Evaluation of Interactive College Piano Teaching's Effect Based on Artificial Intelligence Technology

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ABSTRACT

In recent years, with the economic development of various countries, education has also made great leaps, and piano teaching has been popularized and promoted in various universities. Pianos are also put into use in universities through normal channels. According to the survey, there are certain drawbacks in the teaching process of piano, which hinder the teaching effect to a great extent. In order to better adapt to the interactive teaching mode, this paper takes the flipped classroom in piano teaching as an example to conduct a systematic study based on the method of artificial intelligence. This paper introduces three typical artificial intelligence technologies and analyzes the three evaluative indicators corresponding to the effect of piano interactive teaching. The analysis results show that the prediction effect based on fuzzy neural inference system is the best. In addition, the three-dimensional display of the prediction data shows that the prediction effect obtained by artificial intelligence shows a strong consistency with the actual evaluation effect.

KEYWORDS

Artificial Intelligence Technology, Evaluative Indicators, Interactive Teaching Mode, Piano Teaching, Psychological Adjustment

INTRODUCTION

The quality of life and public appreciation levels have experienced significant improvements, manifesting both material and the spiritual prosperity within society (Shu, 2018). Under this premise, there has been a growing focus from the government and other sectors of society on the cultivation of artistic and cultural talents in recent years. The traditional emphasis on individual performances has evolved to require more complex and comprehensive piano talents. Therefore, universities worldwide need to adopt diverse educational models to foster innovation in music education, especially in piano studies. The adoption of this versatile training mode can cultivate piano talents that align with social requirements and are complex skills (Kapliyenko-Iliuk, 2018).

Piano teaching in colleges and universities plays an important role in developing students' all-round development (Yan, 2019). In Chinese universities, piano teaching mainly relies on practice and experimentation to improve the effectiveness of teaching. However, the pursuit of innovative

models will present obstacles. Overcoming the challenges will require that schools, teachers, and students work together to reduce resistance. Only through such efforts can students elevate their musical literacy in piano.
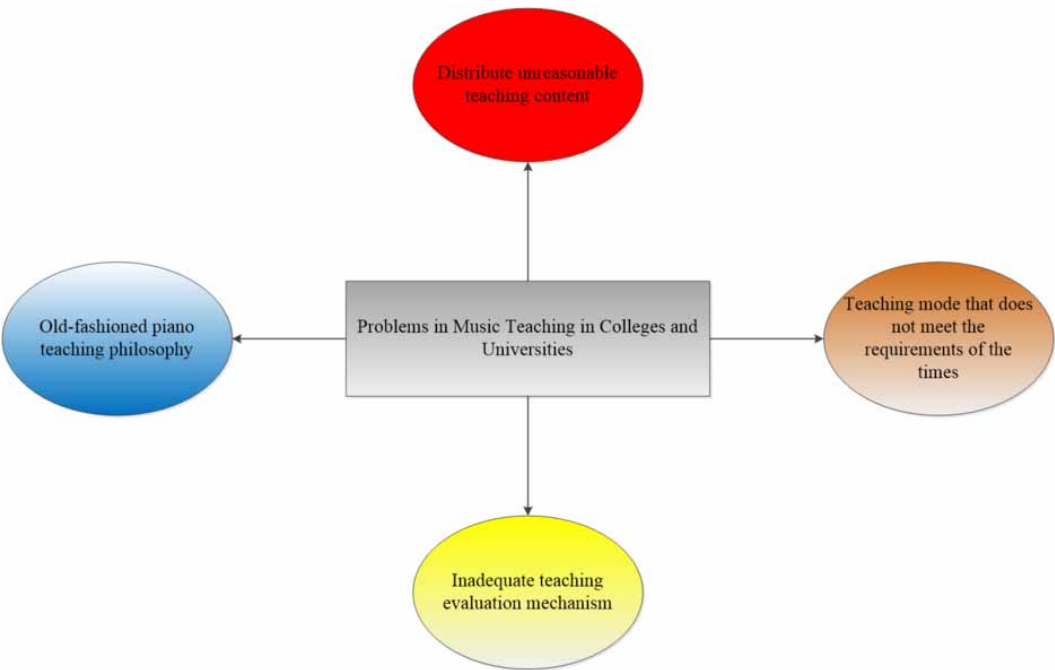
The innovation in piano teaching at universities begins with a shift from original traditional teaching ideas (Comeau et al., 2019). The traditional teaching mode is teacher-centric, resulting passive learning for students who lack effective interaction or communication opportunities with teachers. At the same time, teachers cannot identify aspects for each student, leading to low efficiency music classroom teaching and incomplete piano knowledge. Exposure to this type of environment may cause students to lose enthusiasm for piano learning if they cannot understand the teaching.

To avoid such phenomena, universities must carry out innovative reforms in both teaching modes and content to address the fundamental problem of students' subpar learning status. Piano lessons in universities should focus on the cultivation of students' abilities (Zunkel et al., 2004). The goal of innovation and reform is to enhance students' learning abilities and comprehensively cultivate their musical literacy. In addition, it can also effectively promote students' overall development.

