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Tutoring Systems in English Teaching Evaluation Based on BP Neural Network and Intelligent CAD

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Abstract. In order to improve the quality of modern English teaching, this paper combines the BP neural network discriminant model to construct an English teaching evaluation system to discover problems in English teaching in time and proposes a feature extraction method for static optimal trend and time division. Moreover, this paper introduces the principal component analysis method to reduce the dimension of the features to reduce the computational complexity and uses the entropy weight method to determine the weight of each feature. In addition, this paper proposes a fast data search strategy consisting of coarse and fine matching, which is used to filter historical load data quickly. The research shows that the English teaching evaluation system based on the BP neural network and discriminant model proposed in this paper can improve the quality of modern English teaching in English teaching.

Keywords: BP neural network; Intelligent CAD; Tutoring Systems; Teaching evaluation
DOI: https://doi.org/10.14733/cadaps.2025.S8.73-86

1 INTRODUCTION

Giving full play to the respective advantages of information technology and practical English teaching and setting up a multi-dimensional practical English teaching platform system can support a practical English teaching operation mode that has both unified goals and flexibility. Moreover, it is necessary to combine the existing practical English teaching environment and platform, pay attention to hardware construction, strengthen software investment, give full play to the effectiveness of latent components, and promote the coordinated development of "hardware + software + latent components" [4]. At the same time, it is necessary to form a personalized learning and practice plan to achieve the purpose of "differential practice English teaching + characteristic training" and help students to comprehensively improve their autonomous learning, conscious practice, and self-management abilities [8].In addition, it is necessary to strengthen the construction of a network of experimental English teaching platforms. It is necessary to establish a digital learning platform called "practice English teaching website group + practice-assisted learning resource library" based on the practice of real educational English teaching skills training. Further, it is necessary to study the experimental English teaching resources, English teaching mode, and practical exploration of English teaching activities based on the ubiquitous learning theory and construct a new model of digital English teaching guidance in the whole process of self-learning and personalized education before experimental class, in class, and after class. It is necessary to create a network virtual English teaching experimental platform to give students English teaching experience training that simulates English teaching situations as much as possible [12]. Secondly, it is necessary to strengthen the construction of off-campus practice bases. It is necessary to strengthen contact with local education departments, actively expand the field of English teaching practice, vigorously establish various types of high-quality, practical English teaching bases at all levels, and strengthen the construction and service work of practical English teaching bases. While improving students' practical English teaching ability, it cultivates excellent teachers for basic education and serves local education [17]. Meanwhile, it is necessary to strengthen the pragmatic development of the "dual tutor system". It is necessary to pay attention to the growth and development of teachers of curriculum English teaching theory and to provide care and support in going out for further studies, professional title evaluation, and academic qualifications, and help them solve various difficulties and problems encountered in work and life. It is necessary to focus on building a high-quality curriculum for English teaching faculty with high ideological awareness and strong business ability. At the same time, it is necessary to pay attention to the selection and training of educational internship instructors in off-campus practice schools and to provide practical training guidance for interns in the "dual tutor system" of "dual teacher interaction and collaborative education" [17]. It is necessary to strengthen the construction of effective operation and management mechanisms of various experimental English teaching platforms. Finally, it is necessary to explore a scientific, efficient, and pragmatic networked practice English teaching management service mode through the construction of a networked practice English teaching environment and an open multi-dimensional English teaching platform. It is necessary to create a good English teaching practice environment for pre-service education, entry education, and in-service education training and support the efficient implementation of the training model [6].

