Research Article

An Evaluation Method of English Teaching Based on Machine Learning

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The evaluation of English teaching is becoming increasingly popular. An English teaching evaluation approach based on machine learning is developed in order to improve the accuracy of the English teaching evaluation and reduce the inaccuracy of the English teaching evaluation. Firstly, the specific meaning of the English classroom teaching evaluation is analyzed, the selection principle of the English classroom teaching evaluation index is designed, and the selection of the English teaching evaluation index is completed. Second, the machine learning technology is examined, and the analytic hierarchy process is used to produce the judgment of the English teaching assessment index. Then, using the principal component analysis, calculate the eigenvalues and eigenvectors of the evaluation indicators to determine the contribution of the English teaching quality assessment indicators. Finally, create the English teaching evaluation weight calculation model using the machine learning approach, and acquire the English teaching evaluation’s complete results using the fuzzy evaluation method. The experimental results show that when the number of iterations is 60, the normalized mean square error of the effectiveness of the method is 0.03, and when the number of tests is 30, the effectiveness of the method is 0.99; this shows that the method can improve the effectiveness of the English teaching evaluation. It can effectively reduce the error of the English teaching evaluation.

1. Introduction

Over the past 30 years since China’s reform and opening up, great progress has been made in all kinds of education at all levels. Free compulsory education has been popularized, secondary education has developed rapidly, and higher education has developed generally. The people’s education has reached eight and a half years. China has stepped from a large country of human resources to a powerful country of human resources [1]. Secondary schools, including junior and senior secondary schools, are the scope of secondary education. Traditionally, the middle school with nine-year compulsory education is the junior middle school, while the commonly said noncompulsory education stage is the senior middle school. On the basis of compulsory education, middle schools have improved the quality of the people, faced all the people, and laid the foundation for the lifelong development of all middle school students. The key round of education reform is the evaluation of English teaching and education quality, which plays a guiding role in the development of all middle school students [2–5]. How can we ensure the good development of Chinese students? How to improve the quality of English teaching and education? How to deal with the trend of English teaching and education reform? Recently, the most important part of English teaching and education evaluation is still the examination, and the result of examination evaluation is still the main means of rating. How to ensure that the examination results better reflect the real academic level? These problems are worthy of our in-depth exploration, fully aware of the importance and urgency of promoting the reform of middle school education quality, so as to accurately grasp the requirements of the middle school education quality. Therefore, the research on the evaluation of English teaching quality, evaluation methods, and problems has also become the focus of the educational circle [6, 7].

With economic globalization and the informationization of social life, English has become a widely used language in the world. As the most widely spread language in the world, English acts as a bridge between countries and regions. It has
narrowed the distance between countries and regions in the global village and promoted the development of the economy, commerce, trade, humanities, science, and other fields. It has naturally become a skill that modern people must master. China's one belt, one road China has been making great progress in China in 2025. More and more Chinese companies have become multinational companies. Advanced English compound talents are more important [8]. In China, English has now become a compulsory subject in middle and even primary schools. Due to the lack of the language environment in China and the differences between Eastern and Western cultures and ways of thinking, English teaching results are often unsatisfactory. In order to improve English teaching quality, stimulate interest in learning English, and narrow the gap between China's English teaching activities and major English-speaking countries, the research on English teaching quality evaluation has important practical significance and theoretical value [9]. College teachers' teaching quality evaluation is an important way to improve the teaching management level and teachers' teaching ability. Using teaching quality evaluation, students can give feedback on teachers' teaching situation, teachers can reflect on the teaching effect, and schools can effectively implement teaching management improvement and train teachers. English teaching is an important part of college education, and the evaluation process of English teaching quality is more complex. At present, the evaluation methods of teaching quality include questionnaire survey, fuzzy comprehensive evaluations, and expert scoring. The questionnaire survey method is simple and easy to operate, but its evaluation results are easily affected by the number of questionnaires, design level, and other factors. The fuzzy comprehensive evaluation method is fast and has no fixed limit on the number of samples [10]. The expert scoring method is authoritative, time-saving, and labor-saving, but its evaluation results are limited by the experience and level of experts. Therefore, this paper proposes an English teaching evaluation method based on machine learning to effectively improve the effect of the English teaching evaluation.

