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Research Article

College English Teaching Evaluation with Neural Network

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The notion of abilities in colleges and universities is undergoing a substantial transition, and the accompanying curricular view is also evolving in response to the demands of social and economic development. Students who are not English majors in college or university play a critical role in growing their knowledge of foreign languages, improving the quality of foreign languages, and fostering their capacity to use the language in real-world situations. As a result, one of the most important methods to assess the quality of a college's curriculum is to look at how well it teaches English. Consequently, how to evaluate collegiate English instruction has become a major concern. This research offers a neural network (NNs) for evaluating collegiate English education based on the BP network's application principle. The main work is as follows: (1) based on the peculiarities of college English teaching assessment, the weights and thresholds of the BP network are tuned using the global optimization ability of the ant colony algorithm. (2) To improve optimization ability of ACO, an update of pheromone is realized by combining global as well as local methods. In formula of the global update pheromone, a function is added to adjust the information residual coefficient according to the distribution of the solution. The residual coefficient of the local pheromone is adjusted according to the way of the minimum error judgment. (3) Optimize the BP algorithm with the improved ant colony optimization (IACO), build the IACO-BP network, and comprehend the optimal selection of weights and thresholds. Optimized BP algorithm is applied to the English teaching evaluation.

1. Introduction

The new era is characterized by economic globalization and the internationalization of science and technology. English is the primary language used for international political communication and trade, worldwide distribution of information and technology, and the exchange of resources and education. As English has grown in importance as a means of boosting one's global competitiveness, so has the market for individuals who are both fluent in multiple languages and adept at communicating across cultures. Foreign language study is currently mandatory at all levels of education and is often regarded as an essential component of a well-rounded civic education. College English is important for non-English majors in higher education because it improves the quality of their education, broadens their knowledge, and nurtures their unique abilities. Since the development of practical work skills and talent is closely linked, its quality is an important criterion for evaluating college curriculum design. As a result, research on college English instruction has exploded in recent years [1–4].

From exam-oriented education to quality education, the purpose of college English teaching has increasingly switched from the prior emphasis on reading and writing skills to nurturing college students' comprehensive English application abilities. The quality of college English classroom education has a direct impact on students' capacity to use English as a means of communication. Parents, colleges, and society are all worried about how to improve and ensure the quality of instruction, and this is an issue that cannot be overlooked. Based on grasping the connotation and new requirements of college English teaching, constructing a relatively perfect teaching quality assurance system has extremely important theoretical and practical significance in today's emphasis on quality education [5–8].

Despite the fact that the state and students have both put in significant effort, the teaching results are not up to par. Even while students' reading skills have risen, many still struggle with their listening and speaking skills, which have also increased. The new century's demands on national scientific, technological, and economic development will not be met by the English competence of college graduates, particularly their capacity to apply English. All of these factors combine to create this issue: a lack of timely curriculum updates, a sluggish examination process brought on by the national uniform examination, a dysfunctional social climate, and a disjointed educational system. Each step of university education has its own English-teaching structure, which is not effectively connected. The lack of a scientific, logical, and operable evaluation index system and method for classroom teaching quality is one of the most essential factors. For a long time, the quality of college English instruction has been measured solely on test scores, rather than on the effectiveness of the teaching process. Negative direction and negative incentives for English instruction are provided by using just the CET-4 and CET-6 college English test scores as the only basis for measuring the quality of teachers' teaching [9–12].

It is critical for college English teachers to conduct regular evaluations of their instruction. Teachers can use it to get feedback on their teaching, enhance their administration of classrooms, and ensure the quality of their instruction. Student learning strategies, methodologies, and efficiency can all be improved by using this strategy. The teaching assessment will eventually shift from depending primarily on the fourth and sixth grade examinations to the combination of teaching summative evaluation and process evaluation. The key to evaluating the overall quality of English instruction at the college level is classroom teaching quality evaluation, which is an essential aspect of the process. Its primary goal is to provide a comprehensive, systematic, scientific, and reasonable evaluation process for the inherently necessary improvement of college English classroom instruction [13–15].