The evaluation of teachers' practical ability is a necessary measure that must be taken seriously, carefully designed and pragmatically promoted under the guidance of the educational development of building a high-quality education system and in the situation where the "double reduction" policy is imperative. First, determine the structure and standard of teachers' practical English teaching ability that match the high-quality development of education [1]. Teachers' practical English teaching ability should point to the comprehensive development of students, and should take students as the center, take students' life development effect as the scale, and use the actual English teaching quality as the standard to plan and judge the structure and standard of teachers' practical English teaching ability. The structure of teachers' practical English teaching ability should include the ability to establish English teaching goals, the ability to develop English teaching resources, the ability to design the English teaching process, the ability to evaluate the quality of English teaching, the ability to guide students' development, etc. standard system [3]. Secondly, according to the structure and standard, carry out the evaluation of teachers' practical English teaching ability. For the evaluation of teachers' practical English teaching ability, a multi-sample, multi-subject, multi-dimensional, and long-term evaluation plan should be adopted, and the evaluation principle of combining quantitative evaluation and qualitative evaluation should be adhered to, and teachers, students, parents, and schools should be used as evaluation subjects. Multi-subject evaluation plays multiple functions to promote the development of teachers' practical ability; it is necessary to extend a long period of time and evaluate teachers' practical English teaching ability from a sustainable development perspective [18]. Finally, promote excellence through evaluation and continue to improve. Evaluation is a review and inventory of teachers' practical English teaching ability. It is necessary to promote teachers' reflection, promote teachers' awareness, and promote teachers' comprehensive ability including practical English teaching ability. It is necessary to take the continuous improvement of teachers' practical English teaching ability as a long-term project, integrate multiple resources and multiple forces, and take multiple measures and multi-dimensional interventions to ensure that teachers continue to develop and optimize practical English teaching capabilities in theoretical learning and practical actions [5] .

Regarding the status quo of college teachers' informatization teaching ability, literature [15] found through investigation that college teachers generally have awareness of informatization teaching, but the technology, knowledge and level have not been improved accordingly, mainly reflected in image processing software, video and audio editing , screen recording software, animation and web page production. Literature [16] found that the overall level of information-based teaching ability of young teachers in colleges and universities is acceptable, but the basic information literacy (awareness and attitude, basic knowledge and skills), information-based teaching analysis ability, design ability, implementation ability and evaluation ability are not good enough. Balanced, there is polarization in each ability dimension, except "basic knowledge and skills" that need to be further strengthened, the other four aspects are relatively good. Literature [10] pointed out that college teachers' informatization teaching design and implementation ability is insufficient, and the integration ability of information technology and curriculum is weak. The survey of literature [11] shows that college teachers as a whole have the basic ability of informatization teaching, but the ability to innovate teaching mode and informatization teaching research ability with the help of information technology needs to be improved; the awareness, literacy, ability and research ability of information technology into teaching4 There are significant differences in the ability of each dimension, and there are also differences in some demographic variables and school types, showing a development process from "awareness of literacy to ability to research". Literature [9] found that college English teachers have a high awareness of information technology, but the use of information tools is limited to "PPT" and "multimedia classroom system", and they are familiar with new tools such as micro-lecture production software and online open course platform. Not enough, the utilization rate is not high; informatization ability declines with the growth of age, teaching age and professional title, and rises with the growth of academic qualifications. Male teachers are higher than female teachers, and teachers who have participated in training are significantly higher than those who have not participated in training. Literature [2] found through investigation that college teachers have strong awareness and attitude of informatization teaching, and can use information technology to carry out teaching; the level of informatization teaching knowledge and skills is in general and needs to be improved urgently; the application level of informatization teaching is average, and it is difficult to adapt to the "Internet + "The needs of the times. The literature [13] survey found that the interviewed teachers lacked awareness of active learning and exploration of emerging information technology and educational concepts, and their understanding and mastery of education informatization 2.0 related documents, technologies, and educational concepts were very low. The implementation ability is insufficient, and the ability to use big data for individualized and precise teaching is insufficient.

Scholars generally focus on the investigation of information-based teaching ability, but there is no unified understanding of the conceptual definition and structural dimensions of information-based teaching ability. Informatization teaching design ability, informatization teaching implementation ability and informatization teaching evaluation ability are the three recognized sub-competencies in the dimension of scholars' ability structure [19]. Literature [14] believes that the informatization research ability of college teachers is also very important, and scientific research ability is also an important ability feature that distinguishes college teachers from primary and secondary school teachers, but consciousness and ability are two different concepts, and strong consciousness does not mean high ability. . Reference [20] College teachers' informatization teaching and research ability refers to the total ability of teaching and researching using information technology means under the guidance of informatization teaching theory, supported by information technology, mainly including the knowledge and skills of informatization teaching, informatization teaching. The ability of design, implementation and evaluation in the process, the ability of information technology research and development, etc.

This paper combines the BP neural network discriminant model to construct an English teaching evaluation system to find out the problems in English teaching in time and improve the effect of English teaching.

