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Retraction

Retracted: Evaluation Method and Implementation of Vocal Music Teaching Performance under a Wireless Communication Environment

Security and Communication Networks

This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] H. Liu, "Evaluation Method and Implementation of Vocal Music Teaching Performance under a Wireless Communication Environment," *Security and Communication Networks*, vol. 2022, Article ID 2597772, 9 pages, 2022.

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Research Article

Evaluation Method and Implementation of Vocal Music Teaching Performance under a Wireless Communication Environment

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With the development of society, modern educational technology and electronic information technology are more and more closely combined. Auxiliary teaching products based on computer technology, multimedia technology, and network technology emerge one after another. How to combine modern wireless communication technology with modern educational technology to evaluate the teaching effect has become one of the hot topics in the field of modern teaching research. In view of the lack of communication between teachers and students and evaluation methods of the teaching effect in traditional vocal music teaching, this paper designs a method of evaluation of vocal music teaching effect in a wireless communication environment. First, this paper designs a feedback system of vocal music teaching based on wireless communication. Second, due to the influence of vocal music teaching effect, the factors are diverse, and the neural network has the advantages in processing the data with nonlinear strong robustness and dynamic characteristics. And we use BP (back propagation) neural network as a mathematical model to receive teaching feedback information. Then, the simulation results show that the proposed method can not only evaluate the effect of vocal music teaching but also has good feasibility and practicability. Finally, the method proposed in this paper can help improve the teaching level and efficiency of the school and has a great theoretical value and practical potential.

1. Introduction

In the traditional classroom teaching mode, active communication between teachers and students is often lacking [1, 2]. If this goes on for a long time, students will feel bored in learning and lack the sense of participation, and teachers will find it difficult to know how each student has grasped the knowledge in real time, affecting their grasp of the rationality of classroom teaching progress. Therefore, the traditional classroom teaching mode must be reformed in order to meet the increasing learning requirements of teachers and students. In the classroom, teaching and learning go on at the same time, and further preaching is for learning. Therefore, teachers need to use a variety of feedback methods to understand the learning effect of students and adjust teaching methods according to the real-time teaching situation [3]. The traditional teaching feedback methods are mainly divided into the following three types:

(1) Verbal feedback: Teachers analyze students' mastery of classroom knowledge through oral communication such as classroom questioning, classroom discussion, and students' questioning, so as to adjust teaching methods. The disadvantage of this approach is that the feedback information teachers get is somewhat one-sided, and they cannot fully grasp the learning situation of students. Meanwhile, students' attention is distracted due to the lack of sense of participation, leading to the loss of classroom teaching effectiveness.

(2) Written feedback: Teachers observe students' mastery of knowledge and existing problems through blackboard writing, homework, and classroom tests. The disadvantage of this method is that the teachers in the classroom time and energy cannot carry out effective teaching diagnosis for every student. In addition, the phenomenon of plagiarism among students increases the difficulty for teachers to assist.
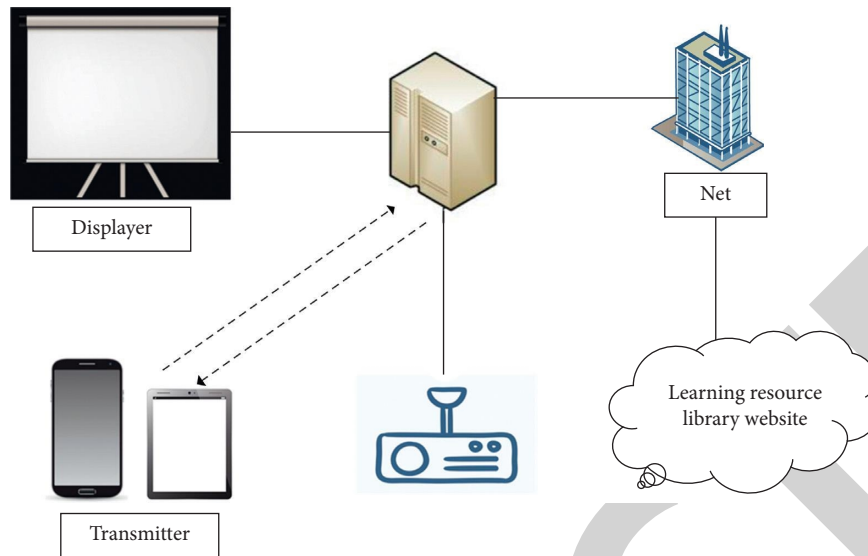
Figure 1: The schematic diagram of the wireless feedback teaching system.

