Hindawi
Mathematical Problems in Engineering
Volume 2022, Article ID 5817752, 8 pages
https://doi.org/10.1155/2022/5817752

Research Article

Research on Piano Informatization Teaching Strategy Based on Deep Learning

Yihao Hou

Guangxi Arts University, Nanning 530023, China

Correspondence should be addressed to Yihao Hou; 6180201053@stu.jiangnan.edu.cn

Received 23 January 2022; Revised 28 February 2022; Accepted 5 March 2022; Published 23 March 2022

Academic Editor: Naeem Jan

Applying information technology to piano teaching can effectively avoid these problems. The application of information teaching means can not only enrich teaching methods but also enhance students' interest in learning. Deep learning (DL) focuses on immersing students in knowledge and learning situations, emphasizing critical thinking, and realizing the intrinsic value of knowledge. Understanding DL theory is of great significance to deepening the teaching reform in China. BP algorithm is a very effective algorithm for prediction and evaluation. In this paper, the complex factors affecting the quality of piano information teaching are comprehensively considered, and the improved BP neural network (BPNN) algorithm is used to evaluate and predict the quality of piano information teaching. The model structure of BPNN for evaluating and predicting the quality of piano information teaching is given and simulated in MATLAB. The results show that the evaluation and prediction method overcomes the subjective factors of expert evaluation and obtains reasonable results. Compared with the traditional BPNN algorithm, it has good applicability.

1. Introduction

With the development of information science and technology, great changes are taking place in modern teaching technology, teaching concepts, teaching contents, and especially teaching methods. The integration of new technology and education is deepening, and more and more research on the use of information technology to carry out subject teaching has achieved good results [1]. Information-based teaching mode has been gradually applied to piano teaching, which makes piano teaching forms diversified, which greatly stimulates students' interest in learning, thus effectively improving their learning efficiency. Therefore, teachers must work hard to learn the information teaching mode, constantly carry out corresponding inquiry and study, and better promote students' learning through modern educational methods.

At present, in front-line teaching, many schools implement in-depth teaching in piano information teaching, with the aim of promoting students' deep learning (DL) and avoiding students' deep understanding caused by fragmented and shallow learning. But there are some problems in practice [2, 3]. Literature [4] thinks that DL is to deepen the difficulty of learning and let students learn difficult knowledge instead of simple knowledge; it is DL. For simple problems, simple knowledge learning is shallow learning, which is not ideal learning. Literature [5] holds that, before learning, individuals have their own experience and cognitive structure, and learners are not passively receiving information. It is a process of actively selecting and processing according to one's own experience, thereby obtaining newly constructed knowledge. Literature [6] holds that teachers must set up a good problem situation in order to have a deep dialogue with students, inspire students to think, and guide students to study step by step so that the classroom can produce a spark of wisdom and guide students to study in-depth. Literature [7] thinks that curriculum objectives should be designed from three aspects: knowledge and ability, process and method, emotional attitude, and values. The three are mutually infiltrated and integrated.

The true goal of information-based instruction is to maximize students' learning potential, raise their knowledge level, grow their learning ability, and engage them in meaningful learning. In the process of piano teaching, the application of modern information technology can greatly improve the quality of piano teaching, help students enrich piano professional knowledge and skills, and lay a good foundation for future study and progress [8]. At the same time, through the application of modern teaching methods, teachers can organize teaching activities in a more planned way and help students actively participate in piano learning. As a result, research into the use of new information technology teaching methods in piano instruction is required.

2. Characteristics of DL

The concept of "DL" originates from the research of artificial intelligence, which allows computers to learn from experience and explain the world according to a hierarchical conceptual system. Each concept is defined by its relationship with some relatively simple concepts. Hierarchical conceptual design enables computers to learn complex concepts with the help of simple concepts. If these concepts are built on top of each other, a "deep" (multilevel) diagram can be drawn, so it is called DL [9, 10].

The teaching logic of DL is that teachers guide students to develop the core qualities of disciplines through the design and implementation of discipline teaching, including the study of core contents, the formation of higher-order thinking, and the promotion of key abilities. From the perspective of students' cognitive order, the teaching logic of DL lies in the understanding and cognition of complex concepts or knowledge, which requires learners to deeply process and interpret the information they have learned, which embodies the learning state of DL from shallow to deep, from the outside to the inside, and from low to high and step by step [11].