2 NETWORK DYNAMIC OPTIMAL POWER FLOW OF ENGLISH TEACHING SYSTEM BASED ON DATA-DRIVEN

With the rapid development of technologies such as the Internet, sensors, the Internet of Things, and 5G communications, a large amount of historical load data has accumulated in the database of the English teaching system network. This has paved the way for the data-driven correlation theory to be applied to the dynamic optimal power flow of the English teaching system network. Under the background that the database of the English teaching system network has massive historical data, this chapter proposes a data-driven English teaching system network dynamic optimal power flow method.

2.1 Data-Driven Dynamic Optimal Power Flow Framework

The English teaching system network generates massive data every day, which is collected by sensors and stored in the database. Looking for the equipment adjustment strategy corresponding to the historical load sequence from the database can guide the optimal control scheme under the current negative sequence level. The data-driven dynamic optimal power flow framework is shown in Figure 1.

For the data-driven strategy, the first step is to extract the daily load curve of the English teaching system network or the load characteristics of the network nodes of the English teaching system in each period. After that, the rough matching operation is performed on the current load sequence and the historical load sequence through the symbol feature so as to obtain several historical load sequences as candidate sets. Then, the current load sequence and the historical load sequence are finely matched by numerical features so as to obtain the historical load sequence that is most similar to the current load sequence. Then, the control scheme of the most similar historical load sequence is applied to the current load sequence, and it is judged whether the constraint conditions are met, and if so, the result is output.

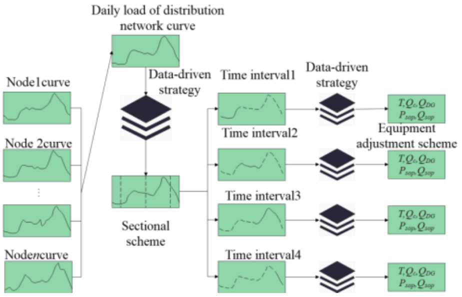
2.2 Feature Selection

In the subsequent process, the data-driven strategy will be used to find the most similar historical load sequence according to the daily load curve and the load level of each node. This section mainly introduces the characteristics of time division and static optimal power flow.

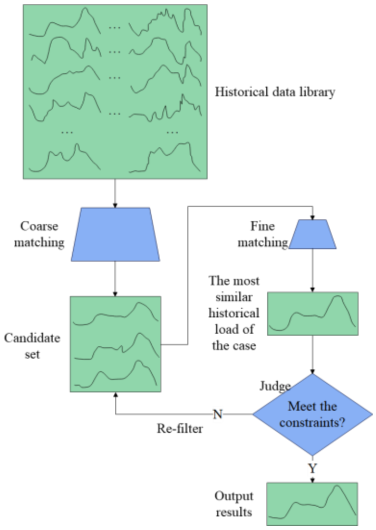
The existing methods for extracting load sequences mainly include Piecewise Aggregate Approximation (PAA) and Piecewise Linear Approximation (PLA). Therefore, this paper adopts the intuitive and easy-to-calculate PAA to extract the features of the load sequence.

The process of feature extraction by PAA is shown in Figure 2. The dimension of the original daily load curve is n, and the original daily load curve is evenly divided into segments using PAA; the value of each segment is represented by the mean value of the segment load, and its mathematical expression is as follows:

$$x_i = \frac{\sum_{j=i-1\ k+1}^{i-k} y_j}{k-1}, i = 1,2,\cdots m \tag{1}$$



（a）A Framework for solving the dynamical optimal power flow



（b）Data-driven strategy.

Figure 1: The Framework of Data-Driven Optimal Power Flow.

In the formula, y_j is the sampling point of the original daily load curve, x_i f is the extracted feature, and k is the compression ratio $k = n / m$.

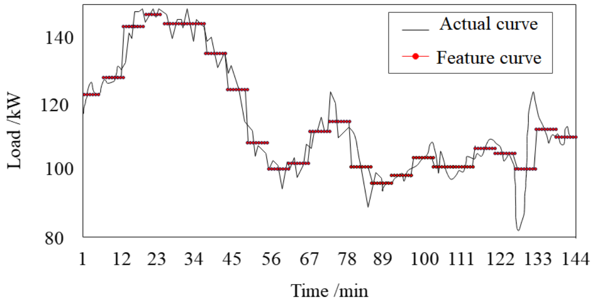


Figure 2: Characteristics of daily load curves extracted by PAA.