(3) Physical projection display feedback: Teachers show students' learning results through physical projection and multimedia demonstration, so as to understand some specific problems existing in students' learning, so that teachers can carry out targeted classroom teaching [4, 5]. The disadvantages of this approach are similar to verbal feedback. It is difficult to ensure the participation of everyone and cannot accurately grasp the overall classroom teaching efficiency.

With the development of wireless communication technology, the application of wireless communication technology in the field of education has become the key research direction of the new mode of contemporary teaching. At present, the mainstream wireless communication technologies applied in the field of education include bluetooth, RFID, UWB, WiFi, infrared [6, 7]. This technology has the functions of instant evaluation, investigation, statistics, and record, which plays an important role in helping teachers get the feedback information of students in time and adjust and optimize classroom teaching strategies in time. The receiving device of the evaluation system is directly connected to the corresponding network (such as campus network), and the relevant information is transmitted to the server and integrated into the database. The schematic diagram of wireless feedback teaching system is given in Figure 1. The typical wireless feedback teaching system under information technology mainly consists of a set of simple personal handheld signal transmitters and a receiver connected to the classroom computer for signal acquisition. When students answer questions through handheld transmitters, the system will automatically generate various reports required by teachers after receiving signals, and the results will be displayed on the large screen display equipment in the classroom. Teachers can monitor students' learning progress in real time, analyze students' learning effect according to the feedback data and adjust the corresponding teaching content and progress [8, 9].

Common short-range wireless communication technologies are described as follows. IrDA technology, commonly known as infrared communication technology, uses infrared light for point-to-point communication. The wavelength of infrared ray is invisible. The near infrared in the infrared band is used for infrared communication. The IrDA standard is a point-to-point data transfer protocol and an alternative to connecting cables between traditional devices. Its advantage lies in not needing to apply for frequency use right, and communication cost is low. Second, red outside communication uses light to transmit data, and there is no problem of wireless channel resources being occupied and has strong anti-interference and high security. Third, high data transmission rate is suitable for large-capacity file and multimedia data transmission. Fourth, infrared equipment has the characteristics of small volume, low power consumption, easy to use, and so on required by mobile communication. After years of development, the hardware and software technology related to infrared communication technology has been very mature, and the range of use is more and more extensive. Bluetooth technology has the following advantages: it works in the global open frequency band, has high data transmission rate, and has secure communication; it can bypass obstacles to connect within the effective range and has no requirements on communication perspective and direction. At present, bluetooth technology has been widely used in household automotive electronics, information equipment, industrial equipment, and household appliances, especially in the application of personal LAN. Wi-Fi technology is a kind of short-distance wireless communication technology. Compared with bluetooth technology, Wi-Fi technology is inferior in data security, but better in radio wave coverage, which can fully meet the application needs of families, offices, and even small buildings. The advantage of WiFi technology lies in the wide range of radio waves, covering a radius of about 100 meters. In addition, the transmission speed is very fast, reachable, and penetrable. Radio frequency

technology is radio frequency identification and is also a short-range wireless communication technology. The realization of radio frequency technology requires the use of radio frequency transceiver chip. These radio frequency modules are widely used in civil and industrial fields due to their low power, high reliability, and easy development. However, this RF module has a slow data transmission speed and small data flow, so it is only suitable for building small networks.

The rapid development of education changes the evaluation system in education [10, 11]. In recent years, teaching effect evaluation, as a new evaluation method, has attracted wide attention and has become a research hotspot in the field of international education evaluation. Teaching effect evaluation can not only evaluate students' knowledge and skills but also comprehensively evaluate students' practical ability, exploration ability, innovative spirit, and emotional attitude. Vocal music, as a required course for undergraduate students, is a main course to train students to have the basic ability of music education. This course is a combination of practice, knowledge, skill, and artistry. Combining with the characteristics of this course, the author thinks that the evaluation process of vocal music course is a systematic teaching activity, and the evaluation method of teaching effect is suitable for it and can become possible. At present, the research results of performance evaluation by foreign scholars have been relatively comprehensive and in-depth, and the domestic academic circle has introduced it more, and there are also more scholars to evaluate and score the teaching effect of foreign mature standards. Although we can learn from some foreign theoretical research results, we need to combine the social background of our country, education practice to carry out specific research on the teaching effect of our country, design suitable for the teaching effect evaluation method of our students. Therefore, combined with their own teaching practice, the author from the vocal music course in the process of vocal music teaching design based on the wireless communication environment vocal music teaching effect evaluation method tries to promote the construction and development of new music art course teaching evaluation system from the perspective of vocal music course teaching evaluation [12, 13].