As shown in Figure 1, these problems and contradictions encompass outdated piano teaching concepts, an unreasonable distribution of teaching content, instructional modes that do not meet contemporary requirements, and an imperfect evaluation mechanism. To ensure teaching quality stability, it is imperative to establish an appropriate evaluation mechanism for the teaching content. However, at present, most universities employ a relatively simplistic evaluation approach that cannot fully reflect the teaching standard. Thus, the comprehensive improvement of quality of students' quality remains constrained.

This limitation is mainly due from the insufficient emphasis on establishing a scientific and rational evaluation mechanism for piano teaching in universities. The current mechanism lacks consistency and precision, resulting in a crude approach to assessing piano content. Instead of using students' performance and artistic literacy as primary evaluation criteria, it relies on written test

Figure 1. Problems encountered in music teaching in universities

scores and classroom discipline to judge teaching effectiveness. Therefore, this traditional evaluation mechanism falls short in actively gauging both student learning levels and the teaching level of teachers.

Vyalukhina et al. (2019) pointed out that the traditional Chinese piano teaching content and methods cannot fully meet the current educational needs, presenting an urgent for resolution. As the cradle for cultivating technical talents, Chinese universities should embrace the concept of innovative teaching. Innovative teaching can be used to stimulate students' potential to learn piano. Therefore, Chinese universities must make reasonable arrangements for teaching content and refine teaching methods to enhance students' artistic quality.

Piano education plays an important role in art education. It not only improves students' artistic accomplishment but also cultivates their ability to appreciate art. It is beneficial to the cultivation of students' comprehensive quality without causing any harm.

The university piano teaching mode has, to some extent, transitioned its evaluation method from the traditional exam-oriented model. Shifting from the conventional reliance on exam results, piano teaching now includes regular classroom performance into the comprehensive evaluation system, making it a relatively innovative initiative. However, this comprehensive evaluation system still has defects, notably the absence of relevant content assessing students' emotional expression. In piano creation and performance, infusing sincere emotion into the piano is vital for moving an audience's heart. This emotional depth contributes to students' accomplishments in the field of art and improve their overall creative ability. At present, most universities evaluation systems only allow students to "know the truth but not the reason," failing to stimulate students' potential and shackling the improvement of students' comprehensive ability.

At the same time, university piano teaching focuses on solo instruction, a single teaching model that cannot meet the diverse requirements of piano teaching. This limitation hinders effective teaching outcomes as students struggle to develop collaborative abilities. At the same time, students will lack communication with their peers, impeding mutual learning and the exchange of experiences (Zheng & Dai, 2022). Furthermore, in the solo teaching mode, a short duration of time between teachers and students impacts guidance during practice, impacting improvement. In addition, teachers lack channels for information acquisition to tailor their teaching to individual students aptitudes (Huang et al., 2019).

In view of the problems encountered in music teaching at universities, it is necessary to evaluate the teaching effectiveness within the music teaching process. A lack of comprehensive consideration of the teaching outcomes in music instruction could be seriously detrimental to the popularization and implementation of music teaching in higher education. This article, from the perspective of artificial intelligence (AI), will discuss new ideas for reforming music teaching at universities. Specifically, it will focus on the evaluation methods for assessing the effectiveness of college piano instruction. It aims to obtain solutions that can improve the evaluation methods and strategies employed in music education at the university level.

EVALUATION OF INTERACTIVE PIANO TEACHING EFFECT

As the enrollment within universities continues to expand, issues have emerged, including a sharp increase in student numbers and a shortage of teachers. Therefore, it is necessary to innovate, adjust, and reform the teaching mode of collective piano classes (Yan et al., 2018).

The traditional piano teaching mode, termed "small class," has a small number of students, making it convenient for teachers provide individualized guidance. However, with the expansion of university enrollments, the number of student art majors has also increased, presenting a considerable challenge for teachers (Liu et al., 2018). The surge in numbers has transformed piano teaching into a mode where instructors can "only hear the sound" without seeing the person. It becomes difficult for teachers to guide students in aspects like fingering, playing techniques, piano pedal usage, musical feeling, and musical expression. The student-centered teaching concept has not been effectively implemented, resulting in frequent problems like poor learning quality and lower interest among students.

At present, many universities still use the traditional evaluation mechanism for piano education. The approach emphasizes the results of final exams, supplemented by daily educational evaluations. However, the method is inadequate for effectively evaluating the education outcomes of piano teaching. In addition, it may not be conducive to the future development of piano education.

This method enables students to obtain vivid and intuitive perceptual knowledge, deepening their understanding of the material. It can link theoretical knowledge with practical applications, fostering correct and profound conceptual understanding. In piano teaching, essential elements like teachers' fingering, skills, and pedal usage need to be demonstrated. Due to limitations in piano display capabilities, AI technology can be used to create a complete intelligent piano teaching assistance system.

The system operates by receiving the signal from the teacher's all-encompassing and multi-angle piano demonstrations. The signal is then converted into a visual image and projected onto the large screen. With the one-to-many teaching mode, the system allows real-time instruction for all students, which can improve overall learning efficiency.