DL and shallow learning are corresponding, but not completely opposite. Students in shallow learning treat learning as a task that comes from the outside world and is constrained to complete. This learning model is very realistic and utilitarian, hoping to gain greater returns through little effort, and needs external forces to drive learning. On the contrary, students who adopt the DL method tend to be interested in content spontaneously and adapt the learning method of maximizing the meaning of content. The reason why DL is efficient in learning is closely related to its five characteristics [12]. According to the five dimensions of DL connotation, the characteristics of DL include primary characteristics, inherent characteristics, essential characteristics, necessary characteristics, and trend characteristics (see Figure 1).

2.1. The First Characteristic: Understanding Cognition. The process of DL is firstly a learning process based on understanding. Some studies believe that the improvement of personal autonomy has a great relationship with "understanding," and understanding is of great significance to the deep cognition of individuals [13]. The process of understanding can not only add new elements to the original knowledge but also integrate and generate a new cognitive structure in the process of continuous development.

2.2. Inherent Characteristics: High-Order Thinking. What is called high-order thinking touches upon the mental activity or cognitive ability occurring at a higher cognitive level, which is characterized by analysis, synthesis, evaluation, and creation in the classification of teaching objectives [14]. The process of DL's comprehensive knowledge processing requires students to use abstract thinking and organize pieces of information into a whole through logical reasoning and critical thinking, and the result of knowledge processing is that they can use integrated knowledge to solve problems in situations.

2.3. Essential Feature: Overall Connectivity. Learning is a step of connecting multifarious information sources and nodes [15]. Various knowledge is associated with each other in students' consciousness like neurons, and it is required to gain knowledge in order to tune up or modify the strength of this connection. DL requires learners to learn to communicate continuously in the whole learning process and to keep a holistic view. It also requires teachers to guide learners to form this learning strategy of holistic connection. This kind of learning can ultimately promote people's all-round development, which is the essential feature of the DL process.

2.4. Essential Feature: Creative Criticism. Creative learning is opposite to traditional maintenance learning, which can cause changes, updates, and reorganizations and raise a series of questions. In the process of DL, it is necessary not only to accumulate knowledge but also to emphasize the interactivity and creativity of education and to advocate the dynamic relationship among the various elements of the educational process. In the era of the knowledge economy, this kind of creative and critical learning is essential in school education.

2.5. Trend Characteristics: Expert Construction. As far as the learning process is concerned, the powerful way to actively transform the external factors of learning into autonomous learning is expert learning so as to achieve a comprehensive and systematic understanding or a gradual process of mastering new knowledge and purposefully promote the development of knowledge and ability in one's own field. Expert-based learning needs a process, and it also needs a process to reach the level of expert knowledge construction, which is the ultimate goal of DL and the trend characteristic of DL.

3. Research Method

In this section, we have defined the BPNN principle and improved the learning algorithm, establishment of evaluation index system of piano information teaching quality, and

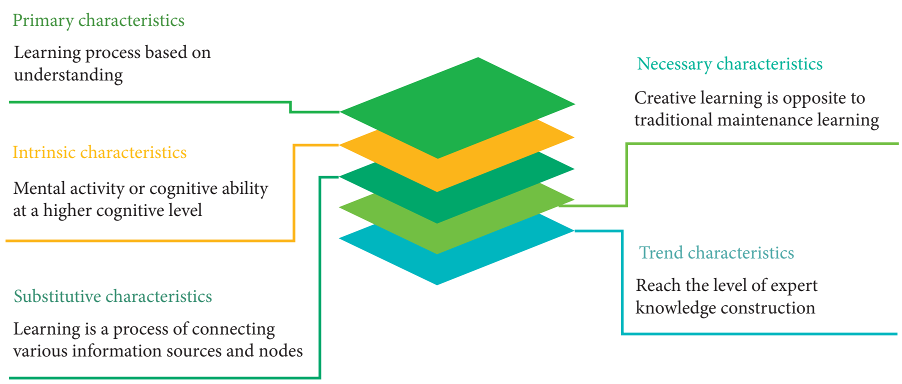

FIGURE 1: Five characteristics of DL.

determination of the evaluation and prediction model of piano information teaching quality based on BPNN.

