranging from minor to severe, such as deducting a certain number of incentive points, downgrading the level, or suspending access to platform courses for a specified period.

To incentivize packaging nodes to actively participate in packaging activities, this platform has established corresponding incentive mechanisms to attract more users to participate. After a super node completes the packaging and on-chain process of a new block, it will receive corresponding incentive points as a block reward.

3.2.3 Incentive Point Calculation Model

The evaluation indicator system for the blockchain-based music education resource sharing incentive model is shown in Table 5. Based on the three different stages of incentive value acquisition, the trust value calculation model in this paper mainly consists of three major module scoring factors: resource contribution dimension, platform collaboration dimension, and value realization dimension, with incentive points accounting for 40%, 30%, and 30%, respectively.

α represents the trust value obtained by users through resource contribution, platform collaboration, and value realization according to the formula in this model, such as α = A × 40% + B × 30% + C × 30%, where $\alpha \in (0,100)$. It is expressed by the following formula:

$$\alpha = A*40\% + B*30\% + \frac{\sum_{i=1}^{\infty} C_i * k_i}{\sum_{i=1}^{\infty} k_i} * 30\% \tag{15}$$

Among them, $C_i = \max(C_{il}, C_{i2})$; k_i represents the number of times the user has evaluated digital educational resources in the user evaluation module; q_i represents the number of times the user has packaged and uploaded digital educational resources to the blockchain in the blockchain module. The formula is expressed as follows:

$$C = \frac{\sum_{i=1}^{\infty} C_i * k_i}{\sum_{i=1}^{\infty} k_i} \quad [C_i = \max(C_{i1}, C_{i2}), C_{i1} < 0] \tag{16}$$

Table 5: Evaluation system of incentive sharing model for music education resources

First-level indicators	Secondary indicators	Assignment rule
A:Resource contribution dimension (40%)	A1: Music resource upload (40%)	Each valid audio uploaded will earn 10 points, with a daily limit of 5
	A2: Quality of music resources (30%)	When the student study completion rate is ≥70%,5 points will be added for every 100 plays and 8 points will be added for every 10 collections
	A3: Original innovation value (20%)	Original work certification +50 points per piece; exclusive first release resources +30 points
	A4: Metadata integrity (10%)	Complete the composition style/BPM/lyrics, etc. +5 points per item
B:Platform collaboration dimension (30%)	B1: Effective interaction (50%)	Good comments (at least 3 likes) +2 points per comment;
	B2: Platform promotion contribution (50%)	Resource score (weighted average ≥ 4 stars) +1 point per time
C:Value realization dimension (30%)	C1: Resource liquidity (60%)	Each resource sales share +0.5% points; tip income conversion 1:1 points
	C2: Ecological construction incentive (40%)	Development tools/plugs +100 points per item;

3.2.4 Uses of Incentive Points

Users can upgrade their incentive points once they reach a certain threshold. Different levels correspond to different reward mechanisms and privileges. The specific uses of incentive points are shown in Table 6. As shown in the table, Level 1 users can download sheet music/accompaniment for free (5 per week), have access to basic music composition tools, and receive campus music club news updates. Level 2 users can unlock the advanced music library, enjoy access to course live stream replays, a 20% discount on instrument rentals, and eligibility for a lottery to win student tickets to concerts. Level 3 users can obtain priority broadcasting rights for original works, the right to apply for sponsorship for campus performances, access to an AI mixing assistant, and the ability to exchange elective course credits (0.5 credits). Level 4 users are rewarded with 1-on-1 guidance from producers/mentors, direct access to school-level evening party auditions, NFT services for their works, and a 50% reduction in music competition registration fees. Level 5 users are eligible for internship referrals (record companies), crowdfunding support for original albums, instrument upgrade subsidies, and alumni entrepreneurship fund applications. As such, the incentive points (α) generated by users through platform interactions are matched to different user levels and corresponding reward and punishment systems based on the value of their incentive points. The application of this reward and punishment system further incentivizes students' enthusiasm for acquiring knowledge related to music blockchain technology, while also curbing certain undesirable behaviors encountered during online teaching, thereby promoting the application of “blockchain+” technology in music education.

Table 6: Specific uses of incentive points

<table>
<tr><th>Grade</th><th>Title</th><th>Limit of integration</th><th>Reward</th><th>Punish</th></tr>
<tr><td>Level 1</td><td>Music is new</td><td>0-30</td><td>Free download of music sheet/accompaniment (5 copies per week); Basic arrangement tool usage rights; Campus music club information push</td><td rowspan="5">Plagiarism: Warning + 50 points deducted; Malicious negative review: 30 days of silence; Resource resale: 100 points deducted + earnings frozen; Exam cheating: Level down + 100 points deducted; Academic misconduct: 50 points deducted; Download brushing: 50 points deducted</td></tr>
<tr><td>Level 2</td><td>Campus musicians</td><td>31-60</td><td>Unlock the advanced music library; access to live course reviews; 20% discount on instrument rentals; and a chance to win student tickets for concerts</td></tr>
<tr><td>Level 3</td><td>Club star</td><td>61-80</td><td>Priority broadcasting of original works; Sponsorship application rights for campus performances; AI mixing assistant; Elective course credit exchange (0.5 points)</td></tr>
<tr><td>Level 4</td><td>Create new ideas</td><td>81-90</td><td>1v1 mentoring by production mentors; direct audition for school-level party; NFT service for works; 50% reduction of registration fee for music competitions</td></tr>
<tr><td>Level 5</td><td>Campus Artist</td><td>91-100</td><td>Internship recommendation qualification (record company); original album crowdfunding support; Musical instrument upgrade subsidy; Alumni entrepreneurship fund application</td></tr>
</table>

