Research Article

College English Teaching Evaluation Model Using Natural Language Processing Technology and Neural Networks

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College English is one of the most important basic courses in college education, and classroom evaluation is one of the effective means to improve teaching efficiency. Multidimensional classroom evaluation system, which reflects the characteristics of college English courses, is the premise to standardize the evaluation process and ensure the fair and reasonable evaluation results. Based on NLP (natural language processing) technology and neural network, we use NLP to optimize BPNN (BP neural network) method to construct CETE (college English teaching evaluation) system model, which quantifies the concept of teacher evaluation index as input, makes the data clear, and takes the teaching effect as output. The training results show that the network can fit the training data well, and the prediction effect is remarkable, which indicates that the CETE model based on the BPNN method optimized by NLP is reasonable and feasible.

1. Introduction

CETE (college English teaching evaluation) is based on college English teaching rules, principles, and objectives, and it employs scientific evaluation techniques, means, and methods to make value judgments on the effectiveness of college English teaching and the achievement of teaching goals. Classroom teaching is critical for improving the overall quality of the course because it is the central link in college English education. It is necessary to establish a target evaluation index system [1] in order to realistically and comprehensively evaluate the complicated and changeable system of college English classroom teaching. Simultaneously, college English is developing a brand-new classroom teaching evaluation system so that college students can clearly define their learning objectives, recognize their strengths and weaknesses in the English learning process, and significantly improve their English language skills and level [2]. The college English teaching method includes a system for evaluating teachers. Setting up a comprehensive evaluation system can help teachers reflect on their teaching situation by displaying the teaching effect objectively and comprehensively.

Many universities are now implementing a teacher evaluation system in which students grade teachers. All school subjects are divided into theoretical, practical, experimental, and other categories, and evaluation indicators are established for each subject, with students anonymously scoring the subject’s class teacher. However, because evaluators include colleagues, experts, leaders, and students, the evaluation information of a teacher’s lecture quality is influenced by a variety of factors, including the evaluator’s personal preferences and knowledge structure, resulting in a complex nonlinear relationship between inputs. The system’s output makes it difficult to create a mathematical model that is both reasonable and scientific. Fuzzy comprehensive evaluation method [3], grey system theory [4], Markov chain [5], support vector machine, and other comprehensive evaluation methods [6] are currently the most common traditional CETE model methods. Despite the fact that the corresponding relationship between teaching quality and each evaluation index is taken into account, the evaluation process...
may include arbitrary factors or subjectivity, ignoring the complex nonlinear relationship between teaching quality and each index affecting teaching quality. Some indicators' results are difficult to assess using traditional methods, and the calculations and solutions are time-consuming. These algorithms are also incapable of self-learning [7]. NLP (natural language processing) is widely used in today's development environment. With the growth of the Internet over the last 20 years, the demand for this technology is growing, making text processing and analysis very practical in a variety of fields. The application significance of BPNN as a complex nonlinear correlation approximation allows the above problems to be solved.

The evaluation of college English teaching is a multidimensional, fuzzy, and complex nonlinear problem. There are many indicators that affect teaching quality, and there is a complex nonlinear relationship between different indicators that affect teaching quality and teaching quality [8]. In this paper, a variety of teaching quality evaluation methods currently used are compared and analyzed, so as to provide some reference for establishing a more objective, fair, and scientific CETE system.

The main innovations of this paper are as follows:

1. This paper takes college English classroom evaluation as a breakthrough point, analyzes its principles and contents, and then puts forward the concrete points of evaluation system construction to comprehensively improve the efficiency and quality of college English classroom evaluation.

2. The key of CETE is to establish a complex nonlinear relationship between the evaluation results of teaching quality and the indicators that affect teaching quality. Therefore, this paper systematically simulates the teaching quality (output) of university teachers and its influencing factors (that is, the teaching quality evaluation index as input) by using the characteristics of BPNN's nonlinear approximation ability, and establishes the relative error in the iterative process, gradually optimizes the parameters of backtracking algorithm, and establishes the corresponding evaluation model.