2. Related Work

Computer application in the field of education, and as a modern teaching aid and tool, began in the 1950s. From the birth of the early 50s linear program, branch, generation system, and the computer-assisted instruction system, so far nearly 30 years of research of the intelligent teaching system is put forward and its development, and it serves to show the computer technology application in the field of human education and development speed, the form of diversification and became popular [14, 15]. The idea of intelligent education application has appeared in the period of computer aided education, but the degree of realization of the idea is different in different periods. Because the role of computer in education and teaching, on the one hand, is closely related to the development level of computer technology and also related to the degree of application and demand in different fields of education. Therefore, in the intelligent application of computer in education, from its development process, there are roughly computer-assisted teaching, intelligent teaching system, intelligent network teaching platform, and other representative application modes. The intelligent teaching system was produced in the early stage of artificial intelligence application in education, involving the comprehensive fields of artificial intelligence, computing science, psychology, and pedagogy. The purpose of this study is to make computers play the role of teachers and endue them with intelligent behaviors to replace teachers to become learners' guides and helpers to a certain extent, so as to achieve individualized teaching and individualized teaching effect. The intelligent teaching system in the user interface, teaching content and teaching process, and other aspects of a more comprehensive design mainly reflects the detailed description of the course, teaching course learning and learning process evaluation and other functions and at the same time, in the multimedia, teaching a set of speech synthesis, image display technology, with good man-machine interaction dialogue function [16, 17].

Any kind of teaching evaluation method should be put into practice, not only should there be feasible evaluation plan but also have clear teaching evaluation operation procedures. What needs to be further considered is that in order to break the disadvantages of the traditional vocal music teaching evaluation model, we must deeply explore the real connotation of formative evaluation and summative evaluation, and master the specific operation methods and implementation procedures. At present, the study of performance evaluation by foreign scholars is more thorough and comprehensive, and there are many related works. Many educational experts have been engaged in performance evaluation research for a long time, which has formed a relatively perfect theoretical system and has been widely used in practice. In recent years, there have been systematic researches on it. Through the above elaboration, we should transform the specific teaching goal of vocal music teaching into the specific behavioral stage goal that can be observed; that is, the teaching process can be clearly used to guide evaluation activities and improve learning efficiency standards. Specific studies are as follows:

(1) Master basic theoretical knowledge of vocal music, with basic theoretical level and understanding ability of vocal music art. Cultivate students' correct singing posture, positive singing psychology, and good singing habits.

(2) Understand the rules of Chinese and foreign singing languages, sing Chinese adapted songs in standard Mandarin with clear articulation and natural pronunciation.

(3) Establish the correct concept of sound, train the students to use the correct breathing method, strive to achieve the stability of larynx when singing, develop good habits of clauses and breathing, and use the breath to support the sound of singing.

(4) Train students to have the ability to understand and analyze songs, learn knowledge and skills, and sing different types of songs and to cooperate with accompaniment, resulting in more complete expression of the ideological mood of the song.

At present, in the vocal music teaching of normal colleges in our country, most of the students only stay on the evaluation of vocal music training and singing, and most of the students stay on the evaluation of skills, resulting in a single and narrow knowledge structure in the field of vocal music [18, 19]. Now with a final exam to determine the score, it will let teachers and students lose a lot of opportunities to expand teaching content and improve learning in the teaching process, but also sacrificed a lot of poor basic conditions of the general students of vocal music learning interest, making the realization of teaching goals became an empty talk. Therefore, at present, the music education curriculum in normal colleges is expanding day by day, and the number of vocal music classes cannot be increased. It is practical and worthy of attention to change the past teaching methods, interlace important theoretical knowledge of vocal music in the teaching of vocal music training and singing, and expand the evaluation content and methods of vocal music training and singing in the cognitive field. Since the perception and imagination of music are not easy to measure, it is not suitable to adopt strict quantitative evaluation but comprehensive evaluation to evaluate the training and singing of vocal music students in normal universities. The most reasonable evaluation is mainly formative evaluation, supplemented by summative evaluation. In the traditional vocal music teaching process, in fact, formative evaluation is everywhere, and its process is more important than the result; once the skill is formed, it is difficult to correct. Due to the expansion of teaching objectives and evaluation standards, the corresponding evaluation means and methods are also greatly increased [20, 21]. Vocal music art is the art of emotional experience, and in order to cultivate students' interest in music, it is necessary to pay attention to create an artistic atmosphere to infect students in the teaching process and pay attention to the development of latent music courses. On this basis, there are specific evaluation methods: observation method, essay test, questionnaire method, grade scale method, and so on. As the evaluation criteria and evaluation content have been diversified, the above evaluation methods should not be used singly but throughout the whole teaching process. According to the different evaluation information content to be collected, various evaluation methods can be integrated.

