Hindawi

Research Article

Evaluation Method of Music Teaching Effect Based on Fusion of Deep Neural Network under the Background of Big Data

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Music is an art course that is different from traditional subjects. It not only needs to teach basic music knowledge but also needs to show the timbre contained in music itself, the form of music creation, or the effects expressed by music. The teaching effect evaluation model for traditional subjects can no longer be applied to the teaching effect evaluation of music subjects. If the traditional subject teaching effect evaluation model is used to evaluate the music subject teaching effect, it will easily lead to the inaccuracy of the effect evaluation. Because there is a strong subjectivity in the evaluation of the teaching effect of music subjects, this study combines deep neural network technology to study the feasibility and accuracy of the convolutional neural network (CNN) and long short-term memory neural network (LSTM) method in the evaluation of music teaching effects. It mainly reflects the evaluation under the three characteristics of music basic knowledge, music expression effect, and music innovation effect. The research results show that the CNN and LSTM methods can better extract the three features in the evaluation of music teaching effect, and the maximum prediction error is only 2.23%. Hybrid CNN-LSTM with LSTM neural network has higher accuracy in predicting music teaching effect than single neural network technique. The linear correlation coefficients also all exceeded 0.955.

1. Introduction

Music is a relatively traditional art form that has undergone great changes over time. The art of music is mainly reflected in the timbre, loudness, and the artistic culture it conveys [1, 2]. This leads to a big difference between the teaching method of music and the teaching of traditional subjects. The teaching of traditional subjects can be displayed in the form of textbooks and PPT. It only needs to memorize the basic knowledge and the key methods of doing questions. However, music teaching is not only the memory of basic knowledge, nor is it limited to the memory of knowledge. Different students have different comprehension abilities, which can result in different musical experiences. Therefore, the teaching of music subjects is different from the teaching of traditional subjects, it is more complex than the teaching of traditional subjects [3, 4]. Likewise, the teaching of music subjects cannot simply be evaluated by means of examination papers, so it does not only involve the basic knowledge of music. The teaching of music subjects may

require evaluation of instruments and timbres for effect evaluation. If it uses manual methods to evaluate the effect of music teaching, it will easily lead to the inaccuracy of the evaluation of the teaching effect. It may have a strong subjective factor in it. Because different people experience music differently. For the evaluation of the teaching effect of traditional subjects, it only needs the form of test papers or questionnaires to carry out the evaluation. Because the traditional discipline has a strong objective nature, it does not have a strong subjective nature like the music discipline. Therefore, in order to truly and effectively evaluate the teaching effect of music, an objective evaluation method is needed. The evaluation of music teaching effect mainly includes students' learning effect and students' evaluation [5]. The learning effect of students mainly includes the mastery of the basic knowledge of music, the expression of music, and the innovative effect of music [6, 7]. The students' mastery of the basic knowledge of music can be evaluated through the form of test papers or questionnaires, which is an objective effect evaluation mode. But the expressive effect

of music and the innovative effect of music are a relatively subjective form. Different evaluators have different understandings of music, which can easily lead to inaccuracy in the evaluation of music teaching effects. Finding a suitable evaluation model of music teaching effect is also the key to the success of music teaching.

Big data technology has been successfully applied in many fields of people's production and life. The application of big data technology in the effect evaluation of music teaching is also a new challenge [8, 9]. If big data technology can better guide the evaluation of music teaching effect, it will also promote the innovation and development of music discipline. The main advantage of big data technology is that it can process a large amount of complex data, whether the amount of data is huge or the data itself contain relatively complex relationships. From a big data perspective, the characteristics of any research object can be transformed into a form of data. There will be complex relationships between data with different characteristics, and these complex relationships may have relatively strong correlations or weak correlations [10, 11]. However, big data technology will map and suggest the relationship between these complex data. Since the development of big data, it already has a variety of different algorithms, which can deal with spatially related features, such as image recognition and face recognition [12]. Big data technology also includes algorithms for processing temporal features, which can better handle the temporal correlation between data. For example, it can have better applications in language recognition. It can also better deal with the characteristics related to the environment [13]. For example, reinforcement learning can achieve the correlation between the research object and the environment through reward and punishment measures [14]. In short, big data technology has been well applied in all aspects of life. Deep neural network is also a big data technology that has developed rapidly in recent years. It realizes the mapping of complex nonlinear relationships through the distribution of weights and biases. In the context of the rapid improvement of computer computing power, deep neural network technology can build deeper networks. This means that deep neural networks can handle more complex nonlinear relationships.

If the deep neural network is applied in the process of music teaching effect evaluation, it can extract the characteristics of music teaching evaluation indicators, and it can also complete the nonlinear relationship mapping between music evaluation indicators and music features. This relational mapping is based on many datasets, and it has certain commonalities. This method of evaluating the effect of music teaching is not only based on one kind of music teaching effect. This method is more objective. Deep neural network can effectively extract the characteristics of music basic knowledge, music expression effect, and music innovation effect in the process of music teaching.