3.1. BPNN Principle and Improved Learning Algorithm. BP neural network (BPNN) is one of the most extensively used networks. It has strong self-learning, self-organizing, and self-adapting abilities. The learning process of this algorithm consists of forwarding propagation and reverse propagation. In the forward propagation process, the input information is processed layer by layer from the input layer through the hidden unit layer and then transmitted to the input layer. The state of neurons in each layer only affects the state of neurons in the next layer [16].

In order to speed up the convergence speed of the network, this paper adopts the BPNN algorithm improved by the self-adapting learning rate method [17, 18]. The main reason for the slow convergence speed of the standard BPNN algorithm is the improper selection of the learning rate. The learning rate is too small, and the convergence is too slow; if the learning rate is too high, it may be corrected too much and lead to divergence. Therefore, an improved algorithm of adaptive adjustment appears, and its weight and threshold X update formula is as follows:

$$\Delta X = lr \cdot \frac{\partial E}{\partial X}, \qquad \Delta X = (k+1) = mc \cdot \Delta X(k) + lr \cdot mc \cdot \frac{\partial E}{\partial X}. \tag{1}$$

Here, lr is the learning rate and lr is the variable; mc is the power factor, which is commonly about 0.95. The added momentum term is in essence equivalent to the damping term, which decreases the vibration trend in the learning step, thus increasing the convergence and finding a better solution.

Usually, the criterion for adjusting the learning rate lr is to check whether the correction value of the weight really reduces the error function. If so, it means that the selected learning rate value is small and can be increased by an amount; if this is not the case and overshoot occurs, then the learning rate should be reduced.

3.2. Establishment of Evaluation Index System of Piano Information Teaching Quality. The evaluation of piano information teaching quality is to get the correct grade by analyzing the factors that affect the teaching quality and the influence degree of each element. As a result, the following index system (Figure 2) [19] can be built from a comprehensive long-term perspective of teaching work.

3.3. Determination of the Evaluation and Prediction Model of Piano Information Teaching Quality Based on BPNN

3.3.1. BPNN Model Structure. The BPNN prediction model is shown in Figure 3.

Determination of Input Layer and Output Layer. Since there are 12 main indicators affecting the quality of piano information teaching, the quantity of neurons in the input layer is determined as $n = 12$.

The output of the network is the evaluation result of piano information teaching quality. Consequently, the quantity of neurons in the output layer is determined as $m = 1$. Y indicates the prediction result of teaching evaluation.

Determination of the Quantity of Hidden Layers. Choose three-layer BPNN with a relatively simple structure; that is, there is one hidden layer (HL), and the HL adopts the Sigmoid transformation function.

At present, there is no ideal analytical formula to express the number of neurons in the HL, but the following reference formulas can be provided for reference in choosing the best quantity of hidden units: because the input node is 7, according to formulas (2) and (3), the number of neurons in the HL can be preliminarily decided as 19 or 10.

$$n_1 = \log_2^2 n. \tag{2}$$

$$n_1 = \sqrt{n+m} + a. \tag{3}$$

Here, n is the quantity of input cells, m is the quantity of output neurons, and a is a constant between [1, 10].