In the evaluation of students' mastery of vocal music theory knowledge, since many vocal music theory learning can only be interspersing in the process of vocal music training and singing teaching, summative evaluation should be given priority, and formative evaluation should be supplemented [22]. The purpose of summative evaluation is to comprehensively evaluate students' achievements in a certain course or its important part, and the summative test is the main means. At the end of the study, teachers prepare test questions for students to assess, in the formulation of vocal music theory knowledge of the test paper, attention should be paid to, first of all, the preparation of test questions which must be consistent with the teaching content in line with the requirements of teaching objectives. Second, the proportion of test content can be arranged reasonably according to the cognitive level to improve the credibility and value of the test paper. Taking the cognitive goal of Chinese phonetic knowledge of vocal music language as an example, if too much of the test questions stay in the stage of knowledge objective assessment, then the value of this test paper is very low, and it cannot effectively assess the comprehensive ability that students really should have. In vocal music theory course of study, as an auxiliary formative assessment should be present throughout the course of the teaching process, andthe main purpose of the formative assessment is not to give students grades or provide proof but a determination of a specific learning tasks to master degree, and it also helps teachers to help students focus on should grasp the specific knowledge [23].

Compared with the traditional teaching methods, the Physics Department of the University of Illinois began to implement the interactive classroom teaching reform in physics education research, and successfully established the wireless communication teaching mode. After this model was introduced to Harvard University, physicists at the University of Illinois were inspired to develop the radio frequency system iClicker, which is an interactive answering machine similar to a wireless remote control. In the actual use process, the system is improved and optimized constantly, making its performance more stable and reliable. Subsequently, Macmillan acquired the remote answering interactive teaching system technology, and within a few years, it was promoted to colleges and universities in the United States, making it the most widely used wireless communication teaching evaluation system. Now, the company is developing a tele-qin interactive teaching system based on satellite communication that will allow students to study at home as interactively as they do in the classroom. At present, the wireless conference voting system is more popular in the domestic market. There are few interactive response systems dedicated to classroom teaching, and the research and application of this system is still in its infancy. Of course, some domestic enterprises have been committed to the research and development of interactive teaching products. These companies to imitate the technology of American companies mainly use radio frequency technology and infrared remote control technology as a means of communication because developers do not work in the front line of teaching. Therefore, their system is not very close to the actual classroom teaching needs. So far, no Chinese universities have officially started to use the system.

Although there are few interactive teaching systems in China, there have been many researches on the teaching system based on wireless communication technology [24]. The wireless feedback teaching system has been studied earlier in foreign countries, and the classroom feedback system is widely used in universities, primary and secondary schools, and the practical application effect is obvious. At

present, in the United States, including Harvard University, Ohio State University, Purdue University, University of Washington, and other world-class universities, as well as a large number of primary and secondary schools in the classroom use IRS (interactive response system), which generally improves the quality of teaching and learning efficiency. At present, the application scope includes the United Kingdom, Japan, South Korea, Malaysia, and other countries and regions, and the practical application effect is remarkable; in the United States, it has more than 1 million users. The wireless feedback teaching system has been studied earlier in Taiwan and widely used in primary and secondary schools in Taiwan and has been popularized in primary and secondary schools in mainland China. It has a promising application in university classrooms. At the beginning, Central University in Taiwan began to study how to integrate teaching feedback with technology, and the doctoral team designed related technical products. Learners can enhance their learning ability through classroom learning or the Internet, in a learning community with peers, teachers, and parents. In 2010, there are more than 3000 experimental classes in Taiwan, and nearly 8000 sets of related technology products are applied to teaching activities worldwide. In 2016, the IRS application in Taiwan is further common, and even some schools have reached a machine. At present, experimental classes based on the wireless communication feedback system have been carried out in more than 1000 primary and secondary schools in more than ten provinces and cities in China, such as Beijing, Shanghai, and Guangdong.

Through sorting out the above literature, we can clearly find that the research on the theory and practice of vocal music teaching evaluation in China is still in the initial stage, still stays at the initial level of introduction of teaching evaluation, still belongs to the practice stage at will, and has not yet formed a systematic theory. The evaluation process shows subjectivity and arbitrariness, and the implementer himself lacks in-depth understanding and lacks empirical research on the implementation procedures and methods of vocal music teaching evaluation, so the whole evaluation is quite chaotic [25]. The specific problems can be summarized as follows: the content of the evaluation is too single, focusing on the mastery and application of vocal music skills, and the lack of evaluation of the overall knowledge structure and comprehensive ability of students. The way of evaluation is too monotonous, focusing on the summative evaluation and quantitative evaluation method (i.e., the final examination), and lack of comprehensive and objective evaluation to reflect the progress of students' vocal music learning and promote their overall development. The main body of evaluation is teachers, ignoring the status of students in the evaluation and the importance of students' self-evaluation, mutual evaluation, and other evaluation. The evaluation function tends to discriminate students' singing skills, deviates from the evaluation principle of vocal music teaching and the goal of students' overall development, and affects the change of vocal music teaching concept and the improvement of teaching methods. In view of the existing problems of vocal music teaching evaluation in our country, we put
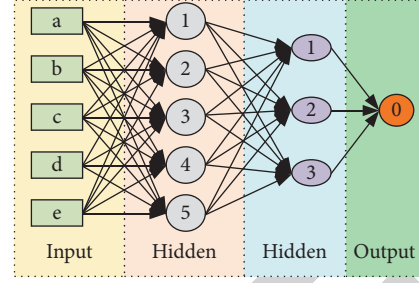