The paper arrangements are as follows: Section 2 discusses the related work of college and universities teaching evaluation. Section 3 defines the various methods. Section 4 analyzes the experiments techniques. Section 5 concludes the article.

2. Related Work

According to research [16], colleges and universities should aggressively promote the integration of information technology and college English curriculum teaching, with information technology continuing to play a key role in current educational technology, particularly information technology for foreign language teaching. Reference [17] outlines the three-in-one relationship between language, culture, and communication and introduces the goals and tasks of college English teaching from perspective for cross-cultural communication. Literature [18] systematically introduced eight methods of foreign language teaching, including cognitive method, conscious practice method, and listening and speaking method. Literature [19] also permeates the connotation of teaching quality management. For example, the report issued in the early 21st century mainly describes how to achieve the goal of English education that can use English. Although the literature [20] did not clarify the specific measures for the quality assurance of English education, it pointed out the directional quality training goals and standards for English education in the country. This is conducive to promoting the process of exploring the quality management scheme of English education.

Literature [21] advocates that schools should continuously improve quality of education, pointing out the establishment of a teaching quality management system guided by quality management system standards. Literature [22] believes that the quality management system commonly used by enterprises provides a valuable reference for colleges and universities, and a lot of knowledge in the quality management system standards can be applied to higher education. Before an effective standard is found, the quality management system standard is an ideal standard to measure the quality of teaching. Literature [23] believes that management based on school teaching is a shortcut to improve quality, and quality management system standards have guiding significance. Literature [24] pointed out that the main purpose of implementing quality management system standards in higher education institutions is to establish an effective teaching quality management system. Reference [25] introduced the quality management system standard into colleges and universities, and discussed the systematic method of its implementation in teaching quality system. Literature [26] introduced the quality management system standard into the internal management and achieved good results. Literature [27] studies quality for undergraduate teaching and believes that the evaluation includes the evaluation of government agencies, the evaluation of foundations, the evaluation of local nongovernmental organizations, and the evaluation of higher education associations. In addition, there are also internal evaluations, and the evaluation results are linked to school qualification certification, teaching quality, and professional certification. Literature [28] has shaped a relatively sound quality management system operation mode through the certification of social professional institutions, the internal evaluation of schools, and the evaluation of the three parties under the supervision of the government. Reference [29] adopts a higher education quality monitoring and evaluation system that combines internal as well as external. Among them, the internal quality control refers to the internal teaching quality monitoring as well as evaluation carried out by the universities themselves. It mainly includes the overall self-assessment of the school, the self-assessment of disciplines and majors, and the establishment of two-level teaching quality monitoring institutions at the school and the college, and the employment of off-campus personnel as supervisors, thereby establishing a scientific quality management system. Literature [30] proposed that the external evaluation system refers to the academic evaluation, which is mainly responsible for reviewing the establishment of academic standards, the acquisition of academic resources, and the management of the overall teaching quality of the university. Literature [31] examined the situation of manufacturing and higher education, identified the similarities and differences between the two, and pointed out the possible difficulties encountered in the implementation of total quality management in higher education.

3. Method

This work uses the BP algorithm to evaluate college English teaching and uses the improved ACO algorithm (IACO) to improve it to build an IACO-BP network for the shortcomings of the BP algorithm.

3.1. BP Network. The NNs are composed of a large number of neurons connected to each other and have a multilayer network structure. By adjusting the parameters in the network structure in real time, it can process all kinds of complex and changeable information. BP is the most common network in the network, because of its outstanding self-learning, mapping, adjustment, and generalization ability, it has a strong advantage in classification. Therefore, it is widely used in many fields.

BP is generally composed of three different network structures, which are the input layer for receiving signals, the hidden layer for processing signals, and the output layer for sending results. Its structure is shown in Figure 1.