This study uses deep neural network technology to study its feasibility and accuracy in the evaluation of music teaching effects. It mainly uses convolutional neural network (CNN) to extract three characteristic factors of music basic knowledge, music expression effect, and music innovation

effect of music teaching. This research is mainly divided into 5 chapters. The problems existing in the evaluation of music teaching effect and the significance of the development of big data technology are introduced in Section 1. The current state of research in music teaching is investigated in Section 2. Section 3 mainly introduces the application design of deep neural network technology in music teaching effect evaluation and it also analyzes the working principle of deep neural network technology. Section 4 mainly introduces the feasibility and accuracy of the deep neural network method in the evaluation of music teaching effect. It mainly introduces the basic knowledge of music teaching, the effect of music expression, and the effect of music innovation. In Section 4, the author introduces the feasibility and accuracy of deep neural network techniques using the average error, music feature prediction box map, and music feature prediction linear correlation coefficient. Section 5 summarizes the full text.

2. Related Work

Music will develop differently in different periods of social development, and it is an important artistic feature that reflects people's production and life. The evaluation of music teaching effect is different from the teaching evaluation mode of traditional subjects. A number of researchers have presented research on teaching models of music. Chen [15] also found that the assessment of music teaching in universities and conservatories is an important part. It has analyzed the feasibility of deep learning methods and neural network methods in the evaluation of music teaching effects. It designs a compensating fuzzy neural network algorithm to study the feasibility of its application in music teaching effect evaluation. And it has verified the feasibility of the model in the actual music teaching practice. The research results show that the fuzzy compensation neural network algorithm has certain feasibility in the evaluation of music teaching effect, which has certain guiding significance for the evaluation of music teaching. Begic et al., [16] has also found that the evaluation and grading of music teaching effects are important links in music education. The evaluation of these music effects mainly includes music listening, music expression, and music learning. It surveyed many elementary school music teachers as well as music students. It found that listening to music and musical expression was the more common assessment model for music teaching in primary schools. He also pointed to student location and gender as important predictors in music teaching assessments. More teachers prefer to assess students' music teaching in the classroom, which is usually carried out by means of oral assessment. Liu [17] believed that improving the tracking and evaluation of students' learning quality of music is conducive to improving the quality of music teaching. It uses the Internet of Things technology and big data technology to design and develop a music teaching quality management system. In this way, the learning quality of students and teachers can be efficiently tracked and designed. This teaching management mode can realize the processing and storage of cloud data, which can solve the difficulties caused

by regional differences. The research results show that this teaching management mode is helpful to improve teaching quality and resource utilization, which is also a valuable teaching system for music teaching management. Espigares et al., [18] used the automatic data processing program to process and study the relevant data in music teaching. It utilizes a telematics platform as a platform for information delivery. It collects a lot of data from the music examination process of students at various schools in Spain, and it analyzes the knowledge of the musical characteristics that exist between these data using a data automation program. It then utilizes Internet technology and telematics platforms to transmit and remotely process these data. The results show that the method proposed in this study is innovative in dealing with assessment tasks in music teaching. Tejada and Morel, [19] focused on teachers and students in Spanish music universities, and it studies the assessment scheme of music teaching using information and communication technology. The main goal of this research is to improve the teaching and music technology of music teachers. It builds an integrated framework of technical teaching content. This research has been well received and highly regarded by the Conservatory of Music. This research has more guiding significance for the evaluation of music teaching. Zhe [20] combined computer technology and teaching expert system to develop an intelligent guided learning system. It can make learning less dependent on teachers, and it can improve learning autonomy. It used the intelligent guided learning system to study the teaching content and learning methods of music sight-singing subjects. It can guide students to complete the study of sight-singing subjects, and then better master the art of music knowledge. The results of the study found that the scoring recommendation system based on difficulty characteristics is the core part of resource recommendation in music teaching. Through the above literature review, it can be found that many researchers have done a lot of research on the effect of music teaching, most of them use questionnaires combined with computer processing of data. Few studies have used deep neural network techniques to process these data. This study uses deep neural network technology to extract relevant spatial and temporal features in the evaluation of music teaching effects. This study mainly adopts CNN and LSTM methods, which are different and innovative from other studies. Once the deep neural network technology designed in this study is trained, it can quickly and accurately display the characteristics of music to students, which can improve the efficiency of music classrooms.

3. Application of Deep Neural Network in Music Teaching Effect Evaluation

3.1. The Significance of Deep Neural Network Applications. This research mainly uses CNN and LSTM technology in deep neural network technology to extract relevant features in music teaching effect evaluation, these features will include spatial features and temporal features. This deep neural network technology will use the nonlinear correlation in the evaluation of music teaching effect for analysis, which
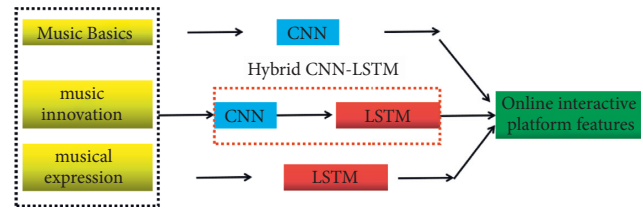

