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Article

The Evaluation and Development of University English Teaching Quality Based on Wireless Network Artificial Intelligence

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Abstract: This study introduces a novel approach to address deficiencies in prior teaching quality assessment systems by establishing a mathematical model for evaluation. Utilizing a neural network trained via a particle swarm optimization algorithm (PSO), the method develops a BP (Backpropagation) model fine-tuned by PSO to capture the intricate relationships among diverse indicators influencing teachers' teaching quality assessment and resulting evaluations. Empirical findings highlight the effectiveness of artificial neural networks in constructing a comprehensive evaluation framework accommodating a wide spectrum of systematic assessments. This approach not only optimizes teaching methodologies but also augments overall teaching efficacy and the quality of educational delivery in a holistic manner. Moreover, it fosters the cultivation of multifaceted individuals proficient in English application skills, contributing to the development of high-quality talent in practical and complex domains. The convergence of advanced mathematical modeling techniques and computational methods, alongside the utilization of numerous indicators, aligns with combinatorial principles, exploring the permutations and relationships of diverse factors impacting teaching quality assessment.

Keywords: blended teaching mode, split-classroom mode, teaching reform, particle swarm optimization algorithm

1. Introduction

The application of modern artificial intelligence technology in the field of education has achieved remarkable results, but it does not mean that it can replace students' language learning. Because English can be used not only for communication but also for expressing human emotions and opinions, AI is not yet able to fully handle various problems in the face of complex language environments. In this context, university English teachers have to bring their own values into play, take advantage of AI technology, and continuously innovate English teaching methods and their own roles to meet the requirements of the development of education in the new era [1]. The main developments in teaching and learning obtained by artificial intelligence technology relying on online platforms can be the establishment of human-machine dialogue systems, big data analysis to grasp students' classroom learning dynamics, and teachers to provide more data information useful for teaching and learning [2]. The use of such technology in the English classroom has completely changed the traditional teaching model in which the teacher mainly transmits textbook knowledge. With the assistance of AI technology, the objects of student communication and interaction are transformed from students and teachers to intelligent machines [3]. Firstly, it enriches the path of students' language input and

output; secondly, it can also penetrate English [4]. The application of artificial intelligence in college English teaching is changing the traditional way of obtaining English knowledge from teachers, and providing students with richer independent learning channels, making it possible to learn English out of the classroom and into students' lives [5]. With the help of artificial intelligence technology, students can use online learning platforms or software to complete English listening, reading, writing and practicing according to their knowledge shortcomings, and upload their learning results to the system to provide feedback to students through assessment, so that they can grasp the problems of English independent learning in time and keep the right direction of learning [6,7]. Teachers can also further optimizing the way students learn independently and enhancing the efficiency and quality of independent learning [8].

The involvement of artificial intelligence technology in the teaching field can replace the traditional teaching mode of teachers in the classroom to answer questions and solve problems, create more space for teachers to teach in the classroom, and help them detach from the heavy teaching work and devote more energy to cultivating students' professional ability and literacy, providing thought help as well as action support for students' all-round development, and accomplishing the goal of cultivating highly capable and high-quality talents [9]. In addition, teachers can also get more time and opportunities for teaching research. For classroom teaching research, teachers can use artificial intelligence data analysis technology to record students' performance in the classroom and draw specific images to form a database that responds to the learning situation [10]. With comparative analysis of student learning, they can understand the strengths and weaknesses of each student and develop personalized teaching guidance programs, forming systematic research results to provide specialized support for teaching practice [11]. In terms of scientific research, teachers can also use AI technology to understand the latest developments and future trends in English teaching, and present the results summarized in classroom teaching in scientific research to improve teachers' cognition of English teaching and increase their experience in teaching practice, helping teachers to achieve competence development and providing help for the evaluation of teachers' titles [12]. In conclusion, the use of artificial intelligence technology in university English teaching can transform the way teachers transfer basic knowledge for teaching, thus providing good prospects for students' employment [13].