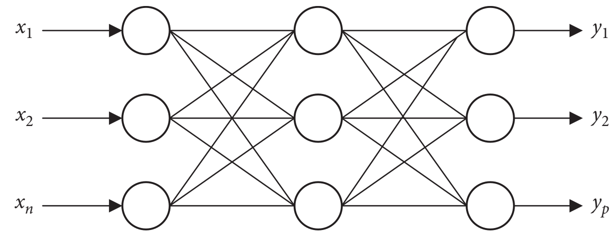

Figure 1: The BP network.

There is no processing done at the input layer of the network. At least one layer of the hidden layer is responsible for processing data. As a result, the output layer is primarily responsible for integrating results from the hidden layer and disseminating them to the others.

To begin, the forward propagation and error reverse propagation phases of the BP network method are divided into two distinct phases. It is via the use of weights and thresholds that information moves from an input to an output layer in a forward propagation process. You can proceed to backpropagation only if the error between your actual output and your expected output is within the acceptable range. The weights and thresholds of each layer of neuron connections are modified one by one according to the error signal during the error backpropagation process. A backpropagation loop is repeated until a predetermined end condition is fulfilled.

The forward propagation method refers to the process of processing the input layer by layer in the forward order of BP. Hidden layer inputs are weighted sums of outputs from all nodes in previous layers. The output layer mainly integrates the data of the hidden layer to obtain the final result and output it to the outside world. If the function of each node is linear, the output of the node is as follows:

$$y_k = \sum_i w_{ik} a_i. \tag{1}$$

The backpropagation process refers to the process of transmitting the error layer by layer in the reverse direction, and adjusting coefficient and weight through gradient descent algorithm, which plays the role of correcting and reducing the model error. First calculate the error:

$$E = \frac{1}{2} \sum_{i=1}^{N} \left(y_i - t_i\right)^2. \tag{2}$$

Then, the weight adjustment formula is obtained by reverse derivation according to the gradient descent algorithm:

$$w_{\text{new}} = w - \frac{\partial E}{\partial w}. \tag{3}$$

The weights between the layers are adjusted repeatedly until the error stops within the range initially set by the network.

Although BP has outstanding capabilities in data parallel processing, fault tolerance, and self-adaptation, it also has strong applicability in the field of data classification. However, due to its complex network structure and numerous parameters, when BP deals with some more complex nonlinear problems, the network model not only requires a long training time, but also tends to fall into local convergence. In view of the defects of the traditional BP model, scholars have optimized and improved the BPNN model in different aspects. Several conventional optimization and improvement methods are as follows: first, the inertia term is introduced. To speed up the convergence speed, an inertia term is added to the adjustment formula of the connection weight coefficient. Second, introduce a momentum term. During the training process, avoid the model from locally fluctuating and falling into the local ideal position. When modifying the model coefficients, a momentum factor that can reduce local oscillations is added to improve global convergence ability. Third, dynamically adjust the step size. According to the training characteristics of different stages of the model, the step size is dynamically adjusted. Fourth, combine intelligent optimization algorithms. Some intelligent optimization algorithms are used to optimize a large number of weight coefficients in the model to achieve parameter optimization and speed up global convergence. Optimizing weight coefficients is currently the mainstream method to improve the performance of NNs models. This chapter also caters to the current research hotspots, starting with intelligent optimization algorithms and BP, trying to combine the advantages of the two to construct a high-performance classification model and apply it to the evaluation of college English teaching.

3.2. Ant Colony Optimization. Using a probabilistic method, ACO is used to determine optimal pathways, inspired by the way ants forage for food. The ACO algorithm can effectively improve the initial selection of network weights and thresholds, hence boosting the BP method's performance.

