Evaluation Method of Vocal Music Teaching Effect based on Computer-Aided Technology and BP Neural Network

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Abstract. There are many evaluation methods for the quality of vocal music classroom teaching. The evaluation of vocal music teacher's teaching effect needs to be evaluated from multiple angles. Whether students score for teachers, or the evaluation of the supervision group, the evaluation given is with some subjective factors. Therefore, it is particularly important to establish objective evaluation method of vocal music teaching effect. In this paper, based on the analysis of the traditional evaluation methods and the reasonable establishment of the evaluation system, the objective of each evaluation index, using the comprehensive evaluation vector as the input, through BP neural network output to get a reasonable score. It not only solves the problem of qualitative index and quantitative index in the comprehensive evaluation index system, but also effectively overcomes the problem of establishing complex mathematical model and mathematical analytical expression in the traditional evaluation process, and avoids artificial subjective arbitrariness, making the evaluation more accurate and effective. The simulation results show that the trained BP back propagation network can simulate a stable evaluation system.

Keywords: BP neural network; Teaching effect evaluation; Computer aided
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1 INTRODUCTION

Higher education quality problem is hot spots in recent years. Every year, dozens of colleges and universities considers the teaching quality as a hot research topic. In colleges and universities, classroom teaching is still the main channel to implement education, and its quality turns to a large extent. Therefore, improving the quality of classroom teaching has become the top priority. Classroom teaching includes many factors, which interact with each other and form a teaching effect network. Among them, Ynag et al. [1] think teachers' classroom teaching is the most important link, which determines the level of talent training and affects the life quality. Therefore, the construction of scientific, systematic and great significance to improve the evaluation, expand the management theory of teachers.

In the previous published paper, it was only through simple processing of teaching indicators, such as calculating the average value or artificially giving the weight of each indicator to weight and sum, and the evaluation results were very subjective. Deng et al. [2] consider the model of teaching quality evaluation system is established by using BP neural network, and the teaching evaluation index is obtained through investigation and analysis. The scalar of the evaluation index is converted into the determined data as its input, the BP neural network training is taken as the actual output, and the teaching effect obtained before is taken as the expected output. Wang e al. [3] think compare the error between expected output and actual output. When the error reaches the minimum expected value, the training is considered successful. After successful training, more accurate weights and thresholds can be obtained, and another set of newly obtained teaching evaluation indicators can be processed with the network after successful training, and the teaching quality evaluation results can be obtained. This method is widely applicable.

Farha et al. [4] think in the competition of vocal music teaching and selection of artistic talents, it is very important to make an objective and fair evaluation of the singer's singing, and usually the method of scoring the average value is used to quantify the evaluation result. Because the subjective evaluation of singing involves people's feelings and thinking, it is difficult to be described by clear numbers or curves, so the seemingly precise score cannot accurately describe the specific level or the state of the evaluated singing object. Le et al. [5] consider there are many factors affecting the singing effect, and the degree of influence of each factor is also different. The traditional grading method uses a simple linear classification mathematical analytical expression, which ignores the nonlinear relationship between the evaluation index and the performance, and the result is very subjective, and cannot reflect the singer's level well and truly. Artificial neural network has the ability to approximate any nonlinear function, and its network itself is a dynamic system identification model, so using neural network for evaluation will make the results more objective.

The difficulty of classroom teaching quality evaluation lies in the design of evaluation indicators and the processing of quantitative process, especially the quantitative problem. If the quantitative method is not scientific, the reliability of evaluation results will be poor. At present, the common evaluation methods are as follows:

(1) Weighted average method

Weighted average method is the school teaching management departments to make evaluation of each index, and according to the importance of every index to set the weight of each index, issuing questionnaires, let evaluators selves are given scores of each index, and then weighted sum score, to judge their selves with scores of the advantages and disadvantages of teaching quality.

Figure 1: BP neural network.