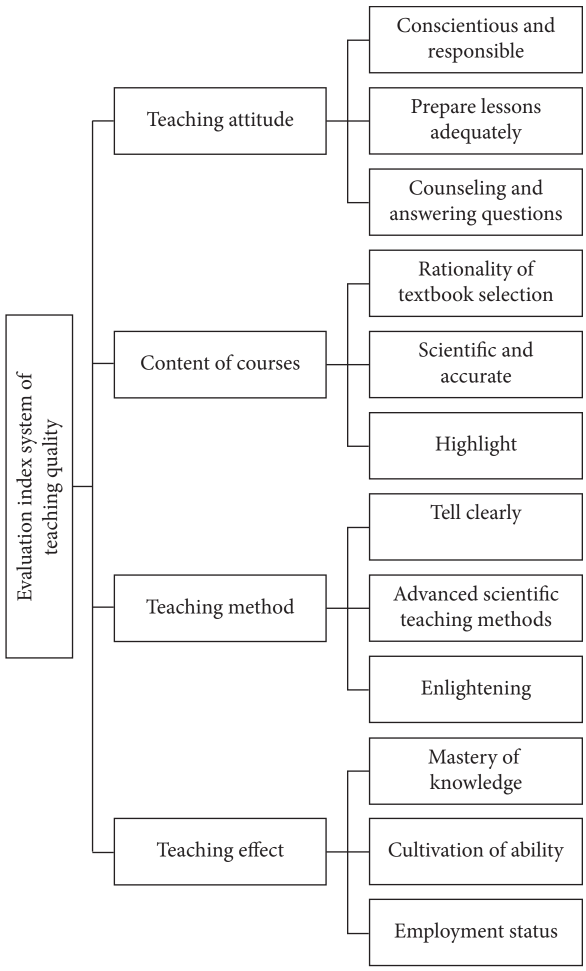

Figure 2: Evaluation index system of teaching quality.

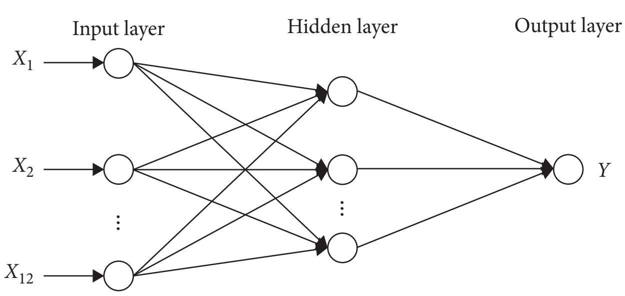

Figure 3: BPNN prediction model.

3.3.2. Learning Algorithm. The learning algorithm of BPNN can be described as follows:

(1) Initialize network and learning parameters, and give each connection weight coefficient ω_{ij}, ω_j and threshold θ_j. Give random values between $[-2/n, 2/n]$, $i = 1, 2, \cdots, n$; $j = 1, 2, \cdots, s$.

(2) Select a pair of sample training data $x_p = [x_1, x_2, \cdots, x_{12}]$ as input layer and y_p as expected output.

(3) Use input data x_p, connection weight coefficient ω_{ij}, and threshold θ_j to calculate the output of neurons in each HL:

$$y_j = \frac{1}{1 + \exp\left[-\left[\sum_{i=1}^{n} \omega_{ij} x_i - \theta_j\right]\right]}. \tag{4}$$

Among them, $i = 1, 2, \cdots, n$; $j = 1, 2, \cdots, s$.

(4) Use the output y_j of HL, connection weight coefficient ω_j, and threshold θ to calculate the output of neurons in the output layer:

$$y = \frac{1}{1 + \exp\left[-\left[\sum_{i=1}^{s} \omega_j y_j - \theta\right]\right]}. \tag{5}$$

Among them, $j = 1, 2, \cdots, s$.

(5) The expected output y_p of the network and the realistic output y of the network can be used to reckon the correction error of the output layer:

$$\sigma = \left(y_p - y\right) y (1 - y). \tag{6}$$

(6) The correction error of HL can be calculated by ω_j, σ, y_j:

$$\sigma_j = y_j\left(1 - y_j\right)\sigma\omega_j. \tag{7}$$

(7) With ω_j, σ, y_j, and θ, the new connection weights and output neuron thresholds between HL and output layer can be calculated:

$$\omega_j(t+1) = \omega_j(t) + \eta(t)\sigma y_j + \alpha\left[\omega_j(t) - \omega_j(t-1)\right],$$
$$\theta(t+1) = \theta(t) + \eta(t)\sigma + \alpha[\theta(t) - \theta(t-1)],$$
$$n(t) = \eta_0\left[1 - \frac{t}{T+M}\right], \tag{8}$$

where $\eta(t)$ is the step size; α is the momentum coefficient, and its value is between [0, 1], generally about 0.9; η_0 is the initial step size; t is the quantity of studies; T is the total quantity of iterations; M is a positive number.