Without knowing where the meal is, each ant seeks for it by releasing a volatile substance called a pheromone along its journey. Although the ants' journey may not appear to be the shortest at first, the volatilization and residue of pheromones cause the concentration of pheromones on each path to fluctuate with time. The ants' path will be shortened accordingly, and the shortest path will be found. When ants are pathfinding, if they come upon a road they have never walked before, they will choose and release pheromones at random. Ants in the same ant colony can perceive the existence of their pheromone, and for offspring ants, the path selection will be based on the concentration of pheromone. The path with a higher probability of being selected is generally the path with higher pheromone concentration, and then this path can be considered as a shorter path. Over time, the shorter paths were chosen by more ants, and the higher the concentration of pheromones on the paths. Finally, the descendant ants of the ant colony all choose the path with the highest pheromone concentration, that is, the shortest path. This is how the ants can find the shortest path among the many paths between the nest and the food. Ants' pathfinding is based on the pheromone concentration on the path, and after the path is selected, the pheromone remaining on the path will be updated. Ant colony algorithm, a simulated evolutionary algorithm, is suitable for parameter optimization of BP algorithm.

The general steps of ACO can be divided into the following steps. The first step is parameter initialization. Set the maximum number of iterations and the distance between nodes, set the heuristic factor, and initialize each path pheromone. The second step is to construct a taboo table. Initialize the taboo table of ants, ants are randomly placed on the nodes, and the corresponding values are added to the taboo table. The third step is to construct a solution. The ants move from the current node to other nodes to follow the state transition probability condition to select the next path. Ants search for paths according to the state transition probability, and then each ant constructs a path solution. The fourth step is to update the taboo table. Each time the ant selects a node, the new node is added to the taboo list. The fifth step is to determine whether the ant colony has completed the pathfinding. If all the ants complete the pathfinding and construct the path solution, go to the sixth step; otherwise, go to the third step to continue to construct the solution. The sixth step is to update the pheromone globally. In the current cycle, update the pheromone on the paths traversed by all ants. The seventh step is the end of the judgment. Otherwise, increase the number of repetitions, and go to the second step to enter the next iteration. Termination conditions can specify the number of iterations of the evolution or define a lower bound on the length of the shortest path.

3.3. BP Network with Improved ACO. A number of researchers have taken announcement of the ant colony algorithm since its introduction. It is dissimilar from other optimization algorithms in that it has strong robustness, has distributed computing, and is easy to combine with other algorithms. There have been many examples of the ant colony algorithm being used in conjunction with other techniques of searching, indicating that the algorithm's search power is powerful and widely applicable. For the combinatorial optimization problem, its optimization premise is to traverse all nodes according to the internal relationship to search for the optimal set of solutions when the internal relationship of the nodes is determined. Ant colony algorithm can solve many complex situations in research, but there are still some deficiencies. When parameters are set incorrectly, the search time will be lengthened, and the quality of the solution will suffer. Secondly, the complexity of the ant colony algorithm is quite high compared to other optimization algorithms. Furthermore, the buildup of pheromones makes it easier to fall into a local optimum and to stagnate. Due to the sluggish convergence time and ease of falling into the local optimum of the aforementioned general ant colony method, this research will use the following three strategies for optimization.

Improvements to path finding probability construct IPP. The ant optimization probability formula adopts the pseudorandom ratio selection instruction, in which p_0 regulates the relative importance of the optimization and the exploration of new intervals, which means that ants can choose the interval based on the principle of high concentration and high probability. According to this idea, the probability that a node selects the interval number where the node is located has the following formula:

$$\begin{aligned} j &= \arg\max\left(\eta_{ij}^{b}\mu_{ij}^{a}\right), \quad p < p_0, \\ j &= j_0, \quad p \geq p_0. \end{aligned} \tag{4}$$

In the above-mentioned ant pathfinding process, the parameter p_0 is a certain probability, which determines the probability of the interval of the node where the optimal solution is located, and p is a random number arbitrarily selected on [0, 1]. Different probability selections can be made for different values, which can ensure the diversity of the solution space.