Although the calculation process of weighted average method is relatively simple, this method artificially assigns according to experience. Obviously, it cannot prove whether each evaluation factor has linear additivity, nor can it prove the rationality of weight [6,7].

(2) Analytic hierarchy process

The hierarchical will be decomposed into an orderly level, and then invite experts to each level of factors for a more objective judgment, corresponding to the relative importance of quantitative expression; Then, a mathematical model is established to calculate the relative importance weights of all factors at each level and rank them. Finally, according to the ranking results, planning decisions and solving measures are selected. AHP can be used to get the weight. THE AHP model cannot answer this question.

(3) Fuzzy comprehensive evaluation method

Fuzzy mathematics, founded by American cybernetics expert L.A. Zeh in 1965, is a kind of mathematics that studies and deals with fuzzy phenomena. Fuzzy comprehensive evaluation method is a method to draw the evaluation conclusion of teacher's classroom teaching quality by using fuzzy mathematics method and fuzzy mathematics comprehensive evaluation model. Fuzzy comprehensive evaluation method can be used to evaluate the value level or mutual priority relationship of the evaluated object [8,9].

In recent years, with the continuous research on deep learning, many problems in daily life can be solved by using artificial intelligence. One of the characteristics of deep learning is that programmers no longer need to write programs to complete the program as in the past. They only need to build a neural network in advance, imitate human brain thinking by artificial means, and match enough data to simulate and train the machine itself, so that the machine can discover data rules and learn them by itself. At present, AI industry is very common, we can see the shadow of ARTIFICIAL intelligence in all walks of life. With the help of neural networks, the AI industry can create entirely new technologies that liberate the human brain to perform multiple tasks on its own. To sum up, artificial intelligence can be defined as the study of human intellectual activities, that is, with the help of hardware and software, let the computer simulate such activities, so as to realize the computer can complete by itself the work that the human brain can do in the past.

Generally speaking, deep neural network model can constitute deep learning model. However, the network structure of deep learning model is generally complex and the number of parameters is often large. Therefore, in order to make the model have better performance, people generally rely on the corresponding manual annotated data to do the corresponding training, otherwise there may be over-fitting problems or training difficulties. However, in general, it is difficult to get enough data, so the data in some application fields are still missing seriously. For example, there are few rare minerals in the world and data on them are often difficult to collect. Another example: it is also relatively difficult for people to collect some relevant data about endangered treasured animals or plants. In addition, even if sufficient data can be obtained, the corresponding manual annotation costs are often high during this period. Therefore, it is difficult for people to use enough data to train the corresponding neural network model, which seriously affects its performance and may lead to serious over-fitting problems of the model. Therefore, using less data to maximize the performance of models is a hot topic in the field of deep learning. Another problem worth paying attention to in this field is that even though deep neural network has completed the simulation training based on a large number of data samples, it still cannot apply the simulation results to other fields. For example, AlphaGo, Google's go robot, has beaten world masters in many games, but is weak in checkers. This is equivalent to artificial intelligence spending a lot of manpower, material and financial resources to conduct simulation training, but it is difficult to apply in cross-industry or just cross-project activities. As AI technology continues to improve, it is hoped that it will achieve capabilities comparable to those of the natural person. Ai can conduct training simulations of new things by observing only a small number of samples.

This paper takes vocal music evaluation system as input, uses BP neural network to build an evaluation model, and verifies that the evaluation results of the model are consistent with the reality through data testing.

BP neural network (as shown in Figure 1) can reduce the artificial influence factors in the traditional evaluation method of index weight determination, and has high accuracy. Hence in this paper, based on the analysis of the traditional evaluation methods and the reasonable establishment of the evaluation system, the objective of each evaluation index, using the comprehensive evaluation vector as the input, through BP neural network output to get a reasonable score [10].