(8) With $\sigma_j, x_i, \omega_{ij}$, and θ, the new connection weights between the input layer and HL and the new connection weights between HL and the neuron threshold of HL can be calculated:

$$\omega_{ij}(t+1) = \omega_{ij}(t) + \eta(t)\sigma_j x_i + \alpha\left[\omega_{ij}(t) - \omega_{ij}(t-1)\right],$$
$$\theta_j(t+1) = \theta(t) + \eta(t)\sigma_j + \alpha\left[\theta_j(t) - \theta_j(t-1)\right]. \tag{9}$$

(9) Through iterative calculation, the allowable error is reached. Then select the second pair of samples for training, and duplicate the exceed algorithm until all the samples are trained, and the neural network evaluation model is completed.

4. Realization of BPNN Piano Information Teaching Quality Evaluation Model

4.1. Preprocessing of Input Data. Because the input of secondary index is obtained by students or experts, it usually adopts percentile system or decimal system, while the input data in neural network adopts Sigmoid function, and the value range of input quantity is between [0, 1], which requires us to normalize the initial data. In this paper, the max–min method is used for normalization because it can keep its original meaning well, and it is not easy to cause information loss. This method is a linear transformation for data processing.

The normalized formula for the input data of student evaluation is as follows:

$$X = \frac{I - I_{\min}}{I_{\max} - I_{\min}}, \tag{10}$$

where X is the input value of the neural network (after normalization); I is the input value of the untreated neural network (the score evaluated by students or experts); $I_{\min}$ is the minimum value of neural network input (the minimum value of student or expert evaluation score); $I_{\max}$ is the maximum value of neural network input (the maximum value of student or expert evaluation score).

4.2. MATLAB Simulation Implementation. According to the evaluation index system, students are asked to score each teacher's indexes. In this paper, the highest score of 8% is removed, the lowest score of 8% is removed, and then the average value is taken as the value of the teacher's 10 input indexes. Normalize the collected sample data, and transform the score data [0, 100] into data between [0, 1]. One to four groups of data are adopted as training data, and the other 4 groups of data are adopted as verification data to check the forecasting outcome of the neural network model generated after training.

MATLAB-oriented BPNN algorithm program implementation has the following four basic steps.

4.2.1. Initialize. Set the weight and threshold initial value functions.

4.2.2. Bring about a Network Forecasting Model. On the basis of the sample data, the quantity of neurons is determined. Meanwhile, users need to decide the quantity of HL, the quantity of neurons in HL, the switch function, and the training function. The set quantity of HL nodes is 6, the objective incorrect is 0.01, and the learning velocity is set to 0.01 [20].

4.2.3. Training of Network. On the basis of the sample input, the objective vector, and the preset factors of the training function, the network is trained.

4.2.4. Simulation of Network. According to the trained network, the test data is simulated. Training data and teacher data are read, the corresponding neural network model is generated after training, the verification data are read and calculated through the network, and the predicted value is output.

Figure 4 is a comparison between actual evaluation results and simulation evaluation results.

According to the experimental data in Figure 4, the training and forecasting precise of the piano information teaching quality evaluation model in view of BPNN is absolutely within the permissible limits, which is a rational and feasible prediction model.

4.3. Comparison of Algorithm Performance. The input sample data is $1.5\pi \sim \pi$, the input space is 0.05π, the sum quantity of samples is 50, and the size of sample data is within $[-4.5, 7.5]$ interval. For the sake of averting the planar variation region of derivative of Sigmoid function, this paper reduces the sample data into [0.15, 0.85] interval.

If X^* is the sample after data step and $X_{\min}$ and $X_{\max}$ are the minimum and maximum values of the initial sample data, the sample can be dealt with in accordance with formula (11).

$$X^* = 0.15 + 0.6 \times \frac{(X - X_{\min})}{X_{\max} - X_{\min}}. \tag{11}$$

Under the preset error accuracy of 0.0001, the beginning learning rate and weights are randomly selected in the interval of [0, 1], and the Sigmoid function is used as the activation function. The new algorithm of improved BPNN is calculated by computer programming. Write down the experimental outcome of the new algorithm, and compare and analyze the learning performance of the improved BPNN. Applying the new learning rate adaptive algorithm to learn BPNN, the error curve of the network is shown in Figure 5.