With the increasing number of students in the classroom, it is necessary to carry out technological innovations to the existing collective piano teaching mode. Through the combination of AI technology and multimedia, an "interactive teaching two-way mode" is formed. This teaching mode mainly includes two systems.

The first system is the teacher's teaching observation system. That is, two rows of multi-track observation cameras are installed in the piano classroom. During the teaching process, the teacher can manipulate the teaching observation system within the two-way teaching system to observe and record the performance of all students. This system is convenient as teachers correct mistakes and supervise in real-time.

The second system is a one-line consultation system for students. In this system, the student requests individualized guidance from the teacher. The teacher, in turn, moves the multi-track observation camera above the student and wears a headset before accepting the student's request. The online single-line guidance ensures that other students' piano practice is not disturbed.

To address the "blind area" of teaching management, AI technology can be used to create an intelligent management system, replacing the outdated manual management model. The blind area refers to the time dedicated to independent piano practice outside of class hours. Students use the smart management system on their mobile phones to view the teacher-uploaded homework repertoire. During this process, the system can analyze various aspects, including the students' piano practice time, number of practice sessions, and intervals between pauses.

The intelligent management system, when combined with the intelligent evaluation system, can evaluate and analyze the performance of students. Teachers can access feedback results for all students via the piano teaching teacher terminal system. This feedback empowers teachers to encourage students to practice better habits, ultimately improving the students' professional level.

The application of AI technology involves quantitative descriptions, providing specific solutions to specific problems. To quantify the impact of AI technology on the evaluation of college piano teaching effectiveness, this article introduces an example of a quantitative research study focused on college interactive piano teaching evaluation. College piano teaching is an important part of college music teaching (Frederico Hartmann, 2019). However, there are still many problems in the current stage of piano teaching in universities. These challenges are usually manifested in the randomness of curriculum education, outdated teaching methods, and differences in students' cognitive abilities (Wang & Zha, 2019).

The flipped classroom represents interactive teaching methods that originated in the United States. It is known for its transformative impact on the traditional role of teachers and students in the classroom setting. This method, also known as the inverted classroom, gained prominence at Colorado Woodland High School in the U.S. (Yu et al., 2023). To ensure that students' learning progress was not impacted by absences, two chemistry teachers made instructional videos for students to use in self-

directed learning. In addition, they answered students' questions online. The teaching method proved popular with students, especially in self-study and review, demonstrating strong practical effects.

In China, the earliest application of this flipped classroom model occurred in university classrooms before gradually entering high schools and compulsory education (Qiu et al., 2019). The flipped classroom, rooted in modern Internet and multimedia technology, has prominent characteristics. First, it can realize the organic transformation of time and space in teaching. Unlike traditional piano teaching where teachers and students engage in synchronous learning, the speed of students' learning is affected by teachers' teaching pace. The approach may result in some students with strong receptive abilities wasting unnecessary time. However, students with poor receptivity have difficulty effectively comprehending the knowledge (Zaid, 2021).

Therefore, using AI technology, this article conducts relevant research on the evaluation rules for teaching effectiveness of the flipped classroom in college piano interactive teaching. Specifically, this article introduces several commonly used AI technologies and conducts predictive research based on the corresponding values of the evaluation indices for the flipped classroom's effectiveness. The article aims to provide solutions and methods for optimizing the evaluation methods of interactive college piano teaching effects (Tian & Li, 2018).

To enhance readers' understanding of the research context, the author outlines the structure of the article. First, the relevant content about piano teaching evaluation is summarized in the second subsection. Second, three typical AI algorithms are introduced. Finally, these techniques are applied to specific research cases.

Given the adaptability of AI technology to address various predictive challenges, the evaluation of piano teaching effectiveness falls within this range. This article is devoted to integrating AI technology into the evaluation process of teaching effectiveness. The process requires a lot of computation and computational resources, necessitating a powerful computing platform. In addition, for abstract research problems, AI techniques cannot predict operations. Whether the issue is a social or natural problem, the selection of prediction objects is very particular. In the following special cases, the authors analyzes the vibration signals and playing melodies within piano teaching.

EXTREME LEARNING MACHINE

The extreme learning machine is a specialized form based on support vector machines (SVMs). Compared with traditional one-dimensional SVMs, it simplifies prediction problems by transforming them into a single hidden layer feedforward neural network based on the regression principle of least squares. In the design of extreme learning machines, researchers can use kernel functions instead of computational hidden layers with many nodes. The computational procedure of an extreme learning machine can be expressed as follows:

$$e_j = \sum_{i=1}^{H} \alpha_i f\left(w_i, c_i, x_j\right) j = 1 \ldots N \tag{1}$$

where ej represents the output value corresponding to the neural network and f represents the nonlinear function represented by the neural network. ωi represents the key node value in the prediction algorithm. ci represents the threshold value in the prediction algorithm and xi represents the predictor variable in the prediction algorithm.

The weight coefficients corresponding to the input layer are randomly generated. This model equation satisfies a Gaussian-based continuous probability distribution. The weight layer of the input layer of Equation (9) can be expressed as follows:

$$\chi = C + Z \tag{2}$$

In the formula, C and Z represent the independent variables related to the extreme learning machine, respectively. λ represents the dependent variable obtained by linear calculation of the independent variables.