3. Organizational structure of the paper:

The first chapter introduces the research background and significance and then introduces the main work of this paper. The second chapter mainly introduces the related technologies of CETE. The third chapter puts forward the concrete methods and implementation of this research. The fourth chapter verifies the superiority and feasibility of this research model. The fifth chapter is the summary and prospect of the full text.

2. Related Work

2.1. Research on NLP Technology. The goal of NLP is to study and process the language using computer technology. That is, the computer is used as a powerful tool for language learning, and it is used to quantitatively study and connect language information. NLP is a unique language description used by both humans and computers, and it intersects with interdisciplinary subjects such as computer science, artificial intelligence, and linguistics.

In the field of natural language processing, the N-gram is a historical feature processing model. The N-gram model can be trained on trillions of words, according to Li et al., and the model's performance is greatly improved [9]. The most recent methods in this field, according to Wen et al., are methods based on machine learning and methods based on deep learning [10]. Kim et al. proposed a summarization method based on a machine learning algorithm that can be learned. Experiments show that the naive Bayes learnable method classifier outperforms all other basic methods [11]. Mustafa et al. proposed a model-based method in which the length of the abstracts generated by this method is positively correlated with the length of the manually compiled gold standard, implying that source articles worthy of abstracts can be implicitly captured [12]. Jararweh et al. classified several open IE solutions into three categories: rule-based, learning-based, and clause-based methods [13]. Mohanan et al. used an encoder-decoder framework in which the decoder predicted the mask part when the encoder input the sentence with the mask field, and they jointly trained the encoder and decoder to improve expression extraction and language modelling ability [14]. Perboli et al. proposed to learn the distributed representation of each word and build a language model to model the word sequence using RNN (recurrent neural network) [15]. In the sentence classification task of NLP, Jean et al. introduced CNN (convolutional neural network). This task extracts sentence features using CNN with two channels and then classifies the extracted features [16]. The results of the experiments show that CNN has a significant impact on feature extraction in natural language.

2.2. Present Situation of Teaching Research Evaluation. Education quality refers to the degree to which the educational achievements are consistent with the development of students' quality according to the curriculum, major, educational objectives, and norms. Educational quality evaluation is to use the theory and technology of educational evaluation to judge whether the educational process and results meet the specific quality requirements. The main body of teaching quality evaluation is the teaching process and its result, that is, the whole process and result of the activity of combining teaching with learning.

By calculating the refined grade evaluation matrix, Hou et al. obtained more scientific evaluation results of education and education quality using the fuzzy comprehensive evaluation method [17]. According to the teacher’s teaching quality evaluation index system and trust standard, Liu et al. established the CETE comprehensive attribute evaluation model, determined the weight of each index, and applied the model matrix by pairwise comparison of true roots [18]. In fact, school teachers' teaching abilities are assessed. According to Jiang et al., [19] the reliability of student evaluations may be better than the best objective test when the
number of student evaluations is sufficient (20 or more). Tang’s teacher evaluation index system is divided into four parts: first, establishing standards based on relevant teacher evaluation principles; second, determining evaluation objectives; third, determining various index system standards; and finally, assigning values to each index using appropriate evaluation methods and quantitative statistics [20]. Tang et al. proposed emphasizing the importance of the evaluation process to teacher development, as well as ensuring a scientific evaluation process to ensure educational quality and establishing communication and feedback links [21]. Shi et al. believe that by providing teachers with teacher evaluation results in a timely and accurate manner, teachers will be able to better understand the benefits and drawbacks of their work, as well as the needs of students and the direction of future development [22]. Teacher evaluation, according to Xin, is one of the foundations for assessing teachers’ teaching quality and professional evaluation of teachers, as well as a chance for teachers to share their teaching experiences, brainstorm ideas, and learn from each other’s strengths [23].