Therefore, this paper selects the load of each node as the original feature to calculate the similarity between the load of each node in the current English teaching system network and the load of each node in the historical data. The mathematical expression of the original feature is as follows:

$$X = \left[P_1, P_2, \cdots P_n, Q_1, Q_2, \cdots Q_n\right] \tag{2}$$

In the formula, X represents the characteristics of the static optimal power flow, P and Q are the active power and reactive power of the node, respectively, and n is the number of nodes.

3 Dimensionality Reduction and Weights of Features

The main idea of principal component analysis is to replace the original variable with as few features as possible on the premise of retaining most of the information of the original variable. The steps of principal component analysis are as follows:

1. Normalization

The characteristics of the static optimal power flow are composed of the active power and reactive power of the nodes. The normalization matrix is obtained after normalizing the original features, and its mathematical expression is as follows:

$$x_{ij}^{'} = \frac{x_{ij} - x_{i,min}}{xj, min_{j,max}, i = 1,2,\cdots m; j = 1,2,\cdots p} \tag{3}$$

In the formula, x_{ij} and $x_{ij}^{'}$ are the j-th feature of the i-th historical load sequence before and after normalization, respectively, $x_{j,min}$ and $x_{j,max}$ represent the minimum and maximum values of the j-th feature, respectively, m is the number of historical load sequences, and p is the number of original features.

2. Calculate the correlation coefficient matrix

The algorithm calculates the Pearson correlation coefficient r between each feature, thereby forming a coefficient matrix $R = r_{ij}\ _{p\times p}$ between p features. Among them, the expression of the correlation coefficient is as follows:

$$r_{ij} = \frac{\sum_{k=1}^{n} x_{ki}^{'} - x_i^{'} \quad x_{ki}^{'} - \overline{x_j^{'}}}{\sqrt{\sum_{k=1}^{n} x_{ki}^{'} - \overline{x_i^{'}}^{2} \sum_{k=1}^{n} x_{ki}^{'} - \overline{x_j^{'}}}} \tag{4}$$

In the formula, r_{ij} is the Pearson coefficient between feature i and feature j, $x_{ki}^{'}$ is the j-th feature of the normalized k-th historical load sequence, and $\overline{x_j^{'}}$ is the mean of feature i.

4 CALCULATE EIGENVECTORS AND EIGENVALUES

The algorithm calculates the eigenvalue $\lambda_i \ i = 1,2,\cdots p$ of the Pearson coefficient matrix, then rearranges the eigenvalues in a descending order, and finally calculates the eigenvector $a_i \ i = 1,2,\cdots p$ of each eigenvalue.

4. Calculate the cumulative contribution rate of the principal components and obtain new features

The cumulative contribution rate of the first m principal components can be calculated as follows:

$$\alpha_m = \sum_{k=1}^{m} \lambda_k \Big/ \sum_{i=1}^{p} \lambda_i \tag{5}$$

In the formula, α_m is the cumulative contribution rate of the first m principal components. After determining the number of principal components, the mathematical expression of the new feature is as follows:

$$z_i = a_{i1} x_1^{'} + a_{i2} x_2^{'} + \cdots a_{ip} x_p^{'} \tag{6}$$

In the formula, z_i is the i-th new feature obtained after using principal component analysis.

The commonly used methods to determine the weight mainly include the fuzzy evaluation method, analytic hierarchy process, and entropy weight method. Among them, the fuzzy evaluation method and the analytic hierarchy process need to rely on experts to score each feature, which has strong subjectivity. After the feature of static optimal power flow is reduced in dimension by principal component analysis, the new feature has no obvious physical meaning, which leads to the problem that the first two methods are difficult to score. The entropy weight method determines the weight according to the amount of information contained in each feature. Moreover, its calculation process is simple, easy to implement by programming, fully utilizes the data of the features, and overcomes the defect that the first two methods make it difficult to determine the weight subjectively when the feature's physical meaning is unclear. Therefore, this paper will use the entropy weight method to determine the new feature weight of the static optimal power flow. The main steps of using the entropy weight method to determine the new feature weight are as follows.

4.1 Standardization

It is assumed that after the dimensionality reduction by principal component analysis, the static optimal power flow has n new features, and the following expression can standardize the new features:

$$P_{ij} = \frac{z_{ij}}{\sum_{i=1}^{m} z_{ij}}, i = 1,2,\cdots m; j = 1,2,\cdots n \tag{7}$$

In the formula, P_{ij} is the standardized feature data, z_{ij} is the j-th new feature of the i-th historical load sequence, and m is the number of samples.