After five studies, it is obvious that the enhanced BPNN's error can be decreased to around 0.01. After that, after more than 40 times of iterative learning, the network can meet the requirement of error accuracy of 0.0001, and the error converges quickly. At the same time, the error curve is smooth, and there is no obvious jumping phenomenon. The learning step of the whole network is fast and stable, which shows that the algorithm in this subject has better representation than the traditional BPNN.

5. Piano Information Teaching Strategy Based on Deep Learning

5.1. Reform and Optimization of Piano Teaching Materials. The main content of piano lessons is derived from carefully chosen instructional materials. Judging from the various piano teaching materials in the current market, most of them are simple rewriting of traditional professional teaching materials, with a narrow vision of selecting songs, paying attention to skill training, and lacking the results of rational thinking. Based on this situation, it is necessary for our piano

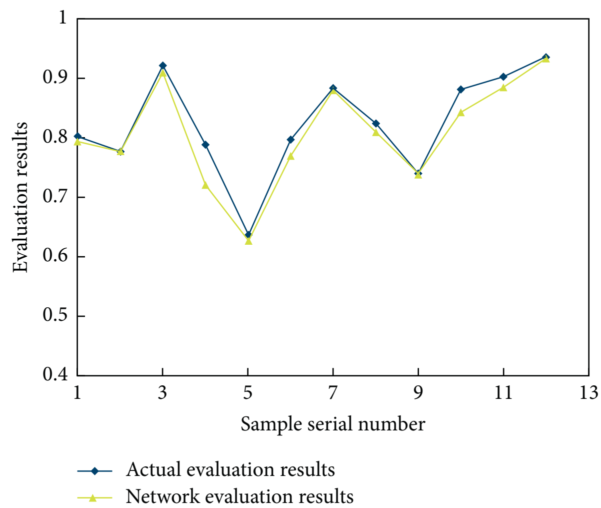

Figure 4: Comparison between actual evaluation results and simulation evaluation results.

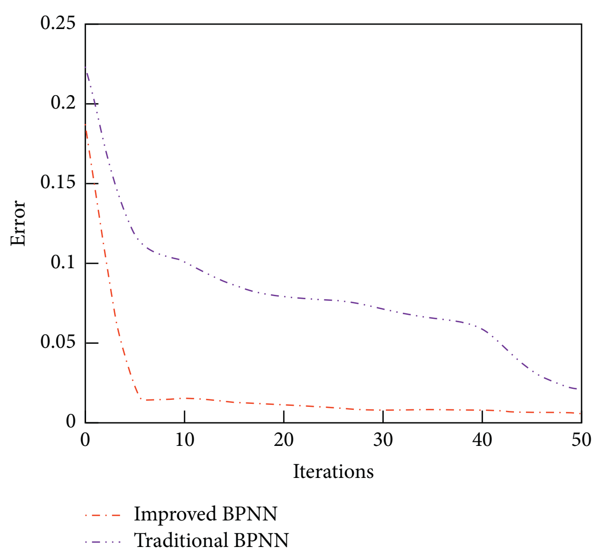

Figure 5: Comparison results of algorithm errors.

teachers to make efforts in the selection and optimization of teaching materials. You can contact them using a variety of methods, including e-mail, forums, and instant messaging applications, to gather the information you need to improve your piano instruction content. Especially at present, some colleges and universities advocate the use of self-made teaching materials. As piano teachers, they can compile teaching materials suitable for their own schools according to the characteristics of local students and the employment direction of students so as to continuously optimize the teaching content.

5.2. Applying Intelligent Piano Sparring System. The application and development of modern information technology can not only help learners complete the corresponding piano learning content but also combine the general rules of piano practice and apply modern information technology to develop an intelligent piano sparring system. The piano sparring machine, which is based on modern information technology, has a large music collection and can also separate the music according to the difficulty of different songs, making it easier for learners of various professional levels to study [21].