The following is a summary of the research: Section 2 discussed the principles of selecting indicators for English classroom teaching evaluation. Section 3 discusses the analysis of machine learning technology. Section 4 discusses the research on English teaching evaluation based on machine learning. In Section 5, the experiment and analysis are discussed, and finally the conclusion brings the paper to a finish in Section 6.

2. Principles of Selecting Indicators for English Classroom Teaching Evaluation

In this section, we discussed the teaching evaluation, English classroom teaching evaluation, and the principles of selecting indicators for English classroom teaching evaluation.

2.1. Teaching Evaluation. Evaluation is to judge the value of people or things. We often make subjective judgments only for the good and bad of people or things, which is a way of judgment and evaluation. In the activity, there are problems of the evaluation subject and the evaluation object, and thus the good or bad obtained will be the final judgment result [11]. In addition, the evaluation subject is the evaluation object, which is mainly aimed at the object of evaluation activities. There are problems of the evaluation subject and the evaluation object in the activities, and thus the good or bad obtained will be taken as the final judgment result, i.e., the changes of the value subject and the value object. In addition, evaluation methods have similarities and differences, including quantitative and non-quantitative. In short, the value judgment of things by the numerical quantitative method is called quantitative evaluation. This method is used to determine the level of object memory ability, but it has significant limits, whereas qualitative evaluation refers to the value judgment made using a non-numerical quantitative method. The non-quantitative evaluation discussed in this paper does not take objective teaching evaluation as the evaluation index, but uses effective evaluation means to make a qualitative analysis of English classroom teaching, timely feedback evaluation teaching, and evaluation, which depends on the realization of teaching and the learning evaluation system, including quantitative and qualitative evaluation indexes, so as to motivate students who often participate in English learning. It also provides teaching reference for English teachers in Classroom Teaching [12–15].

2.2. English Classroom Teaching Evaluation. According to the English curriculum standard, English teaching evaluation is the focus of the English curriculum. It is the real-time supervision of the English teaching process according to the requirements of the new curriculum standard. For the English classroom, it is not only the main part of the evaluation system but also an important teaching means of English classroom teaching evaluation. A reasonable and scientific classroom teaching evaluation can further improve students' learning of the English curriculum and make them learn English. All aspects of students' abilities have been fully developed, such that teachers can get students' feedback information in time, promote the comprehensive improvement between teachers and students, so that the school can understand the basic situation of English classroom teaching in real-time, which is helpful for teaching management and the continuous improvement of the new curriculum [16]. English classroom teaching evaluation mainly refers to teachers testing students’ learning process and judging students’ learning attitude, interest, and English ability through teachers' self-evaluation, mutual evaluation between teachers and students, observation of the students, and the evaluation of students’ homework; this promotes students’ enthusiasm and helps improve teachers’ teaching methods. Furthermore, the main methods in the process of English teaching and that help improve the evaluation of English Classroom Teaching are student self-evaluation and mutual evaluation, group evaluation and encouragement evaluation, image evaluation, and game evaluation [17, 18].
2.3. Principles of Selecting Indicators for English Classroom Teaching Evaluation. In the middle school English classroom teaching evaluation, the abstract evaluation content is transformed into specific and real value judgment elements. In order to make the indicators more reasonable, scientific, and practical, and ensure the reliability of the indicators, this paper expounds on the principles to be followed in the selection of indicators [19].

2.3.1. Integrity Principle. There are many factors affecting middle school English classroom teaching evaluation, and hence there is need to select indicators from many aspects and ranges at the same time; the results of the English classroom teaching evaluation should be considered as much as possible in the process of selecting indicators, so as to provide a reference for future classroom teaching evaluation.

2.3.2. Principle of Authenticity. The selection of teaching evaluation indicators in class needs to be based on the real situation, about the overall performance of the teachers’ teaching in class, avoid personal tendencies on some indicators, and select appropriate and fair indicators [20].

2.3.3. Maneuverability Principle. In the process of selecting indicators, classroom teaching evaluation should be feasible, considering whether the data of some indicators are easy to obtain and whether the indicator factors are clear. Therefore, whether the indicators are reasonable or not, the collected evaluation data have no value [21].