4.2 Calculate Information Entropy

The information entropy of each feature can be expressed as follows:

$$E_j = \frac{\sum_{i=1}^{m} P_{ij} InP_{ij}}{Inm} \tag{8}$$

In the formula, E_j is the information entropy of the j-th feature. The larger the information entropy, the smaller the degree of variation, the smaller the amount of information the feature can provide, and the smaller the role it plays in the subsequent calculation of the similarity between load sequences, so the weight will be smaller.

4.3 Calculate New Feature Weights

According to the size of the information entropy, the weight of each feature can be expressed as follows:

$$w_j = 1 - E_j \;/ \sum_{j=1}^{n} 1 - E_j \tag{9}$$

In the formula, w_j is the weight of the j-th new feature. The size of the weight can intuitively reflect the degree of difference between the calculated similarity of each feature.

4.4 Strategies for Searching for Features

In order to improve the efficiency of searching historical load sequences, this paper proposes a fast search strategy, which mainly includes two steps: coarse matching and fine matching. The search framework is shown in Figure 3.

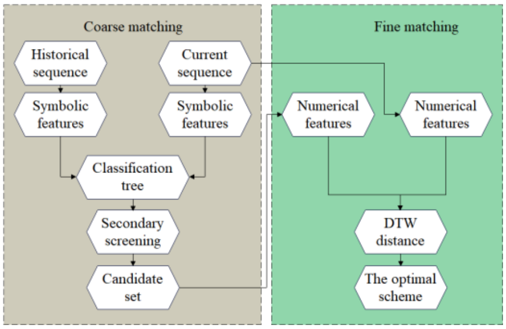


Figure 3: Framework of quick search.

In the rough matching stage, the algorithm first builds a classification tree, uses the symbolic features to preliminarily screen the historical load sequence, and finds the historical load sequence that has the same symbolic features as the current load sequence. Secondly, by setting the threshold, the historical load sequence selected for the first time is subjected to secondary screening. The threshold is set by the number of historical load sequences after the secondary screening. In order to control the number of historical load sequences from being too large or too small, the dichotomy method is generally used to test the threshold multiple times to determine the most suitable size.

In the fine matching stage, based on the numerical characteristics of the historical load sequence and the current load sequence, the distance between each historical load sequence and the current load sequence in the candidate set is calculated, and the scheduling scheme of the historical load sequence with the smallest distance is found.

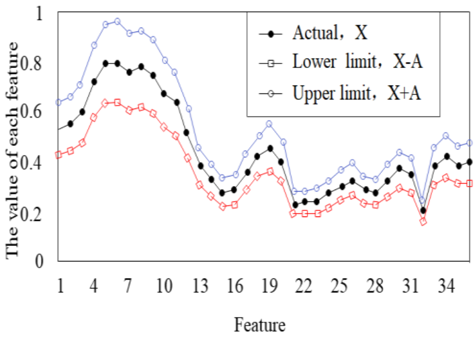


Figure 4: Rules for secondary screening.

It can be seen from Figure 4 that the algorithm performs secondary screening on the N historical load sequences that are initially selected by setting the threshold A. Threshold A is the maximum deviation of each feature operation, and each feature value of the historical load sequence must be within the upper and lower limits. That is, if there is one eigenvalue that exceeds the maximum deviation, the historical load series will be excluded. In general, according to the number of candidate sets that need to be retained, the optimal value is obtained by multiple trials of the threshold.

After using the threshold to filter out the candidate set, the next step is to calculate the distance between each historical load sequence and the current load sequence in the candidate set so as to find the historical load sequence with the smallest distance. As shown in Figure 5, the calculation process of Euclidean distance is relatively simple and easy to implement. It is one of the most commonly used distance indicators, but it cannot handle the bending and stretching of the load sequence.Therefore, this paper will use DTW distance to measure the similarity between two load sequences.

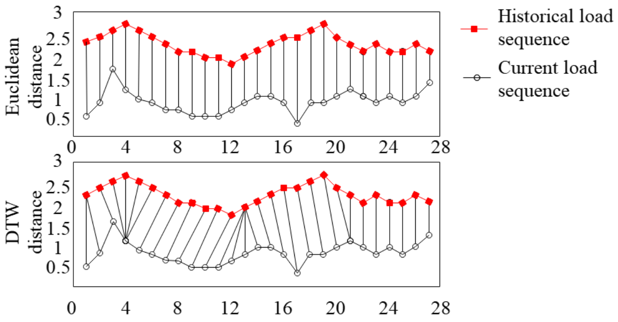


Figure 5: Euclidean distance and DTW distance.