In addition, the piano sparring machine can also develop related software combined with intelligent mobile phone devices, including piano education software, which can correct the problems existing in the practice process, and at the same time, develop corresponding small games combined with piano practice needs to help beginners start learning piano better.

5.3. Reflection and Critical Thinking. DL's thinking expansion points to the promotion of higher-order thinking, which is a mental activity or cognitive ability at a higher cognitive level. In the process of DL, learners form an abstract thinking structure through scientific and rational criticism and logical analysis with the help of the normalization and integration of subject content, thus ensuring that the knowledge groups in students' minds are related, systematic, and logical.

The expansion of higher-order thinking is the basic goal of DL, and the realization of this goal requires students to have certain reflective ability and critical consciousness. Stimulate students' intrinsic motivation, strengthen students' reflective ability, and provide more opportunities to discover, raise, analyze, and solve problems from the perspective of discipline or discipline integration. This process requires students to reconstruct problem solutions on the basis of criticism and continuously cultivate students' higher-order thinking ability in the process of interweaving with curriculum content.

5.4. Introducing Multiple Evaluation System. The evaluation of students' DL and the evaluation of teachers' deep teaching can be combined into one. At present, the widely used quantitative assessment is a simple thinking mode of technical teaching management. In fact, teaching evaluation needs more generative evaluation based on teachers' classroom experience and wisdom [22]. The standard of this evaluation is not how many students are asked and how many questions are set, but whether the questions are open and beneficial to cultivate students' problem-solving ability, critical thinking ability, and innovative ability [23].

Students' internal motivation for DL originates from within, but external evaluation will also have an impact on their DL. As a result, in order to enhance students' DL, teachers should develop a pluralistic and acceptable grading method.

For example, in piano informatization, students are encouraged more and criticized less; do not take test scores as the main criterion to measure students; pay full attention to students' learning process; encourage students' different views and not evaluate students with fixed models and answers; let students reflect on their own learning process, carry out self-evaluation, and so on. In the informatization of piano, recording students' learning process in detail through students' electronic works and electronic portfolio can provide the basis for students to improve their learning and carry out deeper learning.

6. Conclusion

For piano teaching, modern information teaching means is essential. Piano teaching has become easier, and pupils' learning has been more targeted, thanks to modern information technology. DL evaluation model helps students to know their learning stages before and after learning activities. In this way, students can put forward more scientific and reasonable learning expectations; it can also help students to carry out learning activities that are more suitable for their own development so that they can build a systematic knowledge framework in the shortest time. Therefore, the teaching evaluation in in-depth teaching should be based on the promotion of students' development and run through the whole teaching process. Appropriate evaluation methods should be selected according to specific situations. The evaluation model of piano information teaching quality in view of the BPNN algorithm put forward in this paper makes full use of the preponderances of BPNN, strengthens the evaluation of practical teaching links and teaching process management and the evaluation of overall teaching effect, and improves the effectiveness and pertinence of evaluation [24].

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that he has no conflicts of interest.

References

[1] S. Sun, "Evaluation of potential correlation of piano teaching using edge-enabled data and machine learning," *Mobile Information Systems*, vol. 2021, no. 5, pp. 1–11, 2021.

[2] W. Fu, "Random network calculation under the background of 5G network in remote piano music video teaching application," *Journal of Ambient Intelligence and Humanized Computing*, no. 5, pp. 1–15, 2021.

[3] Y. Xie, "Research on piano singing teaching in preschool education," *Advances in Higher Education*, vol. 3, no. 2, p. 155, 2019.

[4] Q. Zhu, "Reconstruction of college piano teaching model from the perspective of "Internet+"," *Region - Educational Research and Reviews*, vol. 3, no. 2, p. 40, 2021.

[5] S. Chen and X. Chen, "The construction of internet + piano intelligent network teaching system model," *Journal of Intelligent and Fuzzy Systems*, vol. 37, no. 89, pp. 5819–5827, 2019.

[6] L. Hamond, E. Himonides, and G. Welch, "The nature of feedback in higher education studio-based piano learning and teaching with the use of digital technology," *Orfeu*, vol. 6, no. 1, pp. 1–31, 2021.