Improvements to the global update pheromone strategy to construct IGUP. Ant pathfinding is mainly based on interval information. When information on path with more information continues to increase, and the other paths with less information continue to decrease or even disappear due to the effect of residual factors, it is easy to fall into a local optimal situation. To improve global convergence ability and search ability for ant colony algorithm, this paper accepts the global adaptive updating pheromone strategy. For the selection of optimal weights and thresholds, the difference between it and the general ACO is as follows. The residual factor used by the general ACO to update pheromone globally is determined. The ant colony algorithm is based on the pheromone update of MMAS. According to the situation of the solution, an exponential function based on a natural constant is added to change the pheromone residual factor, and in this way, the pheromone in the interval is updated globally, so that the algorithm increases the possibility of obtaining the optimal solution. In this way, after one iteration of the ant colony, the pheromone in all intervals is updated globally, and the maximum and minimum value ranges of the pheromone in MMAS are used to adjust the value of the residual factor. The global adaptive method will adjust the size of the pheromone in the next time interval according to the range of pheromone values in MMAS. To calculate the pheromone concentration,

$$
\begin{aligned}
&\mu_{ij}(k+1) = \lambda^{1-h(k)}\mu_{ij}(k) + \Delta\mu_{ij}, \quad \mu_{ij} > \mu_{\max},\\
&\mu_{ij}(k+1) = \lambda^{h(k)}\mu_{ij}(k) + \Delta\mu_{ij}, \quad \mu_{ij} < \mu_{\max},\\
&\mu_{ij}(k+1) = \lambda\mu_{ij}(k) + \Delta\mu_{ij}, \quad \text{others},\\
&\qquad h(k) = \exp\left(\frac{-k}{c}\right).
\end{aligned}
\tag{5}
$$

If the current pheromone concentration exceeds the maximum pheromone concentration or is less than the minimum pheromone concentration, the information residual factor changes relatively under the influence of the function. This prevents the pheromone in the interval from becoming too much or disappearing, causing the algorithm to fall into a local optimum. In this way, the pheromone concentration of each interval is updated globally adaptively according to the distribution of the solution.

Improvements to local update pheromones to construct ILUP: in the process of ant pathfinding, the algorithm selects the interval where the node is located according to the probability; then, the probability of being selected in the interval with high pheromone concentration will increase, which may cause the concentration of this interval to reach the current maximum. In this way, when the solution components selected by the offspring ants are located in the interval, they will be consistently selected in this interval. In this case, the ant colony is stagnant, and the ant colony cannot examine the space further, resulting in the inability to obtain the optimal solution. In order to prevent this phenomenon from happening, in the process of ant colony optimization, the pheromone in the to-be-selected interval is locally updated. In this way, the probability of being selected in the maximum pheromone concentration range can be reduced; that is, the pheromone in the maximum concentration range can be relatively reduced.

Based on the above idea, the error of the current sample calculated in the interval of the maximum pheromone concentration is compared with the minimum error of the sample calculated by the algorithm to determine whether to fall into the local optimal solution. Suppose that the ants are in the node selection interval, and locally update the pheromone in the interval:

$$\mu_{ij}(k+1) = \lambda\mu_{ij}(k) + \Delta\mu_{ij}. \tag{6}$$

If it is greater than the minimum error, the ant colony algorithm is easy to fall into the local optimum, so it is adjusted according to the following formula. Otherwise, the parameters will not change.

$$\lambda(k+1) = \lambda(k)^{d}. \tag{7}$$

After the update of the pheromone residual factor in the above formula, if the interval with the largest pheromone concentration is selected multiple times, the pheromone residual coefficient of the current interval will be reduced or even reduced to a minimum value, thereby reducing the pheromone concentration in the interval. Then, the pheromone in the maximum pheromone concentration interval is updated locally, which can increase the possibility of ants searching the space. This effectively increases the diversity of the solution space while avoiding the occurrence of stagnation. Combined with the improved strategy of global and local adaptive updating of pheromone, the ACO algorithm can be effectively avoided from falling into local optimum, and the global search ability of the algorithm can be improved. The ant colony algorithm improved according to the above improved strategy can be called IACO.