2. Advantages of teaching based on the integration of information technology

2.1. It is conducive to cultivating students' independent learning ability and interest in learning

Combining the respective advantages of the split-classroom teaching mode and the blended teaching mode, under the information technology-based split-classroom blended teaching mode, lectures and discussions are staggered, so that students can have sufficient time to arrange their own learning, such as reading the textbook content deeply, completing the assigned homework, choosing the most suitable way and time to understand deeply, and internalizing and absorbing the teaching content taught in class in a personalized way, which This helps students to develop self-directed independent learning, and also helps them to actively think about problems during the internalization and absorption process, to stimulate their subjective initiative to observe and find problems, and to encourage them to bring their own confusion and problems to the face-to-face discussion class to discuss and solve with the teacher and classmates. In the discussion classroom, the teacher takes the form of group discussion and whole-class communication to organize students' discussion. Students present their homework results, share their learning experiences, and answer each other's questions and confusions, and students have the opportunity to brainstorm and think together, which helps cultivate students' divergent thinking ability, teamwork ability, self-expression ability, and interpersonal communication ability, and can effectively enhance students' participation. Realize students' self-worth embodiment and have a great sense of gain and satisfaction, thus fully mobilize students' learning enthusiasm [14].

2.2. *It is conducive to improving teaching efficiency*

The traditional didactic teaching method is that classroom teaching is completely dominated by teachers, completing the teaching content predetermined by teachers in advance, and the practice process in the combination of lecture and practice is only within the limited framework of teachers' teaching design, without getting rid of teachers' ideas and arrangements to think, therefore, the nature of passive learning of students has not been changed, so students lack initiative and enthusiasm in learning, and the teaching effect is obviously not ideal [15]. The hybrid teaching mode based on information technology support, mainly guided by line oriented, constructivism, cognitivism and other teaching theories, relying on diversified teaching methods, realizes the organic integration of classroom lectures, classroom discussions and online learning [16]. It can also present the role of student-led-subject combination, thus returning the main position of students to classroom teaching, enhancing the interactivity between teachers and students, and significantly increasing the participation, which in turn enhances collaborate, thus achieving the purpose of effectively improving the teaching effect [17].

2.3. *Give full play to the teacher's guiding role*

Under the blended teaching mode of split-classroom, the teacher's role changes from being the lecturer of "filling the classroom" to being the guide of the learning process, and the teacher organizes the teaching process, uses information technology and intelligent teaching tools and means to control the overall process of students' learning [18]. The teacher organizes the teaching process, uses information technology and intelligent teaching tools and means to have macro control over the overall process of students' learning, and can supervise students' learning behaviors through online platforms, APPs and smart terminals, evaluate students' learning performance, and provide timely feedback to students [19]. In the classroom discussion, the teacher plays the role of a learning companion, guiding students to learn and discuss, no longer allowing students to passively accept learning according to the teacher's predetermined ideas, fully reflecting the main position of students in the learning process, encouraging each student to dare to express their views, bravely collide with ideas, be good at interactive communication, and learn to collaborate and advance [20,21]. Students can not only learn knowledge, but also develop their creativity, thinking ability and teamwork ability in the learning process, helping students to develop comprehensively [22].

2.4. *Beneficial to the effective use of high-quality teaching resources*

With the rapid development of modern information technology, Internet technology network online courses, large-scale online open courses MOOC, the emergence of national high-quality open courses, online courses into the general trend of college education teaching system, for teachers to obtain and select a large number of high-quality teaching resources to provide a convenient and guarantee [23]. Teachers can combine the characteristics of their courses to select high-quality resources for innovative teaching design: rich teaching content, diversified teaching forms, and novel teaching resources [24]. According to their learning needs and interests, students can jump out of the limitations of time and space and conduct independent fragmented learning anytime and anywhere through the Internet platform, APP or mobile smart end to maximize the utilization of teaching resources [25].