In the formula, two independent variables and one dependent variable can be expressed as follows:

$$C = \begin{bmatrix} c(x_1) \\ \cdot \\ c(x_N) \end{bmatrix} = \begin{bmatrix} c(w_1, c_1, x_1) \dots c(w_H, c_H, x_1) \\ c(w_1, c_1, x_j) \dots c(w_H, c_H, x_j) \end{bmatrix} \tag{3}$$

$$\chi = \begin{bmatrix} \chi_1^{\mathrm{T}} \\ \cdot \\ \cdot \\ \chi_H^{\mathrm{T}} \end{bmatrix} \tag{4}$$

$$Z = \begin{bmatrix} z_1^{\mathrm{T}} \\ \cdot \\ \cdot \\ z_N^{\mathrm{T}} \end{bmatrix} \tag{5}$$

Extreme learning machines can continuously optimize their algorithms by learning from data, improving their prediction capabilities and application effects. In the field of education, extreme learning machines can be used to develop personalized learning plans, providing students with more accurate learning content and teaching strategies based on their learning situation and performance. This, in turn, can improve the learning effectiveness.

PREDICTION BASED ON FUZZY NEURAL INFERENCE SYSTEM

The neural reasoning system is made up of three components. This intelligent algorithm can choose from many sets of member functions, ensuring the effect of fuzzy logic on the input data (Wei, 2018). The fuzzy inference system can be divided into three inference modes according to the "if-then rule" inference operation. In a one-dimensional system, a typical rule set with two computational rules for fuzzy inference can be expressed as shown below.

The fuzzy comprehensive evaluation is carried out from the second level of factors. The evaluation object can be set as the factor at the second level, and the membership degree of the kth element in the evaluation set is denoted as r_{ijk}. Then, the single-factor membership degree matrix of the second level is:

$$R_i = \begin{bmatrix} r_{i11} & r_{i12} & \mathrm{L} & r_{i1p} \\ r_{i21} & r_{i22} & \mathrm{L} & r_{i2p} \\ \mathrm{M} & \mathrm{M} & & \mathrm{M} \\ r_{in1} & r_{in2} & \mathrm{L} & r_{inp} \end{bmatrix}$$

(6)

Next, the first-level fuzzy comprehensive evaluation model can be expressed as follows:

$$R = \begin{bmatrix} \mathrm{B}_1 \\ \mathrm{B}_2 \\ \mathrm{M} \\ \mathrm{B}_m \end{bmatrix} = \begin{bmatrix} r_{11} & r_{12} & \mathrm{L} & r_{1p} \\ r_{21} & r_{22} & \mathrm{L} & r_{2p} \\ \mathrm{M} & \mathrm{M} & & \mathrm{M} \\ r_{m1} & r_{m2} & \mathrm{L} & r_{mp} \end{bmatrix}$$

(7)

where R stands for the numerical matrix of the fuzzy nervous system. B and M are independent variables in their matrix.

The prediction based on fuzzy neural inference system can be applied to interactive college piano teaching effectiveness evaluation methods. Fuzzy neural inference systems can analyze students' learning data and performance, facilitating the evaluation of teaching effectiveness. At the same time, these systems can provide corresponding teaching suggestions and strategies to help teachers better adjust teaching content and methods to enhance overall teaching effectiveness.

PARTICLE SWARM OPTIMIZATION ADVANCED ALGORITHM

Particle swarm optimization is an advanced algorithm mainly used to simulate various social behaviors, such as reproductive inversion between populations and birds looking for food. Like the conventional genetic algorithms, particle swarm optimization evaluates the quality of solutions based on fitness, but its rules are simpler than the genetic algorithms (Chen et al., 2019).

These particles automatically search for both a single best position and a global best position according to the optimal solution to the problem, according to the optimization criteria found in nature. In each iteration, the researchers re-updated the computations based on the particle's position and velocity (Zhou et al., 2018).

The relative motion trajectory of each particle can be updated according to the following equation:

$$\begin{cases} \theta_i = \omega \times \theta_i + c_1 r_1 (p_{best} - \lambda_i) + c_2 r_2 (g_{best} - \lambda_i) \\ x_i = x_i + \nu_i \end{cases}$$

(8)

According to Equation (8), any optimization problem can be simplified as a process of finding the best position and the best speed for a particle (Song, 2017). This process includes both individual and overall optimization. The above formula reflects the process for updating the position and velocity of each particle.

In the actual calculation and application process, the square sum of errors can be used as the optimal function expression for the optimization of particle swarm advanced optimization. Then, the particle swarm optimization calculation can be viewed as the problem of finding the minimum value of the fitness function. Figure 2 illustrates the computational flow chart of the particle swarm optimization algorithm.