In order to calculate the DTW distance between two load sequences, the algorithm first sorts the eigenvectors X and Y in chronological order and constructs the distance matrix as follows:

$$D = \begin{bmatrix} d\ \ x_1,y_1 & d\ \ x_1,y_2 & \cdots & d\ \ x_1,y_p \\ d\ \ x_1,y_1 & d\ \ x_2,y_2 & \cdots & d\ \ x_2,y_p \\ \cdots & \cdots & \ddots & \vdots \\ d\ \ x_p,y_p & d\ \ x_p,y_2 & \cdots & d\ \ x_p,y_p \end{bmatrix} \tag{10}$$

In the formula, p is the number of features, and $d\ x_i, y_j$ represents the Euclidean distance between the i-th element x_i in the feature vector X and the j-th element y_j in the feature vector Y. The smaller the distance, the closer the two elements are.

As shown in Figure 6, the curved path is the set of adjacent elements in the distance matrix D, which can be expressed as follows:

$$W = w_1, w_2, \cdots w_k, \cdots \tag{11}$$

For this set of sets to form a curved path, the following three basic conditions are required:

1. Continuity

In the set of adjacent elements, any two adjacent points x_{i_1}, y_{j_1} and x_{i_2}, y_{j_1} must satisfy:

$$\begin{cases} 0 \leq \left| i_1 - i_2 \right| \leq 1 \\ 0 \leq \left| j_1 - j_2 \right| \leq 1 \end{cases} \tag{12}$$

2. Boundary conditions

In order for the first and last elements of two feature sequences to match each other, the starting and ending positions of a set of sets that form a curved path must be x_1, y_1 and x_p, y_p .

3. Monotonicity

In the set of adjacent elements, any two points x_{i_1}, y_{j_1} and x_{i_2}, y_{j_1} before and after must satisfy:

$$\begin{cases} 0 \leq \left| i_1 - i_2 \right| \leq 1 \\ 0 \leq \left| j_1 - j_2 \right| \leq 1 \end{cases} \tag{13}$$

DTW is the curved path with the smallest distance, and its mathematical expression is as follows:

$$DTW\ X, Y\ = \min \left[\sum_{i=1}^{k} D\ W_i \right] \tag{14}$$

In the formula, K is the total number of curved paths, and $D\ W_i$ is the distance of the i-th group of curved paths.

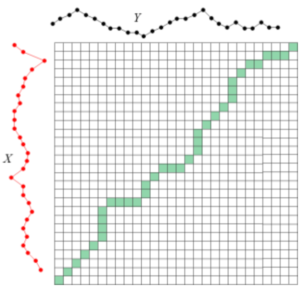


Figure 6: Composition of a curved path.

5 ENGLISH TEACHING EVALUATION SYSTEM BASED ON BP NEURAL NETWORK AND DISCRIMINANT MODEL

The overall process of the English teaching quality evaluation model in colleges and universities based on the BPNN model proposed in this paper is shown in Figure 7.

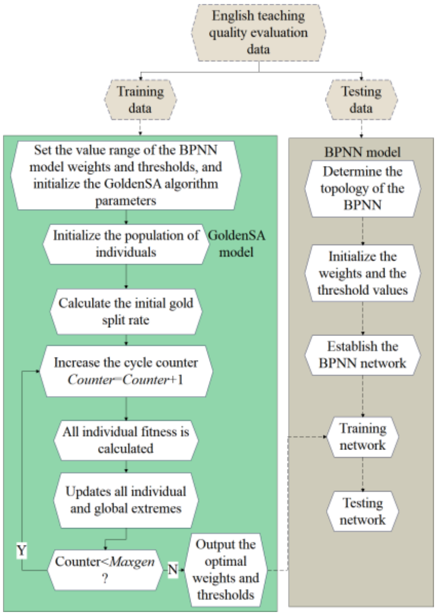
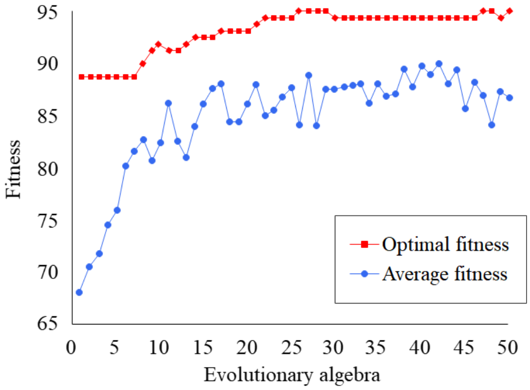
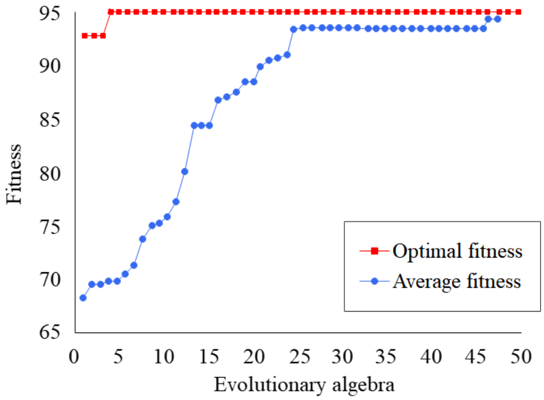