Figure 2: The diagram of BP neural network.

forward a method of vocal music teaching effect evaluation under the wireless communication environment, which has been accepted in many evaluation fields. It will break the disadvantages of traditional teaching evaluation, accompany the whole process of students' learning, and promote students' all-round development. Based on the above discussions, the contributions of this paper can be concluded as follows:

(1) This paper is the first to evaluate vocal music teaching effect by using the neural network model in wireless communication environment

(2) The research of this paper not only has certain theoretical value but also has potential application prospect

3. Materials and Methods

3.1. BP (Back Propagation) Neural Network. The diagram of BP neural network is given in Figure 2. The error is less than a certain value, and it indicates that the network training is completed.where x_i is the real value and c_i is the predicted value. Then, the hidden layer can be expressed as

$$E = \sum_{i=1}^{m} (x_i - c_i)^2, \tag{1}$$

$$E = \frac{1}{2} \sum_{\kappa=1}^{\ell} [d_\kappa - f(net_\kappa)]^2 = \frac{1}{2} \sum_{\kappa=1}^{\ell} \left[d_\kappa - f\left(\sum_{j=0}^{m} \omega_{j\kappa} y_j \right) \right]^2. \tag{2}$$

Expanding further to the input layer, there is

$$E = \frac{1}{2} \sum_{\kappa=1}^{\ell} d_\kappa - f\left[\sum_{j=0}^{m} \omega_{j\kappa} f(net_j) \right] = \frac{1}{2} \sum_{\kappa=1}^{\ell} d_\kappa - f\left[\sum_{j=0}^{m} \omega_{j\kappa} f\left(\sum_{j=0}^{n} v_{ij} \chi_i \right) \right]^2. \tag{3}$$

It can be seen from the above formulas that the network input error is a function of the weights of each layer, so the error can be changed by adjusting the weights. Obviously, the principle of adjusting weights is to reduce errors continuously, so the weights should be proportional to the gradient descent of errors. Since formulas (4) and (5) are partial derivatives of process data, their values range over the entire real number field.
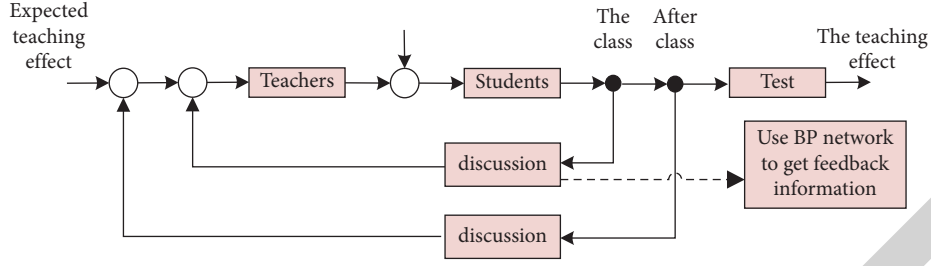
FIGURE 3: Teaching process based on the wireless feedback system.

$$\Delta\omega_{jk} = -\eta\frac{\partial E}{\partial \omega_{jk}} \quad j = 0, 1, 2, \ldots, m; \ \kappa = 1, 2, \ldots, \ell, \quad (4)$$

$$\Delta v_{ij} = -\eta\frac{\partial E}{v_{ij}}\partial \quad i = 0, 1, 2, \ldots, n; \ j = 1, 2, \ldots, m. \quad (5)$$

Then the weight adjustment formula of each layer is

$$\Delta\omega_{jk}^{h+1} = \eta\delta_{h+1}^{\kappa}y_j^h = \eta(d_\kappa - o_\kappa)o_\kappa. \quad (6)$$

According to the above rule layer by layer analogy, the weight adjustment formula of the first hidden layer is

$$\Delta\omega_{pq}^1 = \eta\delta_q^1\chi_p = \eta\left(\sum_{r=1}^{m_2}\delta_r^2\omega_{qr}^2\right)y_q^1. \quad (7)$$