In the process of evaluation, we should give play to the feedback function, emphasize the forming function of evaluation, and strengthen the implementation of the incentive function in the evaluation results. However, how to embody these concepts in the concrete implementation process and methods of teacher qualitative evaluation, how to embody the diversity of evaluation topics and objectives in the evaluation process, and how to set more detailed evaluation standards have not been further studied. Therefore, it is necessary to further study how to strengthen the appropriateness of teachers’ qualitative evaluation in different disciplines, the appropriateness of disciplines and evaluation contents, and the induction of evaluation methods to the evaluated teachers.

3. Methodology

3.1. Construction of CETE System. With the rapid development of information technology under the new situation, the education field is an important channel and forerunner to deliver high-quality talents to society and enterprises. It is necessary to introduce more advanced educational concepts and establish CETE system. Based on truly advanced technology, a more diversified, comprehensive, targeted and modern class evaluation system can meet the requirements of continuously raising the construction consciousness to a new level. The design principle of index system refers to the standards to be followed when designing the evaluation index system, which are often arranged by practitioners. Therefore, when designing the CETE system, the following structural principles should be followed:

3.2. Principles of Science. One of the most important principles in establishing a university classroom quality evaluation index system is science. They do not overlap or contradict one another, and the evaluation criteria are realistic, objective, and comprehensive, all of which can be met with teachers’ help. In essence, classroom teaching is a mutual influence and interaction process between the two sides of education. The main body of learning activities is always students, who are often regarded as the ultimate realization of classroom teaching effect. Teachers are the planners and implementers of classroom instruction, and understanding of teaching objectives is the primary criterion for assessing the effectiveness of classroom instruction, which should not be overlooked. Simultaneously, combining self-evaluation with that of others can greatly improve CETE’s objectivity and comprehensiveness, as well as aid in the improvement of the teaching process. Also, make use of both quantitative and qualitative evaluation methods. Quantitative evaluation employs mathematical methods to objectively and accurately record the behaviors and teaching effects of teachers and students in the college English classroom, as well as to reveal the potential relationships and laws between various behaviors.

3.3. Principle of Stratification. The evaluation index system of college classroom teaching quality consists of several indexes, which must have a certain structure. The principle of hierarchy is that when designing the index system and selecting evaluation indexes for evaluation purposes, we should consider the functions of each index in the index system and then consider the hierarchy of indexes. Therefore, when designing the index system, the structure should be clear. The author has collected a large number of literature related to this study and comprehensively analyzed the results of the existing research by referring to various evaluation scales to evaluate the quality of college English teaching (see Figure 1 for the CETE index system).

In this evaluation index, according to the influence degree of college English teachers’ preclass preparation, basic quality, teaching content, teaching method, and teaching effect on the whole classroom, the weight difference is reflected in five dimensions. In order to make the evaluation content objective and reasonable, when different evaluation subjects evaluate teachers, the weight of the same dimension should be adjusted accordingly. Explore the correlation between teachers’ self-evaluation and other evaluations, promoting teachers’ professional development and improving the quality of college English classroom teaching. The correlation between evaluation dimensions enables English teachers to quickly become students’ favorite teaching professionals.

After establishing the index system and method of classroom teacher evaluation, concrete management mechanism is needed to promote the realization of evaluation functions. First, in addition to special observation classes and demonstration classes, classroom evaluation should be combined with ordinary students’ classroom life, with evaluation as a mechanism to promote teachers’ classroom and students’ learning progress. Second, evaluation should not be limited to formal professional lectures and peer lectures, but should be combined with external evaluation and self-evaluation of teachers and students. The real evaluation lies in the evolution of teaching staff. Finally, in order to maintain the discipline characteristics of college English education, the evaluation system of college English education cannot be transplanted or replaced by the evaluation of other departments.
3.4. CSTE Model Establishment. BPNN (BP neural network) is a widely used neural network, but it has some flaws, including slow convergence, easy local minimum input, difficulty determining the appropriate number of hidden layers and hidden nodes, and poor prediction effect on data with large differences in quantity and quantity [6, 7]. To improve the accuracy of BPNN calculation, the standard BP algorithm (absolute error back propagation) is improved in this paper, and the relative error of data is used as the error signal. We also use self-assessment to give students opportunities for self-study, reflection, and improvement, as well as to help them understand their own English learning environment and fully comprehend the dynamic adjustment or change of word creative learning strategies based on their own learning needs. Additionally, the overall learning outcomes will be improved. Peer evaluation can assist students in accepting fair and objective external evaluation and, to some extent, improving their interpersonal skills.