According to the idea of optimizing the parameters of the BP algorithm by the IACO algorithm, the optimization idea of the improved ant colony algorithm optimization BP (IACO-BP) algorithm can be gained. The IACO-BP algorithm first uses the improved ant colony algorithm to optimize the initial values of weights and thresholds and searches for a set of the most suitable solutions. Then, under the action of the optimal value, the BP algorithm performs learning and training, which can ensure that the weights and thresholds are kept within a range of values as small as possible. This improves the shortcoming that the algorithm is easy to fall into the local minimum and enhances the convergence of the algorithm. According to this idea, the algorithm flow chart of the IACO-BP algorithm is shown in Figure 2.

4. Experiment

In this section, we discuss the database details and define the experiment on training loss. We examine the comparison with different method. We analyze the experiment on improvement strategy.

4.1. Dataset Detail. This work collects college English teaching data from different colleges and universities to construct a data set, which consists of training data and test data. The specific data distribution is shown in Table 1. The input features of each piece of data are 10-dimensional features, and the specific information is shown in Table 2. The label of each piece of data is the corresponding teaching evaluation level, which is divided into four different levels. Accuracy and recall are performance indexes in this work.

4.2. Experiment on Training Loss. Network training is an important part of BP network. This work first evaluates the training process of IACO-BP network. The experimental results are illustrated in Figure 3.

It is obvious that the network loss gradually decreases and reaches convergence. This illustrates the training feasibility of the IACO-BP method.

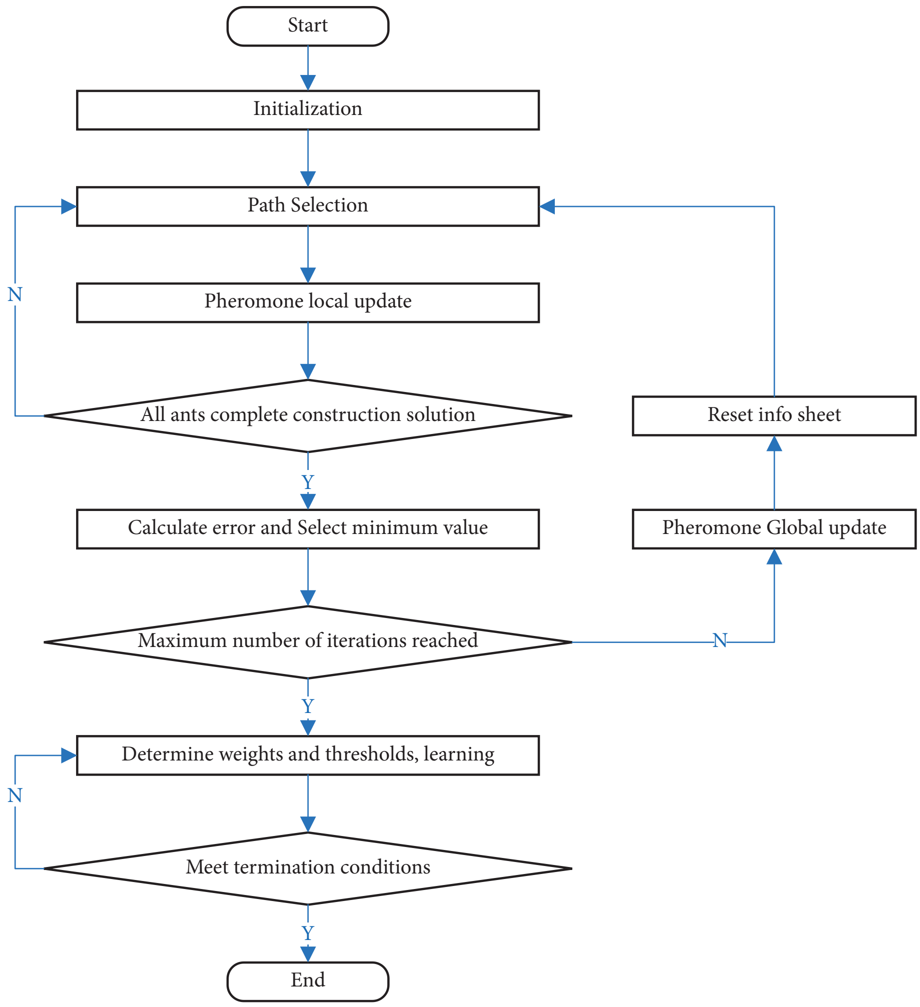

Figure 2: The pipeline of IACO-BP.