The differential evolution algorithm (DE) is introduced into the neural network to optimize the initial weights and thresholds of the network. Hence, the DE algorithm optimizes network parameters to obtain better model performance:

$$x_{i,1} = x_i^L + \text{rand}(x_i^U - x_i^L), i = 1, 2, \ldots, NP. \quad (8)$$

The mutation operation formula is as follows:

$$v_{i,G+1} = x_{r1,G} + F(x_{r2,G} - x_{r3,G}). \quad (9)$$

Then the interlace operation is

$$u_{ji,G+1} = \begin{cases} v_{ji,G+1}, & r_j \leq CR \text{ or } j = \text{rand}(i), \\ x_{ji,G}, & r_j \geq CR \text{ or } j \neq \text{rand}(i). \end{cases} \quad (10)$$

Accordingly, the selection operations are as follows:

$$x_{i,G+1} = \begin{cases} u_{i,G+1}, & f(u_{i,G+1}) \leq f(x_{i,G}), \\ x_{i,G}, & f(u_{i,G+1}) > f(x_{i,G}). \end{cases} \quad (11)$$

The fitness function is

$$f(X) = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(Y_i^0 - Y_i)^2}. \quad (12)$$

Because traditional BP neural networks is prone to local optimum, some optimization algorithms can be used to optimize the parameters of the model, but due to the length of the paper, it will not be described here.

3.2. Wireless Feedback System.

The classroom feedback teaching model constructed by us is shown in Figure 3. Students are the controlled objects, teachers are the controllers, and the teaching content can be regarded as the disturbance input of the system. The feedback information includes timely feedback information, delayed feedback information, and self-feedback information. As can be seen from the figure, homework and quizzes can provide quantitative delayed feedback information, which is convenient for teachers to make statistics and analysis, and for students to compare their scores. However, in the traditional mode, it is difficult to provide quantitative feedback information for statistics and analysis in the way of answering questions and discussing in class. The feedback effect mainly depends on the experience and teaching level of teachers, and sometimes it will become a negative feedback due to unfavorable organization. Therefore, neural network can be used to obtain quantitative instant feedback information in classroom feedback teaching. The two discussions are different, one of them is from the class and the other is after class.

4. Results and Analysis

4.1. Experimental Data Introduction.

In order to understand the present situation of vocal music course teaching evaluation in normal colleges more accurately and in detail, the feasibility and superiority of performance evaluation in vocal music course are analyzed carefully. Before the experiment of performance evaluation, the author selected undergraduate students majoring in musicology in a university to interview. The interview was conducted in the first semester of the year. In order to ensure the coverage of survey subjects, the author selected 600 interviewees in the whole grade and divided them into 30 groups. A total of 600 interview records were collected with a recovery rate of 100%.

In addition, the students of music major and nonmusic major of the school were surveyed, and the data of the survey included students' scores on the teaching effects of different teachers, and the answers of music teaching tests of students of different grades and so on.

4.2. Experimental Results Analysis.

The method framework proposed in this paper is mainly embedded in BP neural network, but because BP neural network is just a general feedforward network, and it cannot process large-scale vocal
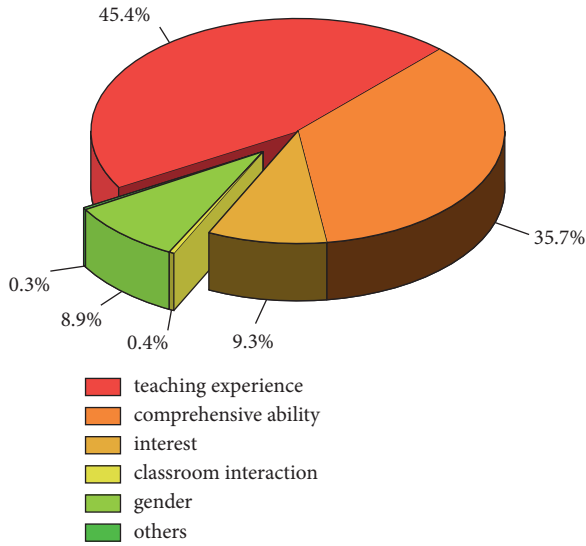
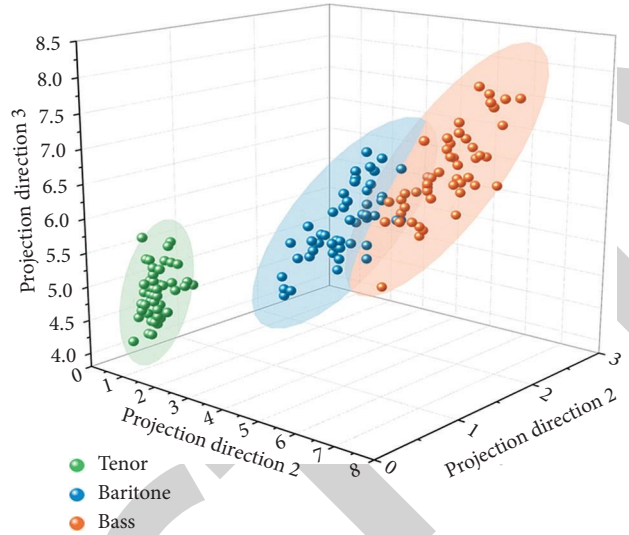Figure 4: The main influencing factors of the vocal music teaching effect.