2.3.4. Principle of Brevity. When selecting English classroom teaching indicators, it is possible to simplify the total amount of indicators selected. If all indicators are selected into the indicator framework, the indicators selected at the beginning will lose their function. Therefore, taking simple and clear indicators can reduce the work for the evaluators [22].

2.4. Index Certification. According to the scores of teachers’ evaluation indicators, we can evaluate the teaching plan, teaching means, classroom setting, teaching attitude, and classroom performance. Through these factors, the selection of indicators is obtained through the experimental results. Table 1 is the system of teachers’ evaluation indicators [23, 24]. Through the preset and screening of indicators, it is finally determined that the middle school English classroom teaching evaluation index system for teachers includes 5 first-class indicators and 12 second-class indicators, as shown in Table 1.

According to Table 1 of the teacher evaluation and certification index system, in terms of teaching attitude, teachers are responsible for teaching strict management of classroom discipline and give timely feedback to students’ questions; among the teaching methods, helping students expand their horizons of English classroom teaching is an important index; in the case of classroom performance, the enthusiasm of students to answer questions is the improvement of the students’ learning enthusiasm, and the oral ratio of Chinese and English is also an important indicator [25].

3. Analysis of Machine Learning Technology

In this part, we defined the RBF neural network and the analytic hierarchy process.

3.1. RBF Neural Network. The RBF neural network is based on the function approximation theory. It is a feed-forward neural network with a strong global optimization ability. It is widely used in the fields of signal processing, image processing, and pattern recognition [26]. The RBF neural network is usually composed of the input layer, the output layer, and the hidden layer. The common structure is shown in Figure 1.

An RBF neural network, the three-layer neural network, has two weight vectors, in which the weight of the input layer and the hidden layer is the static weight (fixed as 1), the weight between the output layer and the hidden layer is the dynamic weight, and the activation function of the hidden layer is the radial basis function [27]. Therefore, the output of the output layer is the weighted sum of the input data after activating the function through the hidden layer. The radial basis function and the dynamic weight are key to the RBF neural network, and the expression of the radial basis function is:

\[ R(k_p - c_i) = \exp\left(\frac{-||k_p - c_i||^2}{2\sigma^2}\right), \quad (1) \]

where \( ||k_p - c_i|| \) represents the norm of \( k_p - c_i \), \( k_p \) represents the sample data input by the input layer, and \( c_i \) and \( \sigma \) represent the center and the width of the radial basis function, respectively. After determining the network weight and the radial basis function parameters, the output of the RBF neural network can be expressed as:

\[ y_i = \sum_{j=1}^{n} w_{ij} \exp\left(\frac{-||k_p - c_j||^2}{2\sigma^2}\right), \quad j = 1, 2, \ldots, n, \quad (2) \]

where \( w_{ij} \) represents the weight of the hidden layer and the output. According to the solution process of the RBF neural network, the network optimization process is to continuously update the dynamic weight, the center, and the width of the radial basis function according to the training data until the whole neural network realizes the required non-linear function approximation.

In order to improve the accuracy and computational efficiency of English teaching quality evaluation of the RBF neural network, genetic algorithm is used to optimize the parameters of the RBF neural network.

3.2. Analytic Hierarchy Process. AHP is mainly used to deal with complex and fuzzy problems. Its main steps are as follows:
3.2.1. Establish an AHP Hierarchy Model. AHP’s hierarchical model mainly includes the target layer, the criterion layer, and the element layer.

3.2.2. Construct Judgment Matrix. The relative advantages and disadvantages of each evaluation index are sorted by the pairwise comparison method, and the judgment matrix is established. For \( n \) evaluation indexes, the judgment matrix is shown in formula (3).

\[
A = (a_{ij})_{n \times n}
\]  

(3)

3.2.3. Calculate the Weight. Calculate the weight \( w \) of each evaluation index.

3.2.4. Consistency Inspection. The consistency inspection judgment index is as shown in formula (4).

\[
CR = \frac{\lambda_{\text{max}} - m_A}{m_A - 1}
\]  

(4)

where \( \lambda_{\text{max}} \) is the maximum eigenvalue of the judgment matrix \( A \); \( m_A \) is the order of the judgment matrix \( A \).