Table 1: The dataset information.

Training set	Test set	Total
10831	3895	14726

Table 2: The detailed information for data feature.

Feature	Implication
X1	Teaching method
X2	Teaching concept
X3	Teaching passion
X4	Teaching attitude
X5	Teaching content
X6	Teacher-student exchange
X7	Course structure
X8	Classroom organization
X9	Knowledge structure
X10	Test score

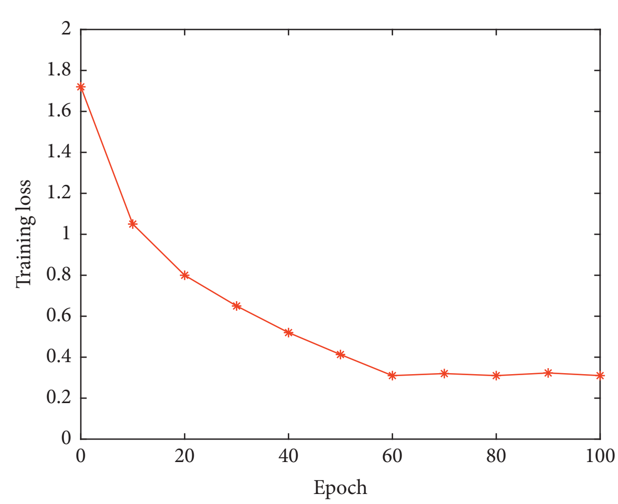

Figure 3: The training loss for IACO-BP.

4.3. Comparison with Different Method. To verify the feasibility of applying the IACO-BP method to college English teaching evaluation, it is compared with other machine learning methods. The experimental results are illustrated in Table 3.

Compared to other methods, IACO-BP achieves the best performance. Compared with the best performing DBN method, 2.3% accuracy improvement and 1.4% recall improvement are also obtained, respectively.

Table 3: Comparison with other methods.

Method	Accuracy	Recall
SVM	88.60	85.22
DNN	91.11	90.33
DBN	93.22	91.70
IACO-BP	95.55	93.11

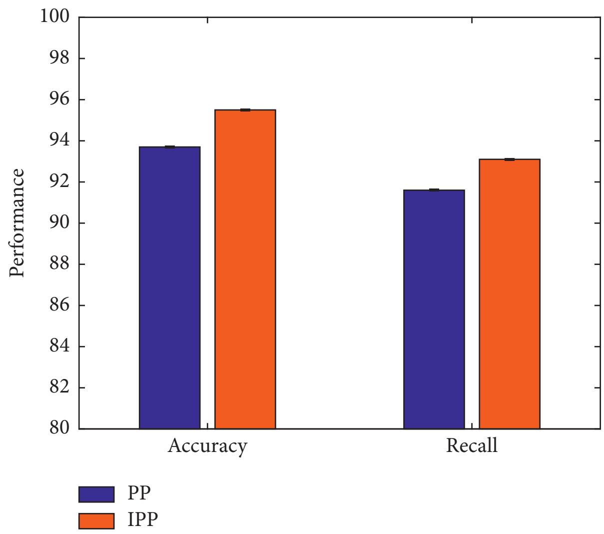

Figure 4: Experiment on IPP and PP.