2 BP NEURAL NETWORK

Since 1950, countries around the world began to compete to develop artificial intelligent machines. When programs have certain criteria and systems of judgment, they can be used to replace human resources in certain situations, that is, today we call AI (artificial intelligence) and cognitive computing. By 1980, after the definition of artificial intelligence was generally understood, the landmark attempt was aborted due to technological limitations. Today, with the rapid development of high and new technology, the continuous innovation of mechanical components, and the cutting-edge research of computer science, many new technologies can be integrated into a machine to achieve the replacement of hardware equipment. Due to the continuous innovation of computer technology and the integration of multi-disciplinary and multi-field technologies, we can see the application of deep learning everywhere in our daily life, such as face recognition and recommendation system.

Artificial intelligence is considered as a "knowledge discipline" due to its comprehensive disciplines, and is regarded as capable of realizing intelligent activities by machines instead of human beings due to its integration characteristics of advanced and sophisticated technologies, which also

represents the center and core ideas of related fields. That is, by studying the trajectory of human movement frame by frame, many commands are given to the machine, and even the knowledge system of the machine itself is cultivated to deal with some behaviors/businesses instead of human beings. Its research content is mainly to learn, knowledge theory and operation by imitating the conscious actions of human beings by controlling the machine through codes.

As the core of artificial intelligence discipline, machine learning is the basis of making computer intelligent. It has the interoperability and inclusiveness of disciplines, and can organically integrate various types of theories. Its main content lies in the use of algorithms, so that the machine has a certain simulation ability, can independently complete some of the previous only human can complete the behavior, the establishment of machinery's own knowledge structure and skill system, and its knowledge structure real-time update and improvement. As one of the most important technologies of artificial intelligence, it is the basis of realizing mechanical intelligence. Generally speaking, machine learning is mainly used to generalize and integrate information, which is then interpreted by artificial intelligence.

Deep learning is the most important algorithm in machine learning. This definition first appeared in 2006. Geoffrey et al. proposed the technology of dimensionality reduction of data with the help of neural networks, and published this achievement in the journal Science. The idea is one of the most important advances in artificial intelligence in the last decade, with breakthroughs in image and video analysis, audio recognition, natural language processing, computer hearing and multimedia. Models under the current category of neural networks teach computers to think and understand the world the way humans do. In 1940, the concept of neural networks, which study the formation of consciousness in the brain and simulate it to solve many types of machine learning problems, began to emerge. In 1986, Rumelhart et al. discovered that the back-propagation algorithm could be used in the training of neural networks. This famous discovery was published in Nature and has been widely used ever since.

Deep learning model is mainly composed of the depth of the neural network model, these models usually has a relatively complex network structure and the large number of parameters, often need to use a lot of artificial labeled training data, obtain good performance in the form of data driven, such as important in the field of computer vision database ImageNet, It has more than 10 million images. According to this characteristic, this paper intends to establish the model of teaching quality evaluation system, through the training of network.

Neural network refers to the multi-layer network system built by a large number of neurons, which uses the activation layer to endow the model with powerful nonlinear fitting ability. The model will learn to extract image features and map the results according to the images input by the designer and the required results. Deep learning can accomplish a lot of work, designers only need to complete the difficult feature extraction work. Designers need to set up network results to improve the efficiency and accuracy of automatic extraction. The core of neural network is based on the combination of matrix multiplication and nonlinearity, through a large number of filtering cores, and then effectively screen out the main features that can help the mapping results, remove the useless features, on this basis for deep learning and classification.

Currently, commonly used structures in engineering include Inception, VGG, and Resnet. In general, the designer will use the original model to conduct corresponding data set training, and then select a model with satisfactory training results for further improvement. The model used in engineering should be fast and accurate. The general way to reduce the model is to reduce the number of ResNet modules or the number of convolutions. At present, the most widely used models

mainly include YOLO, SSD, MASk-RCNN, FRCNN and other network models, all of which have the advantages of high precision and fast speed.