Figure 1: Scheme design of deep neural network technology in music teaching effect evaluation.

will demonstrate a certain objectivity. This will help reduce the human factor in the process of evaluating the effectiveness of music teaching. The important features in the evaluation of music teaching effect vary from person to person, so the traditional teaching evaluation model is no longer suitable for the evaluation task of music teaching effect. Deep neural networks can use a large amount of prior knowledge to evaluate unknown music teaching effects. In a word, deep neural network technology can not only help people to solve the large amount of data in the process of music teaching effect evaluation but can also map the nonlinear relationship between the relevant characteristics of music teaching effect evaluation and the evaluation level. This method only needs to collect a large amount of data for music teaching effect evaluation, and then it can use deep neural network technology to learn and test.

3.2. Design Scheme of Deep Neural Network in Music Teaching Evaluation. This research will combine the actual characteristics of music teaching effect evaluation and the advantages of deep neural network technology to design an intelligent evaluation scheme for music teaching effect evaluation. Once this kind of training is completed, it only needs to provide some relevant effect data in music teaching, and it can complete the evaluation and management of music teaching effect, which will be a fast way. At the same time, it has higher objectivity than traditional manual evaluation of music teaching effect [21]. Figure 1 shows an intelligent scheme for evaluating the effectiveness of music teaching using deep neural network technology [22]. For this scheme design, the most important thing is to collect some datasets with high accuracy. These datasets will contain data on three factors: the basic knowledge of music, the characteristics of music expression effects, and the characteristics of music innovation. These three feature data will go through the data preprocessing process before it can be input to the input layer of CNN. In the process of CNN neural network, these data will complete the extraction of spatial features using the convolution layer and pooling layer of CNN. Then, the output layer of the CNN will be converted into time series-like data. It will be input into the LSTM neural network to extract the temporal features of the music teaching effect. This is music. The expression of music has a strong correlation with time. After the LSTM neural network completes the temporal feature extraction, these data can be output. It saves the optimal weights and biases for testing. In the actual music teaching work, the teacher only provides the music-related knowledge to the deep neural network, and it

can efficiently display the characteristics of music innovation and music knowledge to the students or teachers using the computer-aided system.

The plan of music teaching effect evaluation mainly designs the three characteristics of music basic knowledge, music expression effect, and music creation effect of music teaching effect. There is a complex spatial correlation between these features and the music effect evaluation level. CNN is mainly used to extract the spatial correlation of these three features. CNN has been widely used in many fields related to image recognition, which is also a relatively mature algorithm for spatial feature extraction. Figure 2 shows the workflow of CNN for feature extraction of music teaching effect. Similar to the methods applied in other fields, CNN also mainly uses convolutional layers, pooling layers, and activation functions to complete the extraction of features related to the effect of music teaching. CNN also has a basic perceptron structure, which is a variant of the fully connected neural network. Matrix operations are performed between each factor of the fully connected neural network, which increases the parameter budget. This also leads to excessive waste of computing resources. The CNN method can use the roughness of weight sharing to reduce the amount of computation between parameters. This can reduce the utilization of computing resources, which in turn can build a deeper network structure to extract features with deeper characteristics of music teaching effects.

During the iteration and training of the CNN, the researchers will adjust the gradient descent direction of the weights and biases by adjusting the hyperparameters. Although the impact of hyperparameters on accuracy and convergence performance is relatively small relative to the dataset, however, the choice of hyperparameters is also a more critical link. Equation (1) shows the relation satisfied by the hyperparameters.

$$w' = \frac{(w + 2p - k)}{s} + 1. \tag{1}$$

Equation (2) shows the calculation method of the CNN input layer, which is one calculation method for each convolution operation. Where W and X are data in matrix form. The input data X will complete the feature extraction task through the convolution operation.

$$V = \text{conv2}\left(W, X'', \text{valis}''\right) + b. \tag{2}$$

Equation (3) shows the calculation method of the output layer of the CNN, which will perform nonlinear processing on the operations of the convolutional layer and the pooling layer, and then it can output the data.

$$Y = \phi(V). \tag{3}$$

Equation (4) shows the derivation of weights and biases in each layer of the network. Weights and biases are factors that memorize nonlinear relationships. The derivative operation is a way to find the optimal gradient descent direction. During the operation of CNN, it will involve chain derivation operations.
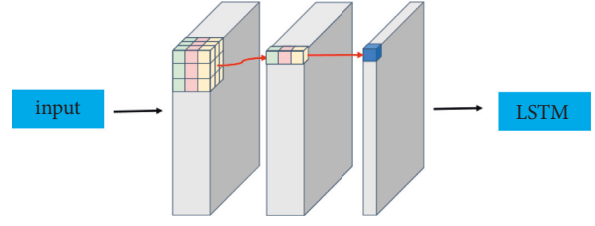

Figure 2: The workflow of CNN in extracting spatial features of music teaching effect.