4. Research on English Teaching Evaluation Based on Machine Learning

In this section, we explained the principle component analysis of the evaluation index, weight calculation, and comprehensive evaluation results.

4.1. Principal Component Analysis of the Evaluation Index. At present, there are many indicators for English teaching quality evaluation. If these indicators are directly input into the RBF neural network without selection, the indicators with weak correlation or redundancy with teaching quality evaluation will affect the accuracy and efficiency of the final evaluation results. Therefore, in this section, the principal component analysis method is used to screen the English teaching quality evaluation indicators to simplify the evaluation indicators and improve the accuracy and timeliness of the English teaching quality evaluation. Principal component analysis can comprehensively analyze the existing English teaching quality evaluation indicators, remove the redundant components in the indicators, and generate new teaching evaluation indicators. The new indicators greatly reduce the amount of data, but can contain most of the information of the original indicators. The reduction of the number of indicators can not only improve the efficiency of the teaching quality evaluation, it can also reduce the complexity of the RBF neural network. The specific process of teaching quality evaluation based on the principal component analysis is as follows:

Suppose the original English teaching quality evaluation index set is:

\[
X = (X_1, X_2, \ldots, X_p)
\]  

(5)

Among them, \( p \) is the number of teaching evaluation indicators. The data of the English teaching quality evaluation indicators are quite different. In order to reduce the impact of big data on small data, it is necessary to standardize the collected data. The standardized processing formula is:
The evaluation index is calculated:

\[
\bar{r}_{ij} = k_{ij} - \bar{k}_j, \tag{6}
\]

where

\[
\begin{cases}
\bar{x}_j = \frac{1}{n} \sum_{i=1}^{n} k_{ij}, \\
s_j = \frac{1}{n-1} \sum_{i=1}^{n} (k_{ij} - \bar{x}_j)^2.
\end{cases}
\tag{7}
\]

After the standardized treatment of the teaching quality evaluation index, the correlation coefficient matrix of the evaluation index is calculated:

\[
R = (r_{ij})_{p \times p}, \tag{8}
\]

where \(r_{ij}\) represents the correlation coefficient between the \(i^{th}\) teaching quality evaluation sample and the \(j^{th}\) index, and the calculation method is:

\[
r_{ij} = \frac{1}{n-1} \sum_{k=1}^{n} k_{ik} \bar{k}_{kj}. \tag{9}
\]

Constructing the characteristic equation \(\lambda u = Ru\), calculate the eigenvalue and the eigenvector of the characteristic equation:

\[
\lambda = (\lambda_1, \lambda_2, \ldots, \lambda_p), \quad \lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_p \geq 0, \\
u = (u_1, u_2, \ldots, u_p). \tag{10}
\]

Calculate the contribution of the main components of the English teaching quality evaluation index to the cumulative variance:

\[
\zeta = \sum_{i=1}^{p} \alpha_i, \tag{11}
\]

where \(\alpha_i\) represents the contribution of the \(i^{th}\) main component in the teaching quality evaluation index. In order to select the main index (i.e., principal component) that can best represent all index information from the teaching quality evaluation index, if the cumulative contribution of the first \(m\) main components is greater than 85%, it can be concluded that these \(m\) main costs can basically represent all the evaluation indexes of English teaching quality. The indexes selected based on the principal component analysis as the new feature vector for evaluating English teaching quality can effectively reduce the dimension of the features and improve the evaluation efficiency while maintaining the performance of the teaching quality evaluation.

**4.2. Weight Calculation.** In English classroom teaching evaluation, the evaluation is divided into three roles: expert, student, and teacher. The model for calculating expert index weights is provided. This model’s computation procedure can be referred to by students and teachers. Experts include \(n\) first-class indicators (four first-class indicators are included in this research), among them: \(U_1, U_2, \ldots, U_n\) and the corresponding weights of these classroom evaluation indicators are \(C_1, C_2, \ldots, C_n\), respectively. For each level-1 index, there are different numbers of level-2 indicators. The number of level-2 indicators corresponding to \(n\) level-1 indicators in English classroom teaching evaluation is \(K_1, K_2, \ldots, K_n\), respectively; thus, the weight of level-2 indicators corresponding to English classroom teaching evaluation indicators is \(C_{11}, C_{12}, \ldots, C_{1k_1}, C_{21}, C_{22}, \ldots, C_{2k_2}, C_{n1}, C_{n2}, \ldots, C_{nk_n}\), respectively. For experts, if there are \(n\) primary indicators, the sum of the weights of the primary indicators in the whole goal is 1. In addition, students and teachers can also be obtained by analogy.