4 Conclusion

This paper utilizes "blockchain+" technology to digitize and share music education resources, and then combines a points-based incentive mechanism to construct a blockchain-based educational resource sharing incentive model. Finally, the teaching effects of this model are analyzed, and a case study on the application of the incentive mechanism model in blockchain-based music education is proposed.

Experimental results show that after intervention with the shared incentive teaching model, the experimental group students' mastery of singing techniques and related knowledge points for singing and playing instruments significantly improved compared to the control group ($P < 0.05$). . After the intervention, the difference between the final scores and baseline scores of the control group was not significant; however, the experimental group's scores on singing technique and blockchain-related knowledge points improved by 9.62–16.98 points, with a significant difference between the two groups ($P < 0.001$). There were significant differences in teaching experiences between the two groups, with the experimental group's total score (89.09) far exceeding that of the control group (57.29), indicating that students held a positive attitude toward music education after the shared incentive teaching model intervention. Finally, based on the incentive mechanism model, an application case study for blockchain-based music education was constructed.

References

[1] Paul, P., Aithal, P. S., Saavedra, R., & Ghosh, S. (2021). Blockchain technology and its types—a short review. International Journal of Applied Science and Engineering (IJASE), 9(2), 189-200.

[2] Poongodi, T., Sujatha, R., Sumathi, D., Suresh, P., & Balamurugan, B. (2020). Blockchain in social networking. Cryptocurrencies and blockchain technology applications, 55-76.

[3] Sabry, S. S., Kaittan, N. M., & Majeed, I. (2019). The road to the blockchain technology: Concept and types. Periodicals of Engineering and Natural Sciences (PEN), 7(4), 1821-1832.

[4] Al-Saqaf, W., & Seidler, N. (2017). Blockchain technology for social impact: opportunities and challenges ahead. Journal of Cyber Policy, 2(3), 338-354.

[5] Firica, O. (2017). Blockchain technology: Promises and realities of the year 2017. Quality-Access to Success.

[6] Li, P. P., & Wang, B. (2024). Artificial intelligence in music education. International Journal of Human–Computer Interaction, 40(16), 4183-4192.

[7] Panjaitan, H., Betlehn, A., Situmeang, T., Khan, M. Z. K., & Miraz, M. H. (2024). Music copyright protection in the digital era: Legal framework and strategies for enforcement. Jurnal Hukum UNISSULA, 40(2), 235-257.

[8] Arewa, O. B. (2016). Copyright and Cognition: Musical Practice and Music Perception. . John's L. Rev., 90, 565.

[9] Ahmad, N., & Chaturvedi, S. (2013). Originality requirement and copyright regime of

music: A comparative overview of Indian perspective. Information & Communications Technology Law, 22(2), 132-145.

[10] Whittle, E. O. (2021). Rage Against the Machine: Copyright Protection and Artificial Intelligence in Music. Va. Sports & Ent. LJ, 20, 56.

[11] Gürfidan, R., & Ersoy, M. (2021). Blockchain-based music wallet for copyright protection in audio files. Journal of Computer Science & Technology, 21.

[12] Siregar, R. H. F. (2023). Notes of protection: A comparative analysis of music copyright laws and enforcement. Indonesian Comparative Law Review, 5(2), 115-126.

[13] Didwania, S. H. (2018). Copyright protection and cumulative creation: Evidence from early twentieth-century music. The Journal of Legal Studies, 47(2), 235-268.

[14] Stopczańska, D. (2019). Music Trademarks and Their Protection in Trademark and Copyright Law. Eastern European Journal of Transnational Relations, 3(1), 53-66.

[15] Zhang, S., & Wang, S. (2023). A blockchain framework for preserving music intellectual property rights. International Journal of Communication Networks and Information Security, 15(3), 26-41.

[16] Meiriño, M. J., Méxas, M. P., do Valle Faria, A., Méxas, R. P., & Meirelles, G. D. (2019). Blockchain technology applications: a literature review. Brazilian Journal of Operations & Production Management, 16(4), 672-684.

[17] Shih, D. H., Shih, M. H., Yen, D. C., & Chang, C. L. (2015). A robust copyright and ownership protection mechanism for music. Multimedia tools and applications, 74(18), 7489-7514.

[18] O’Dair, M., Beaven, Z., Neilson, D., Osborne, R., & Pacifico, P. (2016). Music on the Blockchain. Middlesex University, July.