According to the three secondary evaluation indicators included in CSTE index system, these evaluation indicators serve as the input of the secondary system, the output of the secondary system serves as the neural network input of the education quality evaluation system, and the neural network output of the comprehensive evaluation system of education quality serves as the final result of the evaluation of college English teaching [9]. The structure of the whole system is shown in Figure 2.

Generally speaking, the number of neurons in the hidden layer is determined by the convergence performance of the network. If the number of neurons in the hidden layer is too small, the network may not be trained, or the network may not be "powerful" and fault-tolerant enough to identify samples it has never seen before. If the value of the hidden layer is too large, the learning time will become too long, and the error is not necessarily the best, so there is a problem of how to determine the appropriate number of neurons in the hidden layer. In this paper, the number of neurons in the hidden layer is initially set to 12 according to relevant experience.

In neural network, the input value of each neuron is the accumulation of weights multiplied by the output values of all neurons in the upper layer, and the activation function processes the input values to generate the output of neurons. BPNN neuron transformation function usually uses sigmoid function.

$$f(x) = \frac{1}{1 + \exp^{-x}}.$$ (1)

In the numerical calculation process of standard BPNN algorithm, the absolute error is usually used as the error transmission signal, so the error is often too large. This is because absolute error tends to invisibly enlarge the overall error value of the system without considering the relationship between absolute error and actual value, thus reducing the accuracy of the final prediction result and slowing down the calculation speed. By using relative error as the transmission signal of BPNN error, the influence of these defects can be avoided [14].

Use formulas (2) and (3) to calculate the generalization error $d_{t}^{k}, e_{j}^{k}$ of each unit in the output layer and middle layer.

$$d_{t}^{k} = \frac{(x_{t}^{k} - n_{t}^{k})n_{t}^{k}(1 - n_{t}^{k})}{(x_{t}^{k})^2} t = 1, 2, \cdots, q; k = 1, 2, \cdots, n.$$ (2)

$$e_{j}^{k} = \left[\sum_{t=1}^{q} d_{t}^{k} \cdot v_{ji}\right] h_{j}^{k} (1 - h_{j}^{k}) j = 1, 2, \cdots, p.$$ (3)

The number of neurons in the input layer is 7, because there are 7 auxiliary indicators as input neurons in the network. At the same time, the evaluation target is taken as the output of the network, so the number of output layers...
is 1. The number of neurons in the hidden layer is set to 1, and the number is set to 12. We use random numbers as the connection weights and initial thresholds of neural networks and train BPNN according to the above steps.

In order to train the neural network, the author adopted an improved weight adjustment algorithm:

$$w(t + 1) = w(t) - \eta \frac{\partial J(t)}{\partial w(t)} + \beta [w(t) - w(t - 1)],$$  \hspace{1cm} (4)

where $\beta$ is the smoothing factor; $0 < \beta < 1$; and $\eta$ is the learning factor. The total objective function of its network is

$$J = \frac{1}{k} \sum_{m=1}^{k} (y - p_m)^2 \leq \epsilon,$$  \hspace{1cm} (5)

where $\epsilon$ is any small positive real number and $p_m$ is the expected value.