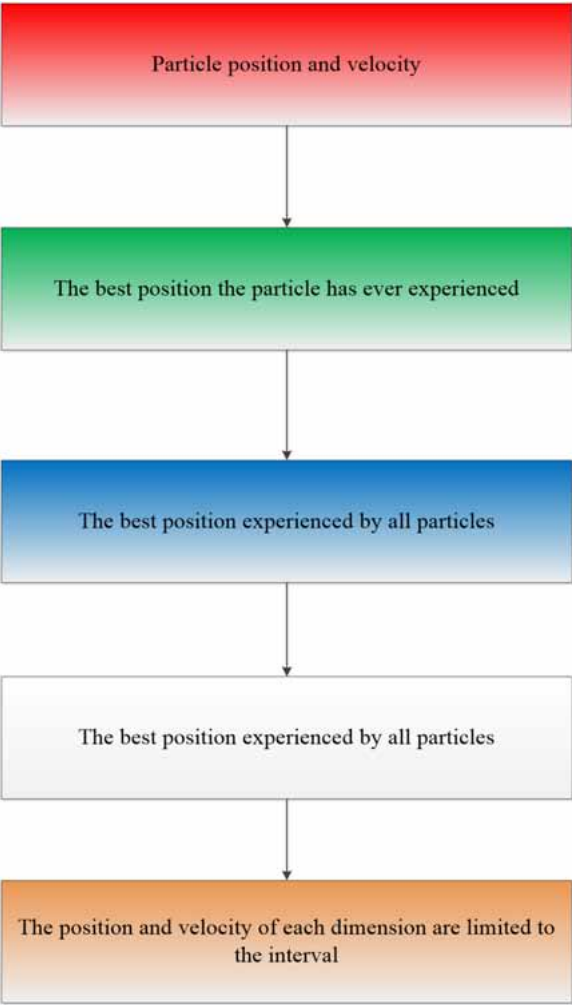**Figure 2. Calculation process of particle swarm optimization algorithm**

Figure 2 shows that the implementation of the PSO algorithm involves several steps. Among them, the selection of the fitness function is an important task. As discussed, the individual and global optimization processes facilitate the identification of the optimal particle. The particle swarm optimization algorithm can optimize the parameters of the evaluation model. In the evaluation of piano teaching effectiveness, the particle swarm optimization algorithm can be applied to adjust the weights and parameters of evaluation indicators, ensuring more accurate and reliable evaluation results.

EVALUATION OF THE EFFECT OF COLLEGE PIANO TEACHING BASED ON AI

Compared with the traditional teaching mode, the flipped classroom, as a modern teaching mode based on modern Internet technology and multimedia technology, boasts distinct characteristics.

In the flipped classroom model, students are given a significant degree of autonomy in their learning. This mode minimizes the influence of teachers on students' learning styles and speeds, which is conducive to students' autonomous mastery of learning practices and positively impacts the cultivation of their ability to think independently and learn independently (Zhao et al., 2021). At the

same time, the flipped classroom model is conducive to the decomposition of knowledge content, breaking down complex information into smaller, more manageable knowledge points. In this way, students can more easily accept the knowledge content and achieve better teaching effect. Moreover, the teaching process can be effectively reproduced (Yang, 2021).
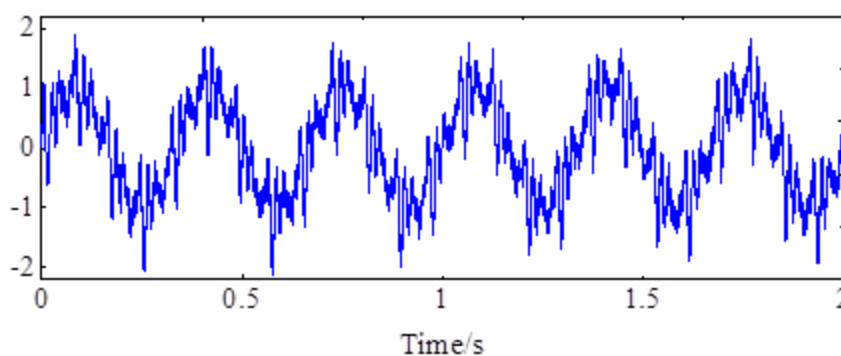
Developmental evaluation in piano teaching primarily involves the teacher's evaluation of students, guiding them to review and analyze their own homework. It also encourages peer evaluation. From the perspective of the specific operational method of the evaluation, this operation mode not only allows for a qualitative assessment of students' language knowledge and skills mastery but also enables a quantitative evaluation students' interests and attitudes through scoring or ranking. The evaluation of college piano teaching effectiveness mainly includes three evaluation modes: (1) portfolio evaluation; (2) learning contract evaluation; and (3) reflection form evaluation.

Combined with the specific evaluation of teaching effectiveness, it becomes evident that students' breathing is affected by their emotions. Playing in a state of panic, for example, may cause tension, which impacts the breathing rhythm. This aspect is a key point that should be given attention in the evaluation of piano teaching effectiveness. Research proves that quantitative research can be carried out by collecting the variation pattern of breathing vibrations during students' piano performances. Figure 3 shows the vibration signal of a student's breathing over time during a university piano teaching evaluation. As shown in Figure 3, the player's breathing amplitude exhibits continuous oscillation over time.