$$E = \frac{1}{2}\sum_{k=1}^{m}\left[d_k - f\left(\text{netw}_k\right)\right]^2 = \frac{1}{2}\sum_{k=1}^{m}\left[d_k - f\left(\sum_{j=0}^{n}\omega_{jk}y_j\right)\right]^2$$

$$= \frac{1}{2}\sum_{k=1}^{m}\left[d_k - f\left[\left(\sum_{j=0}^{n}\omega_{jk}f\left(\sum_{j=0}^{q}u_{ij}\chi_i\right)\right)\right]\right]^2. \tag{4}$$

Equation (5) shows the method of value transfer during neural network computation. This is a recursive form of calculation. The rot180() function means to rotate the matrix 180° counterclockwise. The parameter fully represents the full convolution operation:

$$\delta^{l-1} = \text{conv2}\left(\text{rot180}\left(W^l\right), \delta^l, '\text{full}'\right)\phi'\left(v^{l-1}\right). \tag{5}$$

3.3. An Introduction to the Working Principle of the Related Algorithm.
LSTM neural network is used to extract temporal features in music teaching effect evaluation. The timbre expression and other features in the music teaching effect have temporal characteristics similar to speech recognition. If it is not conducive to the LSTM neural network to extract the temporal features of music teaching effects, it will lead to incomplete extraction of the features of music teaching effects. Figure 3 shows how the LSTM neural network works. In this study, the number of LSTM network layers is 5, which tries to extract the temporal features in the music teaching process as much as possible. The learning rate of the LSTM neural network is set to 0.001, which avoids falling into local minima during training.

The main reason that the LSTM method can memorize historical state information is because it has more gate structures, which can give weights to information at different times. The gate structure can selectively pass state information according to the size of the weight. Each gate structure restricts the passage of information. Equation (6) shows how the input gate is calculated. It will be responsible for selectively passing historical state information and current state information according to the weight.

$$f_t = \sigma\left(w_f \bullet [h_{t-1}, P_t] + b_f\right). \tag{6}$$

Equation (7) and (8) show how the forget gate is calculated. It will forget part of the historical information, and only part of the important historical state information will pass.
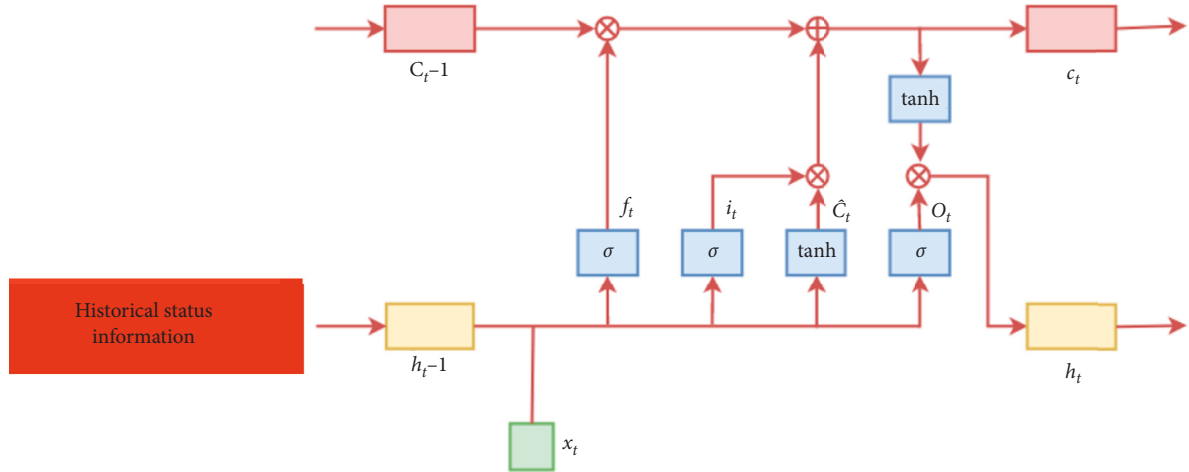
FIGURE 3: The working principle of LSTM in music teaching effect time feature extraction.

$$i_t = \sigma\left(\omega_i \bullet [h_{i-1}, P_t] + b_i\right), \tag{7}$$

$$\widetilde{C}_t = \tan h\left(w_c \bullet [h_{t-1}, P_t] + b_c\right). \tag{8}$$

Equation (9) shows the computation of the refresh gate, which is the task responsible for updating the weights during the LSTM iteration.

$$\overrightarrow{C}_t = f_t \times \overrightarrow{C}_{t-1} + i_t \times \overrightarrow{C}_t. \tag{9}$$

Equation (10) and (11) show how the output gate of the LSTM is calculated. It also selectively inputs historical and current state information to the next neural network layer according to the size of the weight.

$$O_t = \sigma\left(w_o \bullet \left[\overrightarrow{h}_{t-1}, P_t\right] + b_o\right), \tag{10}$$

$$\overrightarrow{h}_t = O_t \times \tan h\left(\overrightarrow{C}_t\right). \tag{11}$$

4. Result Analysis and Discussion

4.1. Comparative Analysis of Prediction Errors of Different Deep Neural Networks. This research will use single CNN, single LSTM, and hybrid CNN-LSTM methods to study the accuracy and feasibility of deep neural network technology in predicting the relevant features of music teaching effect evaluation. The dataset is the first task for which this study needs to be accurate. This study selected the characteristic data of music teaching effect evaluation related to many music colleges and universities in Beijing. As the economic and political center of China, Beijing is also rich in music teaching resources, which will have more characteristics related to music teaching. This is also the requirement of the dataset, which contains the characteristics of the research object as much as possible. These data mainly include the characteristics of basic knowledge of music, the special data of music expression effect, and the characteristic data of music innovation effect. This research will predict and

analyze the characteristic data of these three kinds of music teaching effects.