The sum of the weights of students and teachers in the whole goal is 1, and thus it meets the publicity (12).

\[
C_1 + C_2 + \cdots + C_n = 1. \tag{12}
\]

In English classroom teaching, the weight of each level-1 index of experts, students, and teachers is the sum of level-2 indicators; hence, they all meet the calculation of indicators of experts, students, and teachers, such as publicity (13).

\[
C_i = C_{i1} + C_{i2} + \cdots + C_{ik} \quad (i = 1, 2, \ldots, n). \tag{13}
\]

Namely

\[
\begin{cases}
C_1 = C_{11} + C_{12} + \cdots + C_{1k_1}, \\
C_2 = C_{21} + C_{22} + \cdots + C_{2k_2}, \\
\quad \cdots, \\
C_n = C_{n1} + C_{n2} + \cdots + C_{nk_n}.
\end{cases} \tag{14}
\]

From the above analysis, it can be concluded that the weight calculation process of English classroom teaching evaluation is divided into the following steps.

Calculate the total score \(F\) of the middle school English classroom teaching evaluation questionnaire; before calculating the weight of the secondary indicators of experts, students, and teachers, it is necessary to calculate the total score of the questionnaire of experts, students, and teachers. Now that the score \(F_{ij}\) of secondary indicators is known, the score \(F_i\) of primary indicators is the sum of all secondary indicators under the branch of primary indicators, and the total score \(F\) is the sum of all primary indicators. Therefore, assuming that experts, students, and teachers have \(n\) primary indicators, and the number of secondary indicators under each primary indicator is \(k_1, k_2, \ldots, k_n\), the score of the \(i^{th}\) primary indicator satisfies the following formula:

\[
F_i = F_{i1} + F_{i2} + \cdots + F_{ik_i} \quad (i = 1, 2, \ldots, n). \tag{15}
\]

The total score \(F\) of secondary indicators of family, students, and teachers, respectively, meets the following formula:

\[
\begin{cases}
F = F_1 + F_2 + \cdots + F_n, \\
F = F_{11} + F_{12} + \cdots + F_{1k_1} + F_{21} + F_{22} + \cdots + F_{2k_2} + \cdots + F_{n1} + F_{n2} + \cdots + F_{nk_n}.
\end{cases} \tag{16}
\]
(2) Then, calculate the secondary index weight $C_{ij}$ of the English classroom experts, students, and teachers, where $C_{ij}$ represents the weight of the $j$ secondary index of the I primary index branch, and $F_{ij}$ is the score of the $j$ secondary index under the I primary index branch, and obtain the formula

$$C_{ij} = \frac{F_{ij}}{F}.$$  \hspace{1cm} (17)

(3) According to the above formula (17), calculate the primary index weight $C_i(i = 1, 2, ..., n)$ of experts, students, and teachers, respectively, give the expert index system table, and calculate the weight of experts. Students and teachers can refer to the weight calculation process of experts, as shown in Table 2.

### 4.3. Comprehensive Evaluation Results.

Obtain the expert-level index weight and the expert-level index fuzzy relation matrix $R$, so as to obtain the intermediate variable $B$. Similarly, the intermediate variable $B$ of students and teachers can also be obtained.

$$B = C \circ R = C \circ \begin{bmatrix} C_1 \circ R_1 \\ C_2 \circ R_2 \\ \vdots \\ C_k \circ R_k \end{bmatrix} = (b_1, b_2, ..., b_P).$$  \hspace{1cm} (18)

$b_k (k = 1, 2, ..., P)$ refers to the comprehensive evaluation value of each evaluation index, i.e., the final value of experts, students, and teachers in the English classroom teaching evaluation.

(1) Normalize $b_k$ to obtain formula $b'_k$.