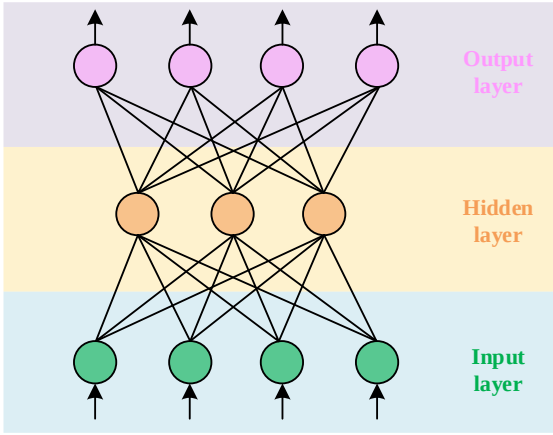

Figure 2: BP network structure

Neural network is a highly abstract model of human nervous system. The basis of its structure is the neuron. According to the biological definition, the neuron consists of two parts: the cell body and the process, which can be further divided into dendrites, axons and synapses. If the current passing through a neuron exceeds a certain threshold, the neuron is activated.

A typical BP network structure is shown in Figure 2. After processing step by step, get an output mode, network output error of the model and the desired output, The error is transmitted by the reverse sequence of output layer, hidden layer and input layer, and the connection weight of each layer is modified layer by layer according to the direction of error reduction. When the error is less than the predetermined value, the whole learning process will end. The predicted results are compared in Figure 3.

The algorithm's steps are as follows.

1) Initialize and set the weights and thresholds to smaller values with uniform distribution;

2) Calculate for each input sample.

What needs to be explained here is that the input vector of the BP network model adopted in this paper is each index in a university. The output of BP network model is the evaluation result. As many samples as possible are used to train the network, so that it can obtain the evaluation ability of the evaluation expert group composed of school supervisors and its emphasis on some important indicators.

In this way, the more accurate information obtained by the BP network through adaptive learning will be represented by the group of weight coefficient values in the BP network model. The well-run BP network model can obtain the evaluation results of the vocal music teaching quality evaluation of a university according to the attribute values of each index to be evaluated. In this way, it is as close as possible to the evaluation of expert judges composed of school supervisors, so as to realize

the effective combination of qualitative and quantitative analysis and ensure the fairness of evaluation.

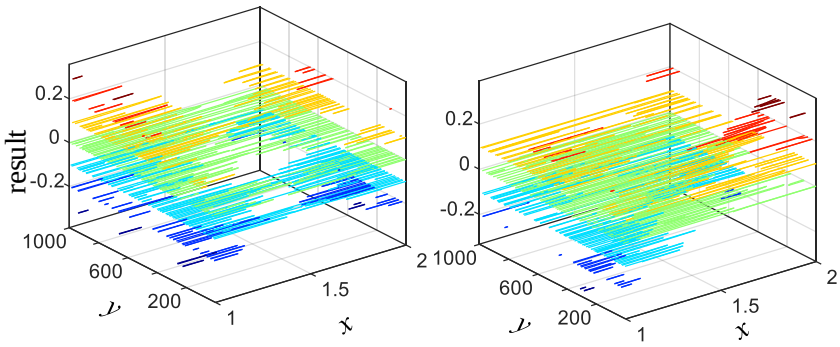

Figure 3: Predicted results.

Teaching evaluation indicators (the scoring range of each indicator is 0-10) : X1: being a good example for teachers, influencing students with their own behaviors; X2: Proper amount of homework, careful correction, patience to answer questions; X3: Stimulate students' interest and inspire innovative thinking; X4: Teacher's dress, mannerisms and mental state; X5: Teaching attitude and teaching skills; X6: Teaching is focused and clear; X7: Able to express complex problems clearly; X8: Guide students to discuss and solve problems; X9: Pay attention to teaching interaction, communication between teachers and students; X10: Make full use of modern teaching methods.

(1) Determination of the number of neurons in the input layer

According to the teaching evaluation indicators in our survey, there are 10 indicators in total, which can be used as the input neurons of the model, so the number of neurons in the input layer is N = 10.