In order to illustrate the accuracy of the hybrid CNN-LSTM deep neural network in predicting the relevant features of music teaching effect evaluation, this study first analyzed the prediction error of a single CNN and a single LSTM neural network in predicting the characteristics of music teaching effect. Figure 4 shows the prediction errors of three features of a single CNN and a single LSTM neural network in predicting the effect of music teaching. In general, both neural network structures can meet the evaluation task of music teaching effect. Most forecast errors are within 3%. Although this error range is relatively large, it can also meet the task of evaluating the effect of music teaching. At the same time, it can also be found from Figure 4 that a single CNN method has a better prediction effect than a single LSTM structure. However, the prediction error of the characteristics of music innovation effect is relatively large, and the prediction error of the two neural networks exceeds 3%. The largest prediction error all reached 3.45%. This kind of error may have a certain deviation in the actual evaluation of music teaching effect.

The three characteristics of music teaching effect all have temporal characteristics similar to speech recognition. If only one feature extraction method is used, it is easy to lead to the incompleteness of feature extraction. It will further lead to the inaccuracy of the prediction effect for the prediction of music teaching effect evaluation. This study also organically integrates the spatial feature extraction method and the temporal feature extraction method to design a hybrid CNN-LSTM deep neural network method, which combines the advantages of the CNN and LSTM algorithms. Figure 5 shows the prediction errors of the three features of music teaching effect using the hybrid CNN-LSTM method. Overall, the prediction errors of the three features of the music teaching effect are significantly reduced compared to the single CNN and single LSTM methods. This further illustrates that the hybrid CNN-LSTM method has better feasibility and accuracy in the three feature tasks of predicting the effect of music teaching. It can also show that the
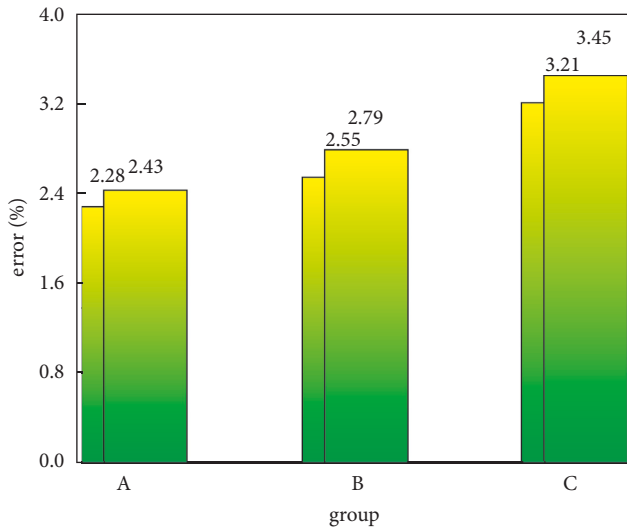
FIGURE 4: Prediction error of CNN and LSTM methods in predicting the characteristics of music teaching effect.

FIGURE 6: Prediction error distribution of music fundamentals features.
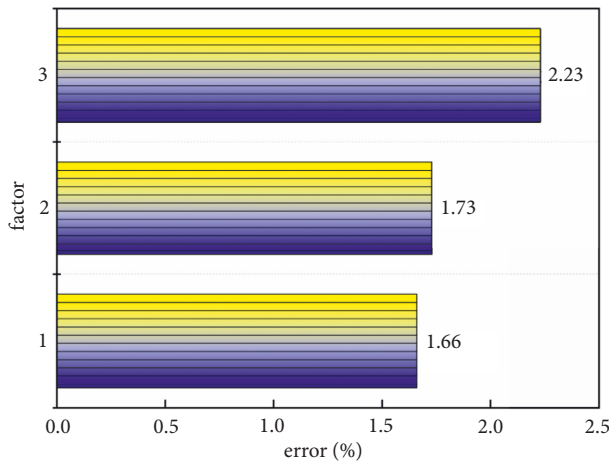

FIGURE 5: Prediction errors of three characteristics of music teaching effect using hybrid CNN-LSTM method.

three characteristics of music teaching effect evaluation have obvious temporal and spatial characteristics, and only using a neural network method to predict the characteristics of music teaching effect will cause certain inaccuracies. For the prediction error of the three characteristics of music teaching effect, the largest prediction error is only 2.23%. This part of the error comes from the prediction of music innovation effect. For the music emotion feature, the prediction error is only 1.73%. There is the smallest error in the characteristics of music knowledge. In the process of music teaching, this part of the error is only 1.66%. There are many fluctuations and mutations in the effect of music innovation, and the innovation effect among different students is inconsistent. It is not as easy to predict as music basics features.