Figure 7: Evaluation model of English teaching quality in colleges and universities.

This paper chooses the evaluation score data of the English teaching quality evaluation index as the input matrix vector of BPNN and the college physical education quality level (excellent, good, average, and poor) as the output vector of BPNN to establish the BPNN model of college physical education quality evaluation. Secondly, this paper uses BPNN to optimize the weights and thresholds of the BPNN model and establishes the BPNN teaching quality evaluation model of physical education in colleges and universities. Figure 8 is a comparison chart of the convergence speed of different algorithms, in which BPNN has a faster convergence speed.



(a) PSO-BPNN



(b) BPNN

Figure 8: Comparison of convergence rates.

The effectiveness of the English teaching evaluation system based on the BP neural network discriminant model is verified, and the statistical simulation test results are shown in Table 1.

Number	*Teaching improvement*	*Number*	*Teaching improvement*	*Number*	*Teaching improvement*
1	*81.79*	*13*	*83.23*	*25*	*82.03*
2	*78.08*	*14*	*81.53*	*26*	*82.24*
3	*81.32*	*15*	*78.81*	*27*	*83.87*
4	*79.84*	*16*	*78.03*	*28*	*84.34*
5	*83.82*	*17*	*79.44*	*29*	*82.51*
6	*81.20*	*18*	*78.42*	*30*	*80.62*
7	*82.97*	*19*	*78.04*	*31*	*82.95*
8	*80.97*	*20*	*85.13*	*32*	*84.45*
9	*79.33*	*21*	*82.39*	*33*	*79.66*
10	*79.67*	*22*	*80.07*	*34*	*79.06*
11	*85.04*	*23*	*83.88*	*35*	*84.04*
12	*80.01*	*24*	*85.61*	*36*	*78.53*

Table 1: Simulation teaching data of English teaching evaluation system.

It can be seen from the above research that the English teaching evaluation system based on the BP neural network and discriminant model proposed in this paper can improve the quality of modern English teaching in English teaching.

6 CONCLUSIONS

It is necessary to strengthen the construction of the English teaching experimental center on campus. Moreover, it is necessary to create, develop, and explore the experimental resources for practical English teaching ability training in schools and give full play to the teacher skills training functions of the English teaching skills training laboratory, the micro-lecture production laboratory, the micro-English teaching skills training laboratory, and the virtual English teaching laboratory. At the same time, it is necessary to open up English teaching skills training courses for teachers, establish and improve the English teaching experimental center on campus, and improve its service function in terms of English teaching practice ability cultivation. In addition, it is necessary to focus on strengthening the construction of an open-practice English teaching platform, hand over the autonomy of learning to students, and let students base themselves on their personal reality. This paper combines the BP neural network and discriminant model to construct an English teaching evaluation system to find out the problems in English teaching over time. The research shows that the English teaching evaluation system based on the BP neural network discriminant model proposed in this paper can improve the quality of modern English teaching in English teaching.

ACKNOWLEDGEMENTS

This article is about the phased achievement of the 2021 Hunan Province offline first-class undergraduate course "Comprehensive English" [Xiang Jiao Tong [2021] No. 218] and the phased achievement of the 2023 Hunan Province Ordinary Higher Education Teaching reform research project "Practice Research on Blended Teaching Mode of College English Integrating Ideological and Political Elements."

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