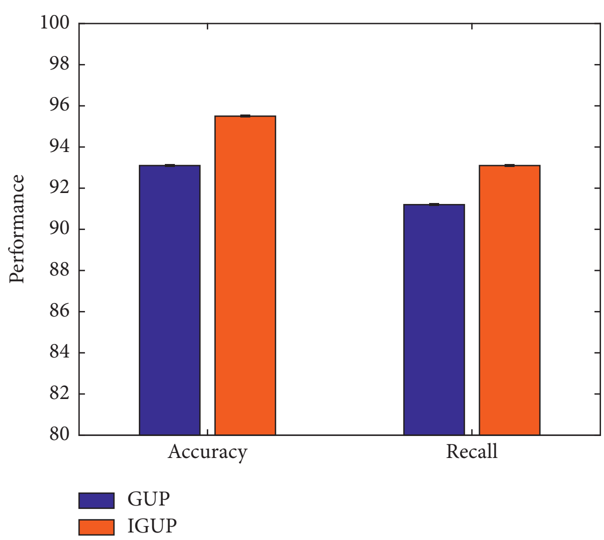

Figure 5: Experiment on IGUP and GUP.

4.4. Experiment on Improvement Strategy. This work recommends three better-quality methods for ACO, namely, IPP, IGUP, and ILUP. In order to verify the effectiveness of these three strategies, comparative experiments are carried out, respectively. First, the presentation using IPP and traditional PP is compared individually. The experimental results are illustrated in Figure 4.

Compared with the traditional PP method, using IPP can bring 1.8% accuracy and 1.5% recall improvement. Then, the performance using IGUP and traditional GUP is compared separately. The experimental results are illustrated in Figure 5.

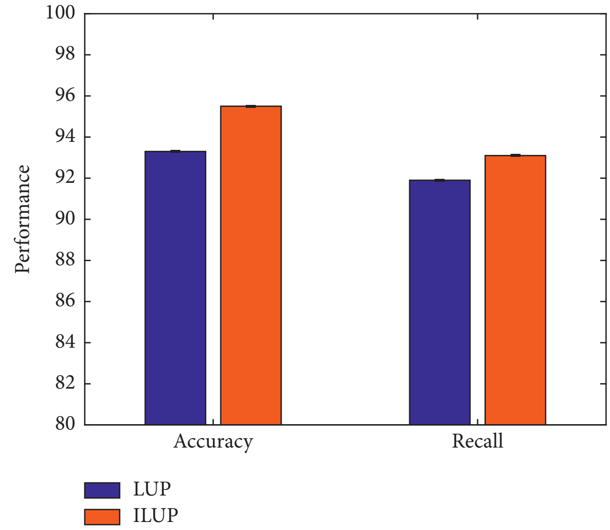

Figure 6: Experiment on ILUP and LUP.

Compared with the traditional GUP method, using IGUP can bring 2.4% accuracy and 1.9% recall improvement. Then, the performance using ILUP and traditional LUP is compared separately. The experimental results are illustrated in Figure 6.

Compared with the traditional LUP method, using ILUP can bring 2.2% accuracy and 1.2% recall improvement. The above experiments verify the correctness and usefulness of this work in improving the ACO algorithm.

5. Conclusion

The quality of instruction has become increasingly important as higher education reform and enrollment growth continue to grow. The development of an effective system for monitoring and evaluating the quality of college English instruction necessitates a significant investment of time and resources. College English instruction's quality assurance system has a hand in it, as there are numerous teaching components and links that all work together. Only a perfect instruction quality assurance system can keep these influencing factors and key links under control, so as to cultivate talents with good English language application ability and comprehensive quality and level for the society and the market. Based on this, this work designs a NNs-based evaluation method for English teaching quality. The specific contents are as follows:

(1) The global search ability of the ant colony algorithm is utilized to optimize the selection of weights and thresholds because of the BP method's tendency to fall into the local optimum. The ant colony algorithm node is used to describe the optimization notion based on the parameters required by the network.

(2) Aiming at the shortcomings for ACO, an IACO algorithm is proposed. A combination of global and

local update pheromone is adopted. In the global update formula, an exponential function is added to realize global update for pheromone. In the local update method, the network error judgment is used as the basis to adjust the residual factors of pheromone to achieve the purpose of local update of pheromone.

(3) The IACO is utilized to optimize BP algorithm, and optimized BP algorithm is applied for the evaluation of college English teaching. The systematic experiments have verified the validity and correctness of this work.

Data Availability

The datasets used during the current study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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