(2) Determination of the number of neurons in the output layer

We take the evaluation result as the output of the network, and the number of output layers m=1

(3) The determination of network hidden layers

According to the previous theoretical proof, in the teaching quality evaluation model.

(4) Determination of the number of hidden layer neurons

In this paper, we preliminarily determined the number of neurons in the hidden layer s=6 according to relevant experience. The evaluated results of x and y are shown in Figure 4.

After that, all the evaluation index data and the relatively perfect teaching quality evaluation results obtained before are input into the network for training. We take the learning rate =0.5 and the minimum fixed error =0.001.

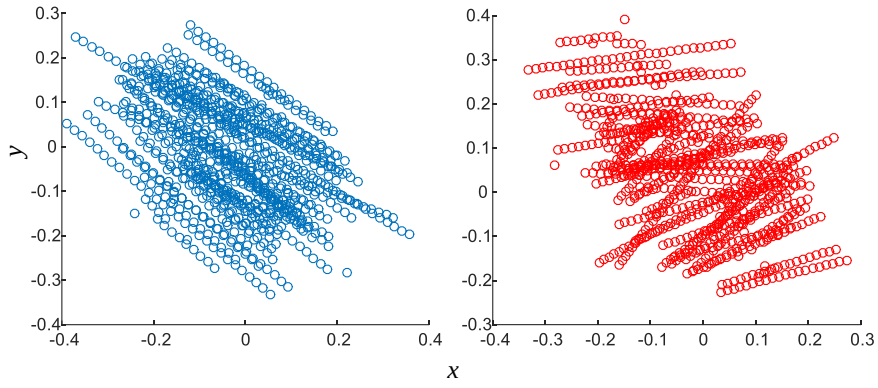

Figure 4: Evaluated results of x and y.

After the training, the appropriate weight threshold value is obtained, which is used to process the evaluation indicators obtained from the subsequent investigation, and the appropriate teaching quality evaluation results are obtained.

3 EVALUATION METHOD OF VOCAL MUSIC TEACHING EFFECT BASED ON COMPUTER AIDED TECHNOLOGY AND BP NEURAL NETWORK

Artificial intelligence is considered as a "knowledge discipline" due to its comprehensive disciplines, and is regarded as capable of realizing intelligent activities by machines instead of human beings due to its integration characteristics of advanced and sophisticated technologies, which also represents the center and core ideas of related fields. That is, by studying the trajectory of human movement frame by frame, many commands are given to the machine, and even the knowledge system of the machine itself is cultivated to deal with some behaviors/businesses instead of human beings. Its research content is mainly to learn, knowledge theory and operation by imitating the conscious actions of human beings by controlling the machine through codes.

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In order to avoid the practice of sometimes partial "strict", sometimes partial "wide", on the same performance of the very different scores. Therefore, please first have attainments of vocal music art and familiar with the rules of vocal music art experts, make each sub-score, and then according to the aesthetic rules of vocal music art to make a more objective and fair total score. Taking item scores as input and total scores as samples, the BP network is trained to learn expert

experience by adjusting weights of each layer, that is, the BP network is used to simulate a stable expert scoring system. The convergence of the proposed method is shown in Figure 5.

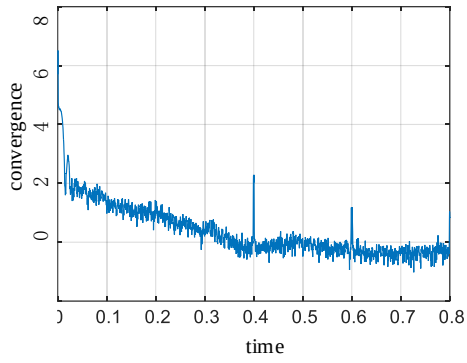

Figure 5: Convergence of the proposed method.