In NLP domain, the rule system is widely used in text classification, data cleaning, antispam, and other tasks. However, writing the rules with high coverage is a challenge. The BP_NRE (BP_Neural Rule Engine) model in this paper shows how to increase the applicable scope of rules in the existing rule system. To build the BP_NRE model, first, we need to abstract the main integrated functional modules from all the rules, then generate the output order through the execution order and parameters of the modules generated by the parser, and finally execute the functional modules in turn. BP_NRE model consists of two main components: function module and rule parser. Function module is used to realize predefined basic logic functions. Rule parser is used to decompose rules and get the layout of functional modules. Sequence tagging is the ability to locate and mark the position of specific keywords in sentences through neural network, in which “Find_Positive” refers to finding a word in regular rules, as shown in Figure 3.

$c_{ij}$ is the $j$ context of the $i$th word, and $v_{ij}$ is the representation of context $c_{ij}$. Then, $p$ is encoded into a fixed-length vector $v_p$ by the same neural network.

Finally, use formula (6) to calculate the score between each context $c_{ij}$ and the fixed-length vector $v_p$, and then use the score of the sequence marking model to determine the mark 0 or 1, whose score $s_i$ is mapped to the mark $y_i$ of each position.

$$s_{ij} = \text{Sore}(v_{ij}, v_p) = v_{ij}^T \cdot W \cdot v_p,$$  \hspace{1cm} (6)

where $W$ is a trainable matrix. For example, given a sentence containing the word $x_2$ and given the keyword $p$, then explain how to get the tag $y_2$ of the word $x_2$, and of course, every word in the sentence also gets its corresponding tag in the same way.

Specifically, the encoder is responsible for reading the input from the source language and encoding it into vector $c$. The input format here is word embedding from the source language, and the encoding process is a recursive process.

$$h_t = f(x_t, h_{t-1}).$$ \hspace{1cm} (7)

On the decoder side, the probability distribution of the target language dictionary is usually calculated given the context vector $c$, and then, the output vocabulary is predicted.

$$p(y) = \prod_{t=1}^{T} p(y_t | \{y_1, \cdots, y_{t-1}\}, c),$$  \hspace{1cm} (8)

where $y$ is the output sequence of the decoding end.

When using attention mechanism to encode input words, the weight of context vector $c_i$ is

$$c_i = \sum_{j=1}^{T} a_{ij} h_j,$$  \hspace{1cm} (9)

Specifically, the gated RNN used in this model is...
calculated as
\[ e_{ij} = a(s_{i-1}, h_j) = v_a^T \tanh \left( W_a s_{i-1} + U_a h_j \right), \]  
(10)

where \( W_a, U_a \) is the parameter of attention mechanism.

Because the model contains two attention mechanisms, the complexity of the model is very high. In order to reduce the model parameters and memory usage, instead of using LSTM (long short-term memory) as RNN in the model, we chose RNN cells with gates [19]. This sequence-to-sequence model with two attention mechanisms is called DAM (double attention mechanism) model (Figure 4).

As a basic method, we train the sequence-to-sequence model with a single attention mechanism and test it on the test set. In order to optimize the network more effectively and automatically, AdaDelta algorithm, a quadratic optimi-

4. Experiment and Results

The evaluation method based on BPNN is characterized by strong parallel computing ability and decoupling ability of BPNN, and good nonlinear mapping ability of network can make input and output match well. And adaptability and specific intelligence, because it effectively overcomes and avoids subjectivity and uncertainty, ensure the objectivity, fairness and science, flexibility, adaptability, and usability of the evaluation results.

The number of neurons in the BPNN output layer is determined by the seventh order system, and the number of neurons in the output selection layer is 1. The number of hidden layers is 7, the number of hidden layers of each secondary system is 3, and the learning rate is 0.2. The momentum coefficient is 0.8. Set the convergence error threshold to zero 0.0001. The training process is shown in Figures 5 and 6.

After the network training, we use different data sets to test (randomly select a different group of 10 samples from the questionnaire) and then check the error between the evaluation target value output by the neural network and the actual evaluation target value. The results are shown in Figure 7.