As shown in Figure 3, the piano vibration signal changes periodically with time. However, this change is irregular. In fact, the interference of various noise signals can be identified. This interference can then be eliminated using signal analysis.

As can be seen in Figure 3, the player's breathing vibration signal is a non-steady-state vibration signal. Research has confirmed that the intrinsic characteristics of this non-steady-state signal can be obtained through signal analysis methods. Existing signal analysis methods include Fourier transform, wavelet analysis, wavelet packet analysis, and Hilbert transform. Fourier transform is suitable for the processing steady-state signals, which can transform the signal from the time domain to the frequency domain representation through the corresponding window function. However, this transformation method is not suitable for the processing of non-stationary signals. Wavelet analysis optimizes the principle of Fourier transform by changing the size of the window function, decomposing the original signal into multi-layer reconstructed signals. However, the high frequency part of the signal is deleted in the wavelet analysis process, reducing high-frequency resolution. To overcome the defects of wavelet analysis, wavelet packet analysis also decomposes the high-frequency part of the signal, effectively improving high-frequency resolution. However, the accuracy of both wavelet analysis and wavelet packet analysis depends on the choice of the wavelet basis function and the number of

Figure 3. Vibration signals in piano teaching

decomposition layers, making them less adaptive. The Hilbert transform, consisting of the empirical mode decomposition and the Hilbert transform, can adaptively decompose the signal into multiple modal components without setting a priori function.

In Figure 3, the signal is decomposed into a finite number of modal components via the Hilbert transform. The time-history curves of specific components are shown in Figure 4.

In Figure 4, there is a distinct relationship between the multiple eigenmode components obtained through empirical mode decomposition. These components are arranged in order of frequency (highest to lowest).

The vibration signal can be decomposed into a series of intrinsic mode components (IMF) and a residual component (r) with the empirical mode decomposition method. The decomposition result can be expressed as follows:
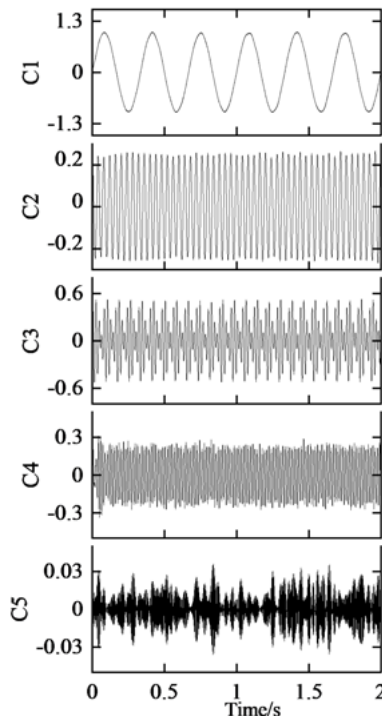
$$y(t) = \sum_{i=1}^{n} IMF_i + r \tag{9}$$

In the formula, IMF represents the multiple eigenmode components obtained by empirical Motai decomposition. r represents the residual term after the decomposition is completed.

Then, the Hilbert transform is performed on the natural modal components decomposed by the EMD method to obtain their instantaneous frequency and instantaneous amplitude. The modal components can be converted into each other between the time domain and the frequency domain to obtain their Hilbert spectrum. It is the three-dimensional time spectrum.

The modal components obtained by empirical modal decomposition can be expressed as $c(t)$. The Hilbert transform of $c(t)$ can be obtained through:

Figure 4. Results of empirical mode decomposition

$$H[c(t)] = \frac{1}{\pi} PV \int_{-\infty}^{\infty} \frac{c(\tau)}{t - \tau} d\tau \tag{10}$$

where PV is the principal value of Cauchy. The formula shows that the establishment of the Hilbert spectrum is obtained through the curve integration in mathematics.

The analytical signal z(t) can be constructed as:

$$\begin{cases} z(t) = c(t) + jH[c(t)] = a(t)e^{j\phi(t)} \\ a(t) = \sqrt{c^2(t) + H^2[c(t)]} \\ \phi(t) = \arctan \dfrac{H[c(t)]}{c(t)} \end{cases} \tag{11}$$

where a(t) represents the magnitude of the function. $\phi(t)$ e represents the phase of the function.

Thus, the Hilbert spectrum can be obtained, representing the distribution of amplitude in the time domain and frequency domain. The relationship between time-frequency-energy can also be obtained. The specific functional form of the Hilbert transform can be expressed as follows:

$$H(\omega, t) = \mathrm{Re} \sum_{i=1}^{n} a_i(t) e^{\int \omega_i(t)dt} \tag{12}$$

where Re is the Cauchy principal value of the function.

According to Equations 9-12, the boundary spectrum, instantaneous energy spectrum, and three-dimensional spectrum of the vibration signal can be obtained as shown in Figures 5-7, respectively.

As shown in Figure 5, the piano vibration signal processed using the HHT method exhibits the following characteristics. These features mainly include that the main vibration frequency band of the vibration signal is mainly distributed in the low-frequency range. This conclusion is consistent with observations found in the blasting vibration signal.