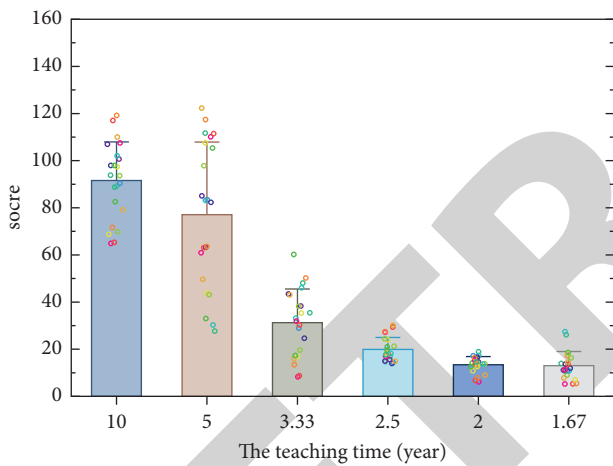Figure 6: Extraction results of three vocal features based on wireless communication.

Figure 5: The relationship between teachers' seniority and scores.

Figure 7: The relationship between the number of answer times and the error rate of students in different grades.

music data, so it is difficult to apply to big data scenarios. First of all, Figure 4 shows the main influencing factors of vocal music teaching effect (determined by manual experience and questionnaire survey). Among them, teachers' teaching experience accounts for the highest proportion, accounting for 45.4%. The second is the students' comprehensive ability (including understanding ability and expression ability), accounting for 35.7%. The third and fourth most important factors were students' interest and classroom interaction, accounting for 9.3% and 8.9%, respectively. Gender and other factors accounted for almost nothing.

We take the teacher's experience as the independent variable, and study the relationship between teaching experience and students' rating of teachers by the equivalent teaching hours and the teacher's teaching experience (shown in Figure 5). As can be seen from the figure, teachers' teaching hours are directly proportional to students' ratings of teachers, which is also consistent with our life experience.
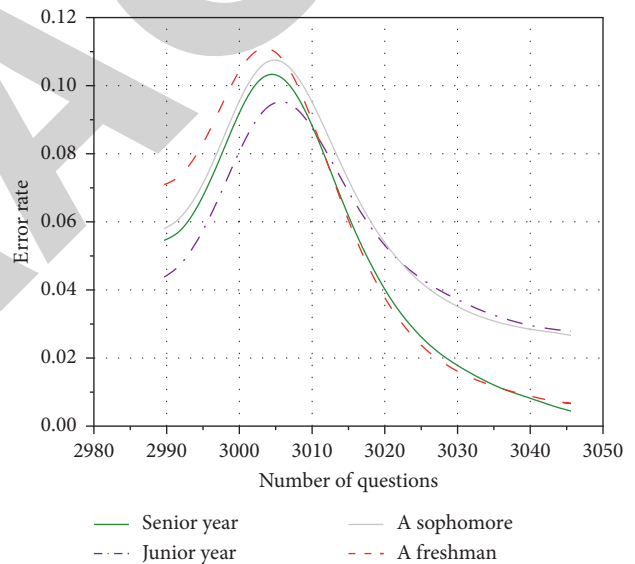
Specifically, the average score of teachers with 10 years of teaching is around 90, which means that students are satisfied with the teaching effect of teachers. Similarly, teachers' scores declined as their years of teaching decreased. This further verifies that the teacher's teaching age is the most important factor affecting the vocal music teaching effect. Among them, colored scatter points represent the distribution of teachers' scores, and this paper mainly solves the mean value of these scatter plots to determine the final score of each teacher.