According to the 10 indicators in the vocal music evaluation system, it is recorded as S = [S 0, S 1... S 16], so the input layer of the network has 10 inputs. What we need is to take the scores of these indicators into comprehensive consideration and give a definite score based on learning experience, so the output layer is determined as one node. According to the experiment, the number of hidden layer neurons is determined to be 6. The implicit layer transfer function is implemented using the "lognSIG" logarithmic Sigmoid transfer function, and the output layer transfer function is implemented using the "pureline" pure linear transfer function. The training function uses the "TraingDM" momentum gradient descent back propagation method to train the network. The network performance function uses the default mSE mean square error function. The prediction is shown in Figure 6.

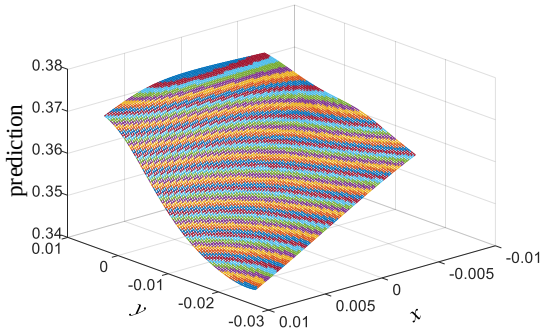

Figure 6: The prediction.

To determine the structure and algorithm of the network, it is necessary to use the selected sample data to train the BP neural model with certain learning norms, so as to improve the adaptability of the network. From the practical research, it is found that the realization of this model adopts BP three-layer network structure, using software MATLAB7.0. The number of training steps is 40, the

target error is 0.001, and the network training times are 80. The data related to the situational teaching evaluation of 8 teachers in a university were collected, and the comparison between the test results and the evaluation results of supervision showed that the error was small, the test results were consistent with the evaluation of supervision, and the evaluation was satisfactory. The test results and supervision evaluation results are shown in Figure 7.

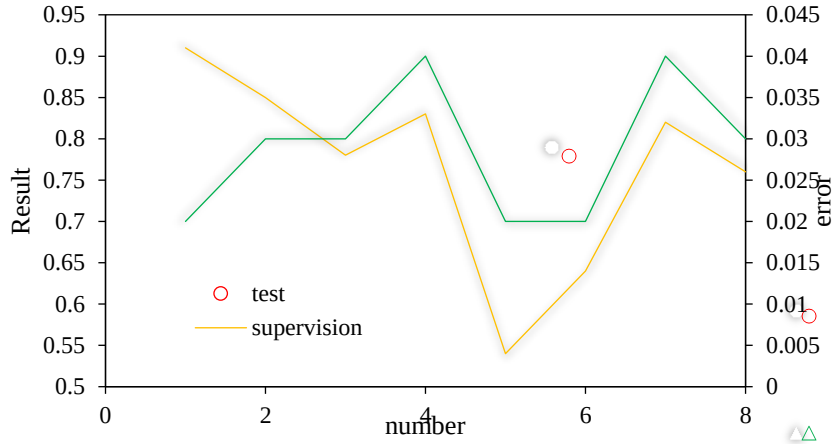

Figure 7: Evaluation results.

4 CONCLUSION

There are many evaluation methods for the quality of vocal music classroom teaching. The evaluation of vocal music teacher's teaching effect needs to be evaluated from multiple angles. Whether students score for teachers, or the evaluation of the supervision group, the evaluation given is with some subjective factors. Therefore, it is particularly important to establish objective evaluation method of vocal music teaching effect. In this paper, by using the evaluation methods and the reasonable establishment, the objective of each evaluation index, using the comprehensive evaluation vector as the input, through BP neural network output to get a reasonable score. The simulation results show that the trained BP back propagation network can simulate a stable evaluation system. It can reduce the artificial influence factors in the traditional evaluation method of index weight determination, and has high accuracy. In a word, the establishment of the teaching management departments of various schools to seek scientific teaching quality evaluation solutions.

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