4.2. Accuracy Analysis of the Hybrid CNN-LSTM Method in Predicting the Effect of Music Teaching. In this study, 30 groups of characteristic data related to the effect of music teaching were selected for accuracy analysis. Each music
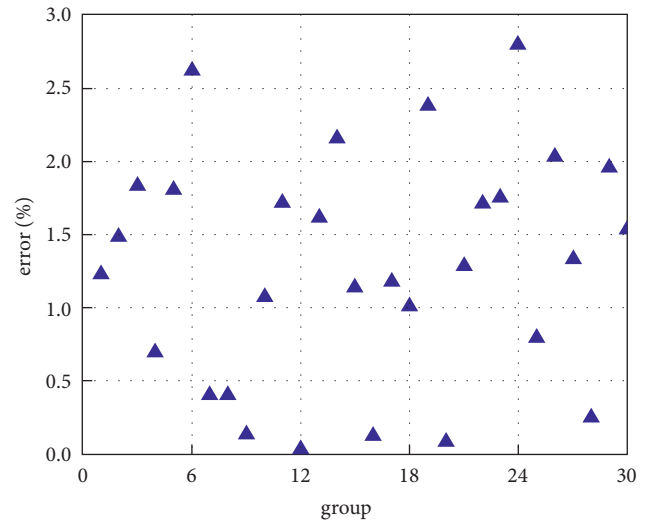
feature data will contain 30 sets of data. Figure 6 shows a scatter plot of the prediction error distribution of the music basics features in music teaching. Overall, the hybrid CNN-LSTM algorithm has high confidence in predicting music basic knowledge features. Most of the errors are mainly distributed within 2%, which is feasible for the evaluation of music teaching effect. Only a small fraction of forecast errors exceed 3%, which is an extremely small fraction of forecast errors. There is a small mutation in the characteristics of music basic knowledge in music teaching, and this part of the characteristics is almost unchanged for different music teaching. This leads to the fact that the characteristics of music basic knowledge are relatively easy to predict.

Among the three characteristics of music teaching effect involved in this study, the effect of music expression is also more difficult to predict. This is because the expressive effect of music is scored differently in different judging criteria. Figure 7 shows the distribution of the predicted linear correlation coefficients of the music expression effect characteristics of the music teaching effect. In Figure 7, in order to more accurately illustrate the effectiveness of the CNN-LSTM method in predicting the emotional features of music, it uses black lines to represent the 95% confidence interval. Most of the data points are distributed on both sides of the linear function y = x, and this part of the distance is also relatively close to the y = x function. This shows that the predicted value of the music expression effect has a similar distribution to the actual value, which can further illustrate the accuracy and feasibility of the hybrid CNN-LSTM method in predicting the music expression effect. The linear correlation coefficient exceeding 0.95 indicates that the hybrid CNN-LSTM algorithm has certain feasibility. In this study, the linear correlation coefficients all exceed 0.955, which shows that the hybrid CNN-LSTM method has high feasibility in predicting the musical expression effect of music teaching effects.

Figure 8 shows the distribution of the predicted and actual values of the music innovation features in the music teaching effect. The blue dots represent the actual values of
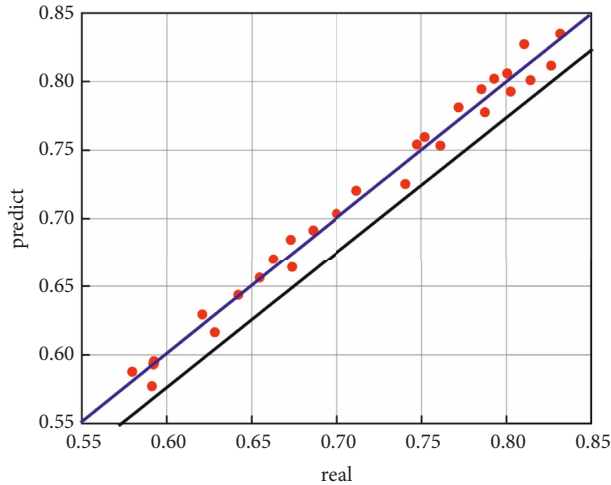
FIGURE 7: Predictive linear correlation coefficients of musical expression effect features.
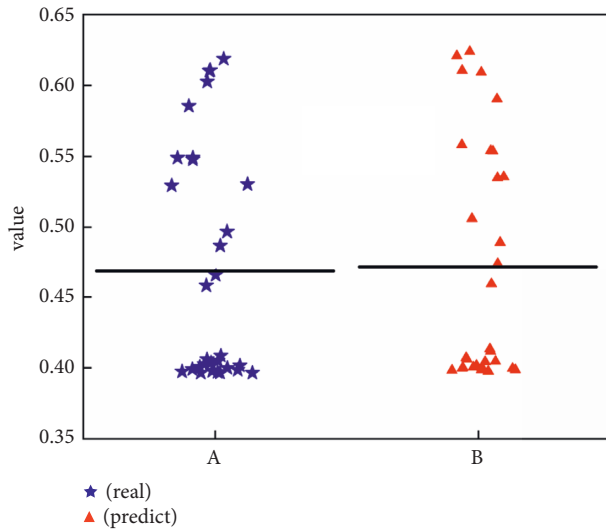

FIGURE 8: Numerical distribution of predicted cabinets for musical innovation effect characteristics.