[7] P. Chen, "Hotel management evaluation index system based on data mining and deep neural network," *Wireless Communications and Mobile Computing*, vol. 2021, no. 1, pp. 1–11, Article ID 2955756, 2021.

[8] Z. Chen, "Using big data fuzzy K-means clustering and information fusion algorithm in English teaching ability evaluation," *Complexity*, vol. 2021, no. 5, pp. 1–9, 2021.

[9] Y. Jiang, "How to interpret a piano work--research processing and teaching guidance of new works," *Literature & Art Studies*, English Version, vol. 009, no. 012, pp. 1339–1343, 2019.

[10] M. Liu and J. Huang, "Piano playing teaching system based on artificial intelligence – design and research," *Journal of Intelligent and Fuzzy Systems*, vol. 40, no. 1, pp. 1–9, 2020.

[11] T. Li, "Application of slack variable-optimized SVM on piano teaching reform," *Journal of Physics: Conference Series*, vol. 1941, no. 1, p. 012084, 2021.

[12] X. Deng, Y. Gu, F. Li, X. Liu, and G. Zeng, "Evaluation of teaching quality of computing method course based on improved BP neural network," *Journal of Physics: Conference Series*, vol. 1774, no. 1, p. 012026, 2021.

[13] L. Jiang and X. Wang, "Optimization of online teaching quality evaluation model based on hierarchical PSO-BP neural network," *Complexity*, vol. 2020, no. 7, pp. 1–12, 2020.

[14] Y. Liu and J. Zhou, "Teaching quality evaluation method based on principal component analysis and BP neural network model," *Journal of Geomatics*, vol. 044, no. 005, pp. 107–109, 2019.

[15] H. F. Guo, Y. U. Ping, L. I. Zhi, L. I. Ju-Li, H. E. Shao-Hua, and W. L. Zhang, "The application of artificial neural network in the evaluation of undergraduate teaching Quality," *Education forum*, vol. 000, no. 005, pp. 213–215, 2019.

[16] B. Yan, H.-P. Yao, M. Nakamura, Z.-F. Li, and D. Wang, "A case study for software quality evaluation based on SCT model with BP neural network," *IEEE Access*, vol. 8, pp. 56403–56414, 2020.

[17] S. Wang, J. Jiang, and X. Lu, "Study on the classification of pulse signal based on the BP neural network," *Journal of Biosciences and Medicines*, vol. 08, no. 5, pp. 104–112, 2020.

[18] X. Yang, J. J. Zhou, and D. Q. Wen, "An optimized BP neural network model for teaching management evaluation," *Journal of Intelligent and Fuzzy Systems*, vol. 40, no. 3, pp. 1–7, 2020.

[19] Y. Luo, X. Zhao, and Y. Qiu, "Evaluation model of art internal auxiliary teaching quality based on artificial intelligence under the influence of COVID-19," *Journal of Intelligent and Fuzzy Systems*, vol. 39, no. 6, pp. 8713–8721, 2020.

[20] Y. You, Li. Liu, and S. Liu, “Application of entropy weight fuzzy comprehensive evaluation to evaluation of teaching quality of college teachers,” *Journal of Ningxia Normal University*, vol. 040, no. 004, pp. 81–86, 2019.
[21] J. Hou, “Online teaching quality evaluation model based on support vector machine and decision tree,” *Journal of Intelligent and Fuzzy Systems*, vol. 40, no. 2, pp. 2193–2203, 2021.
[22] T. Rao, “Analysis on the ideological and political construction of colleges piano teaching in the new era,” *Region - Educational Research and Reviews*, vol. 2, no. 4, pp. 20–24, 2020.
[23] D.. Teaching, “Method of keyboard harmony and piano arrangement,” *China music education*, vol. 000, no. 006, pp. 35–40, 2019.
[24] H. He, H. Yan, and W. Liu, “Intelligent teaching ability of contemporary college talents based on BP neural network and fuzzy mathematical model,” *Journal of Intelligent and Fuzzy Systems*, vol. 39, no. 9, pp. 1–11, 2020.