[19] Wijesekara, P. A. D. S. N. (2025). A Survey on Blockchain-driven Music Industry: Trends, Gaps, and Future Directions. Science, Engineering and Technology, 5(2).

[20] Morrill, K. (2021). Smart Contracts: The Future of Blockchain in the Entertainment Industry. Ariz. St. U. Sports & Ent. LJ, 11, 43.

[21] Wishnia, J. (2019). Blockchain technology: the blueprint for rebuilding the music industry. Cardozo Arts & Ent. LJ, 37, 229.

[22] Owen, R., & O'Dair, M. (2020). How blockchain technology can monetize new music ventures: an examination of new business models. The Journal of Risk Finance, 21(4), 333-353.

[23] Shang, M., & Sun, H. (2020, October). Study on the New Models of Music Industry in the Era of AI and Blockchain. In 2020 3rd International Conference on Smart BlockChain (SmartBlock) (pp. 63-68). IEEE.

[24] Idokogi, D. (2021). Decentralizing creativity: A tenable case for blockchain adoption in

the entertainment industry. Rutgers Computer & Tech. LJ, 47, 274.

[25] Wen, X. (2023). Application of blockchain technology in copyright protection of digital music information. International journal of grid and utility computing, 14(2-3), 136-145.

[26] Bolívar-Chávez, O. E., Paredes-Labra, J., Palma-García, Y. V., & Mendieta-Torres, Y. A. (2021). Educational technologies and their application to music education: An action-research study in an Ecuadorian university. Mathematics, 9(4), 412.

[27] Jin, S., & Zhang, L. (2024). Research on the recommendation system of music e-learning resources with blockchain based on hybrid deep learning Model. Scalable Computing: Practice and Experience, 25(3), 1455-1465.

[28] Hemming, J. (2018). Perspectives in Music Arising out of Blockchain-Technology and Its Corresponding Research Strategies. Etnomüzikoloji Dergisi, 1(2), 177-206.

[29] Lovett, M. (2020). Directions in music: Stakeholder perspectives on blockchain innovations in music streaming. Frontiers in Blockchain, 3, 506721.

[30] Liu, S., & Ba, L. (2021, October). Blockchain technology and its application prospect in higher education. In Proceedings of the 13th International Conference on Education Technology and Computers (pp. 237-242).

[31] Li, B. (2022). Online music teaching resource sharing algorithm based on blockchain technology. International Journal of Emerging Technologies in Learning (Online), 17(24), 69.

[32] Zhang, Y. (2022). Increasing Cyber Defense in the Music Education Sector Using Blockchain Zero-Knowledge Proof Identification. Computational Intelligence and Neuroscience, 2022(1), 9922167.

[33] Luan, B. (2021, September). On the inheritance of national music culture in colleges and universities and the reform and innovation of music education in colleges and universities under block-chain technology. In 2021 4th International Conference on Information Systems and Computer Aided Education (pp. 627-631).

[34] Yu, H., & Zou, Z. (2023). The music education and teaching innovation using blockchain technology supported by artificial intelligence. International journal of grid and utility computing, 14(2-3), 278-296.

[35] Tam, T. N. L. (2019). Music copyright management on blockchain: Advantages and challenges. Alb. LJ Sci. & Tech., 29, 201.

[36] Arcos, L. C. (2018). The blockchain technology on the music industry. Brazilian Journal of Operations & Production Management, 15(3), 439-443.

[37] Senkardes, C. G. (2021). Blockchain technology and NFT's: a review in music industry. Journal of Management, Marketing and Logistics-JMML, 8(3), 154-163.

[38] Kim, K. C. H. (2019). The impact of blockchain technology on the music industry. International journal of advanced smart convergence, 8(1), 196-203.

[39] Centorrino, G., Naciti, V., & Rupo, D. (2023). A new era of the music industry? Blockchain and value co-creation: the Bitsong case study. European Journal of Innovation Management, 26(7), 65-85.

[40] Arenal, A., Armuna, C., Ramos, S., Feijoo, C., & Aguado, J. M. (2024). Digital transformation, blockchain, and the music industry: A review from the perspective of performers' collective management organizations. Telecommunications Policy, 48(8), 102817.

[41] Taghdiri, A. (2019). How blockchain technology can revolutionize the music industry. Harv. J. Sports & Ent. L., 10, 173.

[42] Elmunsyah H,Hidayat W N,Patmanthara S,Dwiyanto F A,Utomo W M & Kusumadyahdewi K. (2020). Adaptive learning system in open educational resource digital sharing community as a media for learning autonomous students. IOP Conference Series: Materials Science and Engineering,732,012110-012110.

[43] Algimantas Venčkauskas,Vacius Jusas,Dominykas Barisas & Boriss Misnevs. (2024). Blockchain-Based Model for Incentivized Cyber Threat Intelligence Sharing. Applied Sciences,14(16),6872-6872.

[44] Yongqing Hu,Weixing Su,Hanning Chen,Maowei He & Fang Liu. (2024). Research on incentive mechanism and evaluation of cross-enterprise distributed research and development resource sharing under networked collaborative design mode. Soft Computing,28(21),1-17.