FIGURE 9: Predictive distribution curve of musical innovation effect characteristics.

the musical innovation features, while the red ones represent the predicted values of the musical innovation features. In Figure 8, the black line represents the average distribution of the music innovation effect of music teaching. For the actual value and the predicted value, it can more accurately reflect the overall situation of the music innovation characteristics. There are relatively large differences in the characteristics of music innovation in music teaching. For different music types, this will be reflected in the relatively large differences in eigenvalues. In general, the predicted value of the musical innovation feature is consistent with the actual value and distribution. This illustrates the feasibility of the hybrid CNN-LSTM algorithm in predicting musical innovation features. Although the music innovation feature is the most difficult to predict the music teaching effect feature, it can also be seen from Figure 8 that the prediction effect can satisfy the prediction task of the music innovation feature of the
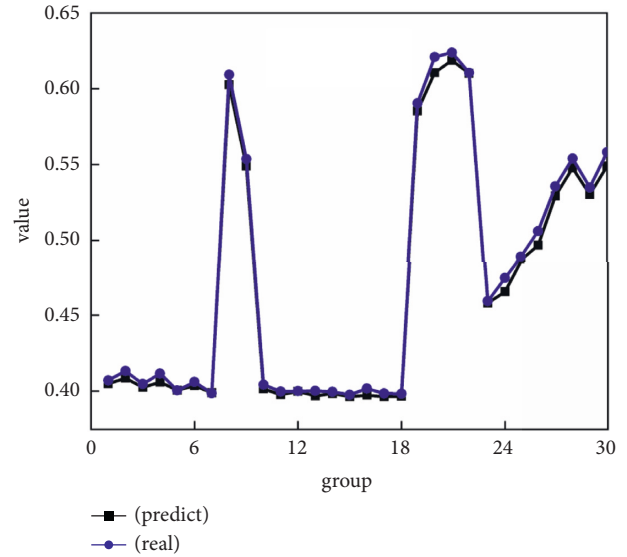
music teaching effect. Figure 9 shows the distribution curve of the predicted value of the music innovation feature. It can be seen from the distribution of the curve that although there are relatively large fluctuations in the values of musical innovation characteristics, there are also many peaks and troughs. However, the hybrid CNN-LSTM can better capture the changing trends and numerical transformations of musical innovation features. Overall, the hybrid CNN-LSTM algorithm has achieved relatively satisfactory results. In Figure 9, the area between the blue line and the black line represents the prediction error of the music innovation feature of music teaching. It can be seen that the area of this part is relatively small for different groups.

5. Conclusions

The teaching effect of traditional subjects will be evaluated by means of examination papers or questionnaires. However, the evaluation of the teaching effect of music subjects contains more subjectivity, which makes it difficult to use the teaching evaluation mode of traditional subjects to evaluate the effect of music teaching. It is also difficult to analyze the music expression effect and music innovation effect of the teaching effect of music subject in a quantitative way, which means that the traditional teaching effect evaluation model is no longer suitable for the evaluation of music teaching effect. The deep neural network method can effectively extract the relevant features of music teaching that people cannot extract, which can establish the mapping relationship between features and time in music teaching. It can quickly help students to find suitable music information.

This study compared the feasibility and accuracy of CNN, LSTM and hybrid CNN-LSTM deep neural network techniques in the evaluation of music teaching effects. The single CNN method has higher accuracy than the single LSTM neural network method in predicting the three characteristics of music teaching effect. However, the

prediction error of these two neural network methods in predicting the music innovation effect of music teaching effect is more than 3%, which is unfavorable for the actual music teaching effect evaluation task. The prediction error of the hybrid CNN-LSTM method in predicting the three characteristics of the music teaching effect is significantly reduced, which shows the reliability and accuracy of the hybrid CNN-LSTM method in evaluating the music teaching effect. The largest prediction error is only 2.23%, which is also derived from the prediction of the effect of music innovation. The CNN method can extract the features of music teaching work, but it cannot effectively memorize the temporal relationship of music teaching features, so it cannot establish the temporal correlation in the process of music teaching. The prediction errors for the characteristics of music basic knowledge and music expression effect are both within 2%. The application of deep neural network technology in music teaching can help music learners quickly find interesting music knowledge, and it can also accurately predict relevant music teaching characteristics. This can increase student motivation.

Data Availability

The data used to support the findings of this study can be obtained from the author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] D. A. Rickels, E. C. Hoffman, and W. E. Fredrickson, "A comparative analysis of influences on choosing a music teaching occupation," *Journal of Research in Music Education*, vol. 67, no. 3, pp. 286–303, 2019.