Besides, we have taken three different vocals (tenor, baritone, and bass) and were used to verify the vocal feature extraction effect of the proposed method. The vocal features are extracted by BP neural network in wireless communication environment and then input into the t-SNE (t-
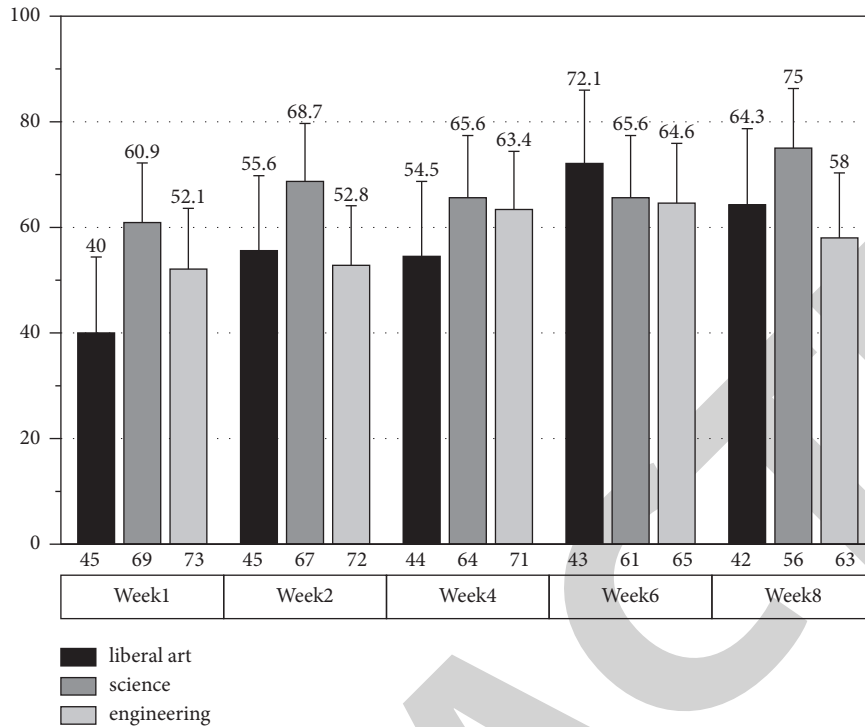
FIGURE 8: The improvement of the teaching effect of arts, science, and engineering students after the application of the system.

distributed stochastic neighbor embedding) model for dimensionality reduction. The results are shown in Figure 6, from which we know that the evaluation method of vocal music teaching in this paper can classify three kinds of vocal music characteristics well, which is conducive to the visual display of different entrance schools, so as to provide teaching effects. Although there are many types of vocal music, in order to verify the effectiveness of this method, we use the three most representative vocal music to verify, namely tenor, baritone, and bass. Thus, the validity of the method in this paper is illustrated.

Figure 7 shows the relationship between the number of questions and the error rate of students in different grades under this teaching system. In general, with the increase of the number of questions, the vocal music teaching system designed can effectively reduce the error rate of students in different grades especially for the freshmen although their vocal music level is not as high as the senior students at the beginning, but after the systematic training, freshmen can obtain the lowest error rate. The errors of the remaining grade students also achieved varying degrees of reduction. However, there is a period of time in the figure where the error rate of the answer shows a rising trend mainly because the model does not have enough training samples, which leads to the under-fitting situation of the model. However, with the increase of the number of questions, the error rate gradually decreases, indicating that our method can achieve a good vocal music teaching effect.

In order to further demonstrate the effectiveness of the proposed method to improve the vocal music teaching effect, Figure 8 shows the degree of improvement of teaching effect of arts, science, and engineering students after the system. As

can be seen from the figure, with the passage of time, the vocal music teaching effect of students of different disciplines presents a rising trend. In particular, liberal arts students saw a 72.1 percent improvement in their sixth week of teaching, while science students saw a 75 percent increase in their eighth week of teaching. Engineering students also saw the biggest improvement in their sixth week with 64.6 percent. From the above results, it can be seen that the method in this paper can evaluate the effect of vocal music teaching well, and the method has good universality.

5. Conclusions

Evaluation is an important link in teaching, and its implementation is inseparable from other links in the teaching system, which needs the chain reaction of teaching material content, teaching methods, and other factors. At present, people's understanding of the concept of teaching evaluation still has a misunderstanding, always regard evaluation as simple as examination or test. The separation of evaluation from the students' learning process has seriously hindered the development of vocal music teaching, and the perfection of teaching evaluation has become an urgent problem to be solved.

Aiming at the disadvantages of traditional vocal music teaching evaluation, we put forward the vocal music teaching evaluation method based on wireless communication technology. After a semester of experimental observation, this study went deep into students' classroom and worked closely with vocal music teachers. The experimental results can fully show that the application of wireless communication technology in vocal music teaching teaching

evaluation is feasible and is also a more reasonable way of vocal music teaching evaluation. Although the method in this paper has achieved good results, the proposed framework uses BP neural network to evaluate the teaching effect, so the large-scale vocal music teaching data will be a subject worthy of further study in the future.

Data Availability

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

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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