Among them, we can clearly observe from the figure that the main vibration energy of the piano performance signal is concentrated around 20 Hz, providing a detailed prediction range for the subsequent prediction analysis.

Taking the three main factors of college piano teaching effect evaluation as the research object, the three AI technologies are used to predict the interactive teaching effect, facilitating the goal of quantitative analysis. Among them, portfolio evaluation is a comprehensive process evaluation that differs significantly from the traditional evaluation based on standardized tests in terms of evaluation subject, standards, and purpose. As the second evaluation index, the learning contract is a pact jointly formulated by teachers and students. It includes the student's learning objectives, the methods to achieve the objectives, the time allocated for learning activities, and the standards for evaluating the activities. It serves as a written agreement or guarantee between the learner and the instructor, aiming to cultivate the learner's ability to plan their own learning and strengthen their sense of responsibility.

Correspondingly, a reflection form assessment is a form consisting of a series of questions or assessment items (Nakata, 2019). Its content can be a kind of learning scaffolding provided by teachers to students, offering a clear learning route and self-assessment tool for learners. Reflective sheets, with the guidance of pre-designed questions, can support students' reflective skills and metacognitive abilities, effectively improving learners' ability to reflect and cultivate their autonomous learning ability.

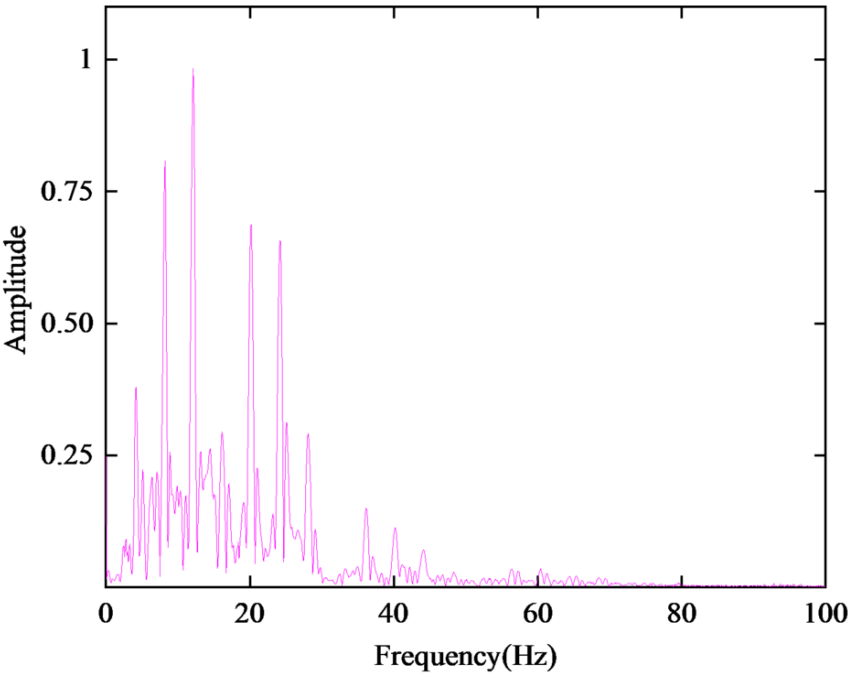**Figure 5. Boundary spectrum of vibration signal**

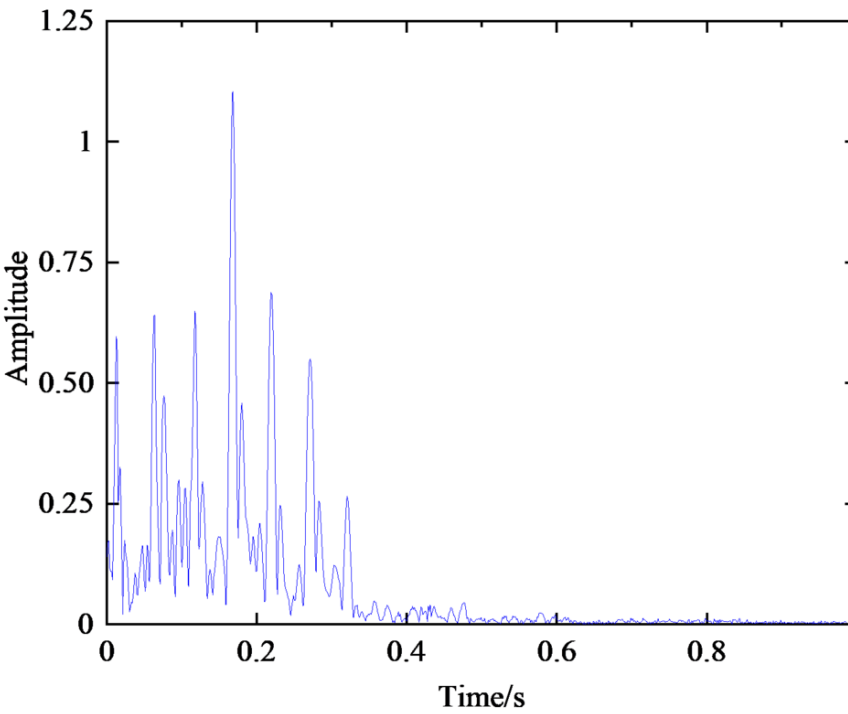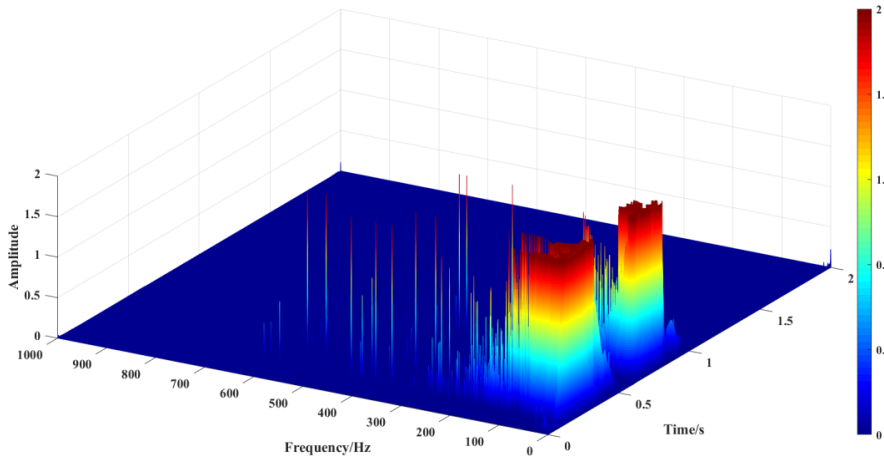**Figure 6. Instantaneous energy spectrum of vibration signal**