[2] D. Wang and X. Guo, "Research on intelligent recognition and classification algorithm of music emotion in complex system of music performance," *Complexity*, vol. 2021, no. 6, Article ID 4251827, pp. 1–10, 2021.

[3] J. Nam, K. Choi, J. Lee, S. Y. Chou, and Y. H. Yang, "Deep learning for audio-based music classification and tagging: teaching computers to distinguish rock from bach," *IEEE Signal Processing Magazine*, vol. 36, no. 1, pp. 41–51, 2019.

[4] S. Cronenberg, "Teaching general music to young adolescents: findings from a survey of music teacher perspectives," *International Journal of Music Education*, vol. 37, no. 1, pp. 43–58, 2019.

[5] K. Salvador, "Assessment and individualized instruction in elementary general music: a case study," *Research Studies in Music Education*, vol. 41, no. 1, pp. 18–42, 2019.

[6] N. Khamrong, "A study of music teaching of private music school, muang district, phayao province Thailand," *International journal of early childhood special education*, vol. 14, no. 1, pp. 1717–1725, 2022.

[7] A. Begic and J. Begic, "Relationship between sociodemographic variables and attitudes of music teachers toward intercultural education[J]," *Nova Prisutnost*, vol. 16, no. 2, pp. 247–260, 2018.

[8] A. Alarifi, A. Tolba, Z. Al-Makhadmeh, and W. Said, "A big data approach to sentiment analysis using greedy feature selection with cat swarm optimization-based long short-term memory neural networks," *The Journal of Supercomputing*, vol. 76, no. 6, pp. 4414–4429, 2020.

[9] M. S. Parwez, D. B. Rawat, and M. Garuba, "Big data analytics for user-activity analysis and user-anomaly detection in mobile wireless network," *IEEE Transactions on Industrial Informatics*, vol. 13, no. 4, pp. 2058–2065, 2017.

[10] J. W. Chan, V. Kearney, S. Haaf et al., "A convolutional neural network algorithm for automatic segmentation of head and neck organs at risk using deep lifelong learning," *Medical Physics*, vol. 46, no. 5, pp. 2204–2213, 2019.

[11] Y. ., M. Chen, Y. J. Chen, W. H. Ho, and J. T. Tsai, "Classifying chest CT images as COVID-19 positive/negative using a convolutional neural network ensemble model and uniform experimental design method," *BMC Bioinformatics*, vol. 22, no. S5, p. 147, 2021.

[12] A. Sherstinsky, "Fundamentals of recurrent neural network (RNN) and long short-term memory (LSTM) network," *Physica D: Nonlinear Phenomena*, vol. 404, no. 5, Article ID 132306, 2020.

[13] J. M. Frame, F. Kratzert, A. Raney, M. Rahman, F. R. Salas, and G. S. Nearing, "Post-processing the national water model with long short-term memory networks for streamflow predictions and model diagnostics," *JAWRA Journal of the American Water Resources Association*, vol. 57, no. 6, pp. 885–905, 2021.

[14] X. Zhao, S. Ding, Y. An, and W. Jia, "Asynchronous reinforcement learning algorithms for solving discrete space path planning problems," *Applied Intelligence*, vol. 48, no. 12, pp. 4889–4904, 2018.

[15] X. Chen, "Compensated fuzzy neural network-based music teaching ability assessment model," *Computational Intelligence and Neuroscience*, vol. 2021, no. 1, Article ID 4251827, pp. 1–11, 2021.

[16] A. Begic, J. Begic, and V. Smitpeter, "Attitudes of students and teachers on evaluation and grading in the teaching of music culture," *Metodicki ogledi-methodical review*, vol. 26, no. 2, pp. 77–101, 2019.

[17] W. Liu, "Integrating data mining with internet of things to build the music project management system," *Journal of Ambient Intelligence and Humanized Computing*, vol. 8, no. 7, Article ID 02237, 2020.

[18] M. J. Espigares-Pinazo, J. M. Bautista-Vallejo, and M. Garcia-Carmona, "Evaluations in the moodle-mediated music teaching-learning environment," *Technology, Knowledge and Learning*, vol. 27, no. 1, pp. 17–31, 2020.

[19] J. Tejada and T. T. Morel, "Design and validation of a music technology course for initial music teacher education based on the TPACK framework and the project-based learning approach," *Journal of Music, Technology & Education*, vol. 12, no. 3, pp. 225–246, 2019.

[20] T. Zhe, "Research on the model of music sight-singing guidance system based on artificial intelligence," *Complexity*, vol. 2021, no. 7, Article ID 3332216, pp. 1–11, 2021.

[21] S. Laato, T. Laine, and E. Sutinen, "Affordances of music composing software for learning mathematics at primary schools," *Research in Learning Technology*, vol. 27, no. 0, 2019.

[22] Y. Su, J. Tian, and X. Zan, "The research of Chinese martial arts cross-media communication system based on deep neural network," *Computational Intelligence and Neuroscience*, vol. 2022, no. 28, Article ID 2835992, 2022.