(2) According to formula (19), the evaluation value, i.e., $w$ value, can be calculated to obtain the evaluation level of English classroom teaching in middle school, as shown in formula (20).

$$w = b'_1 \times v^T.$$  \hspace{1cm} (20)

Thus, the evaluation level $w$ of the English classroom teaching effect evaluation is obtained. If $w$ value is at which evaluation level, the whole comprehensive evaluation is at which evaluation level.

### 5. Experiment

In the experimental part, we discussed the data sources, the normalized mean square error, and the accuracy of the English teaching evaluation.

#### 5.1. Data Sources

Undergraduates and teachers from colleges and majors at a 211 project university were chosen as the survey subjects, and the data collection method was a self-administered questionnaire in order to verify the effectiveness and reliability of the machine learning-based evaluation method of English teaching quality. The evaluation index of English teaching quality is designed into a questionnaire according to the Likert scale, and the questionnaire is randomly distributed to the respondents by the stratified sampling method, such that they can complete the questionnaire independently and review its effectiveness. A total of 370 questionnaires were sent out, and 370 of them...
were recovered, resulting in a 100% questionnaire recovery rate, with 365 valid questionnaires and a questionnaire efficiency of 98.6%.

5.2. Normalized Mean Square Error. In order to verify the effect of this method on English teaching evaluation, the normalized mean square error of the effectiveness of the English teaching evaluation is obtained using the methods of literature [6], literature [7], and this method, as shown in Figure 2.

On analyzing Figure 2, when the number of iterations is 10, the normalized mean square error of the effectiveness of the English teaching evaluation of literature [6] method is 1.01, the normalized mean square error of the effectiveness of the English teaching evaluation of literature [7] method is 0.57, and the normalized mean square error of the effectiveness of the English teaching evaluation of this method is 0.18. The normalized mean square error of the English teaching evaluation effectiveness of literature [6] technique is 0.82 when the number of iterations is 30, 0.58 when the number of iterations is 30, and 0.08 when the number of iterations is 30. When the number of iterations is 60, literature [6]’s normalized mean square error of the effectiveness of the English teaching evaluation method is 0.56, the normalized mean square error of the effectiveness of the English teaching evaluation of literature [7] method is 0.49, and the normalized mean square error of the effectiveness of the English teaching evaluation of this method is 0.03. The normalized mean square error of the effectiveness of this method is much lower than that of the other methods, which shows that this method can improve the effectiveness of the English teaching evaluation.

5.3. Accuracy of the English Teaching Evaluation. In order to verify the accuracy of this method in English teaching evaluation, literature [6]’s method, literature [7]’s method, and this method are used to evaluate the accuracy of English teaching, as shown in Figure 3.

By analyzing Figure 3, we can see that the accuracy of the English teaching evaluation is different under different methods. When the test number is 10 times, the effectiveness of the English teaching evaluation of literature [6] method is 0.79, the accuracy of the English teaching evaluation of literature [7] method is 0.72, and the accuracy of the English teaching evaluation of this method is 0.99. When the test number is 20 times, the accuracy of the English teaching evaluation of literature [6] method is 0.83, the accuracy of the English teaching evaluation of literature [7] method is 0.73, and the accuracy of the English teaching evaluation of this method is 0.98. When the test number is 30 times, the accuracy of the English teaching evaluation of literature [6] method is 0.84, the accuracy of the English teaching evaluation of literature [7] method is 0.71, and the effectiveness of the English teaching evaluation of this method is 0.99. This shows that this method can improve the accuracy of the English teaching evaluation.

6. Conclusion

This paper designed an English teaching evaluation method based on machine learning, created an analytic hierarchy procedure for constructing the judgment matrix of English teaching evaluation indicators, and determined the contribution of English teaching quality evaluation indicators. The weight calculation model for English teaching assessment is built using machine learning, and the comprehensive findings are obtained using the fuzzy evaluation method. The following conclusions are drawn through experiments:
(1) When the number of iterations is 60, the normalized mean square error of the effectiveness of the proposed method is 0.03. This demonstrates that this strategy can help enhance the efficiency of English teacher evaluation.
(2) When the test number is 30 times, the effectiveness of the English teaching evaluation of this method is 0.99. This demonstrates that this strategy can help increase the accuracy of the English teacher evaluations.

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

Conflicts of Interest
The author declares that he has no conflict of interest.

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