As shown in Figure 7, the output value of CETE model built by BPNN is very close to the actual value. That is, the model can judge the teaching effect more accurately according to each evaluation index.

Table 1 shows the comparison between the predicted results and the expert evaluation results.

According to the analysis in Table 1, the prediction accuracy is within the acceptable range, which shows that the CETE model based on BPNN is effective and reasonable.
In this paper, we select two data sets to evaluate the performance of BP_NRE. One is Chinese criminal case classification data set, and the other is English relational classification data set. Various model experiments of Chinese criminal case classification data set are shown in Figure 8.

As shown in Figure 8, in the Chinese criminal case classification data set, the accuracy rate of the rule model RE is 100%, the rules are accurate and reliable, and the recovery rate is very low, resulting in a very low proportion of rules. Part of the reason is that a category may have multiple rules, but when data is randomly divided into test sets, only some rules in one category are included in the test set. It can be seen that the BP_NRE model significantly improves the recall rate with the highest F1 value while maintaining high accuracy.

On the English relational classification data set, a comparative experiment was carried out with the rule model and BP_NRE, the best model in the previous data set. As shown in Table 2:

The results of the English relational classification data set show that the BP_NRE model has a much higher recall rate than the ordinary model RE while maintaining a high level of accuracy. When a neural network is introduced, the experimental results show that BP_NRE can deal with the hierarchical structure of RE and effectively analyze RE while maintaining high accuracy and interpretability. The rule systems RE and BP_NRE are faster than the neural network ensemble model in terms of the model execution speed. The remaining models must be expressed using vectors, and these word vectors must be read when the model runs, so the rule system is faster than other models. Word vectors have a smaller vocabulary than word vectors because they do not require word segmentation. The running speed of the BP_NRE model on the test set can play a role after the word vector representation required by the model is presegmented and constructed. As the data in Table 3 shows, DAM can effectively reduce the number of errors in the output results. At the effective output, the F1 value of the model reaches 0.819, and various errors depend on the training process, as shown in Figure 9.

Experiments show that the performance of the DAM model on the test set is significantly improved after the DAM model is introduced. Nevertheless, the model still has a lot of room for improvement, such as speeding up the training and fine-tuning the model parameters. The purpose of CETE is not to reward or punish academic achievements, but to form a scientific and reasonable incentive mechanism through evaluation and create a competitive environment for sustainable development. Therefore, it is necessary to mobilize the enthusiasm and initiative of teachers to participate in teaching quality evaluation, ensure the fairness of students’ participation in teaching quality evaluation, supervise experts to participate in teaching evaluation for a long time, and deeply understand the importance of educational evaluation.
Quantitative evaluation is simple and easy, and it is more accurate and meticulous to scientifically analyze teaching quality in a quantitative way through statistical analysis. Therefore, the flexible use of various teaching quality evaluation methods and the combination of quantitative evaluation of teaching static factors and qualitative evaluation of teaching dynamic factors can make CETE system more scientific and reasonable. When evaluating the diversity of college English teachers, students’ characteristics, curriculum, teachers’ characteristics, and other factors should be considered, and different evaluation indicators should be adopted according to the background characteristics.

### 5. Conclusions

CETE research emphasizes that under the guidance of the concept of English teaching evaluation, experts, teachers, and students should participate in the evaluation project together, so as to realize the multidimensional evaluation of teaching and learning. CETE system is a complex nonlinear system, and there are many uncertain factors between input and output. BPNN model has high nonlinear function mapping ability, adaptability, and self-learning ability, which can effectively overcome the defects of existing evaluation methods. The optimized BPNN model based on NLP is established, and the principle and methodology of university are expounded. Import the survey data through the software, calculate the training quality score, and compare and analyze the calculated value of the test sample with the survey data value. The results show that it is feasible to analyze and calculate CETE by using the BPNN theory method optimized by NLP.

### Data Availability

The data used to support the findings of this study are included within the article.

### Conflicts of Interest

The authors do not have any possible conflicts of interest.

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