Figure 7. Three-dimensional spectrum of vibration signal

It is known that the closer the square of the correlation coefficient (r^2) is to 1, the smaller the root mean square error (RMSE). This indicates higher prediction accuracy. Table 1 shows the prediction effects of the three AI technologies.

As shown in Table 1, the square of the correlation coefficient corresponding to fuzzy neural inference system is the highest, reaching a maximum value is 0.9752. From the perspective of prediction indicators, the root mean square difference corresponding to the fuzzy neural inference system is the smallest for all three predictors. Among them, the minimum value of the root mean square difference is 0.1962. This comparative result shows that the prediction effect of the fuzzy neural inference system is the most favorable (Ryu, 2018).

From the above analysis results, it can be found that the fuzzy neural network inference system can be used as a representative AI technology in the innovative research on the effect evaluation of interactive music teaching in universities.

Figure 8 illustrates the 3D cloud map of the obtained prediction data corresponding to the two aspects.
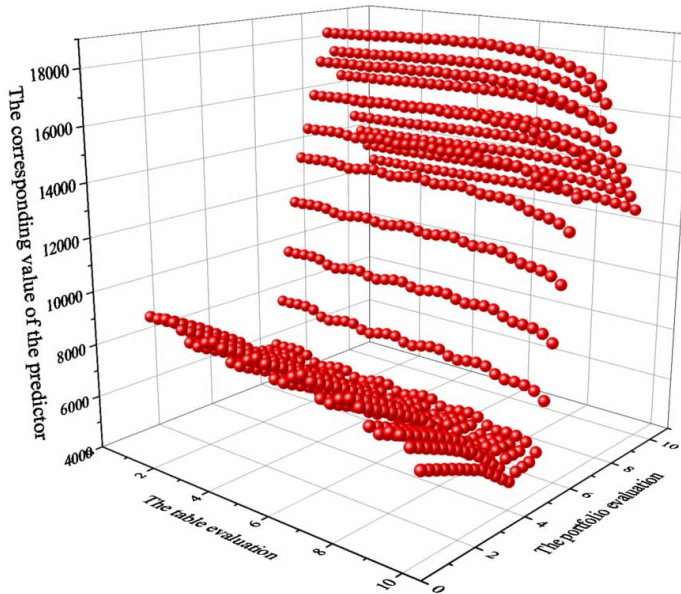
CONCLUSION

Piano teaching in universities holds immense significance in the realm of music education. The accurate and efficient evaluation of teaching effectiveness plays a pivotal role in improving the quality of music education at the university level. This article focuses on quantifying evaluation indicators for piano

Table 1. Comparison of prediction performance of three big data technologies

Artificial Intelligence Technology	The Effect of Regression Analysis	
	r^2	RMSE
Extreme learning machine	0.931	0.2533
Fuzzy Neural Inference System	0.9725	0.1962
Particle Swarm Optimization Advanced Algorithm	0.8974	0.2580

Figure 8. Three-dimensional map display of the evaluation effect of college piano teaching

teaching effectiveness, using the flipped classroom as an example. Employing AI analysis technology, the study analyzes three evaluation star indicators involved with flipped classroom piano teaching. The results reveal that the fuzzy neural network system exhibits the best prediction effect, with a root mean square deviation of only 0.1962. It boasts the largest square of the correlation coefficient, reaching a maximum value of 0.9752. In addition, the three-dimensional data cloud map involved in the prediction data shows strong consistency for the AI system across the two evaluation indicators.

DATA AVAILABILITY

The figures used to support the findings of this study are included in the article.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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