3. Examples of Teaching Quality Assessment

Our university has widely adopted the online assessment system for students, the system of listening to classes by experts of the Teaching Quality Management Committee and the system of teachers listening to each other's classes for grading, and attaches great importance to the quality of teaching. The following 16 evaluation indexes are used, which are expressed by $X_1, ..., X_{16}$. Among them X_1

represents the enthusiasm and fullness of work; X_2 represents the organization of class; X_3 represents the seriousness of lecture; X_4 represents the timeliness and patience of post-lecture counseling and answering; X_5 represents the correct content, capacity and speed of teaching; X_6 represents the scientific, logical and systematic content of lecture; X_7 represents the ability to clarify the key points and difficulties and handle them properly; X_8 represents the situation of linking theory with practice; 99 represents the inspiration of innovative thinking; X_9 represents the assignment of homework. X_{10} represents the assignment and correction of homework; X_{11} represents the use of different methods according to teaching needs; X_{12} represents the use of multimedia teaching methods; X_{13} represents the standardized and vivid teaching language, clear and reasonable writing; X_{14} represents the ability to educate students with the teaching content and classroom discipline; X_{15} represents the teacher's compliance with discipline; X_{16} represents the overall impression of the lecturer. 16 represents the overall impression of the teacher [26–29].

The value range of evaluation indexes was set as [0, 100], and the scores of students, experts, and teachers against 14 teachers of computer science in our college were aggregated to obtain the results shown in Table 1. The analysis of Table 1 shows that the relationship between the evaluation target (i.e. teaching effect) and each evaluation index is complex and non-linear. What kind of relationship exists between them? To solve this problem, we use the neural network optimized by PSO to establish the mathematical model of this evaluation system.

Sample number	Evaluation Indicators																Evaluation Objectives
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	
1	88	92	89	85	92	80	95	89	82	79	81	80	80	79	87	88	89
2	85	84	87	89	87	84	93	88	79	76	83	90	81	78	88	79	86
3	88	83	86	87	90	86	92	85	78	75	86	93	83	73	85	72	80
4	92	84	82	88	88	82	87	86	70	85	89	92	86	92	89	76	83
5	83	90	83	86	91	83	88	82	80	92	92	96	85	93	83	73	82
6	91	89	94	82	93	89	86	83	83	93	93	95	89	85	92	71	81
7	81	87	91	83	96	86	80	86	8	91	96	94	95	86	90	74	85
8	88	79	90	92	98	84	79	84	5	90	94	97	92	87	81	95	91
9	83	86	80	93	90	87	72	80	92	80	97	87	90	81	84	84	79
10	90	85	88	88	87	89	76	95	90	82	90	88	94	80	79	83	75
11	92	82	93	85	88	92	80	92	81	86	93	89	91	83	78	82	73
12	90	92	91	86	86	90	89	79	83	80	92	86	79	86	76	81	92
13	85	93	87	83	85	96	92	82	89	79	85	83	82	92	93	80	85
14	87	80	88	82	83	97	75	83	79	82	86	82	81	79	81	85	91

Table 1. Summary of teaching quality

4. Teaching quality assessment model using BP neural network with PSO optimization

4.1. Basic particle swarm optimization algorithm

The position of each particle $x_i = (x_{i1}, x_{i2}, x_{i3}, ..., x_{iN})$ is a potential solution, and its adaptation value can be calculated by substituting it into the objective function to measure its merit. The particle updates its velocity and position according to the following equations

$$v_{id}^{k+1} = w \times v_i \in [v_{\min}, v_{\max}] + \rho_1, \rho_2 \times r1 \times (p_{id} - x_{id}^k) + \rho_2 \times r2 \times (p_{gd-x_{id}^k}) \tag{1}$$

$$x_{id}^{k+1} = x_{id}^k + v_{id}^{k+1} \tag{2}$$

Where: $i = 1, 2, 3, ..., m$-the population size; $d = 1, 2, 3, ..., n$-the number of dimensions of the search space; v_{id}^k- the d-dimensional component of the velocity of the ith particle in the kth iteration, $v_{id} \in [v_{\min}, v_{\max}]$, i.e., the velocity of the particle v_i is limited by a maximum velocity; a non-negative constant, this parameter is used to adjust the role played by the particle's own experience and social

experience in the motion, respectively

$$w = w_{\max} - \frac{w_{\max - w_{\min}}}{Num_{\max}} \times Num \tag{3}$$

The particle keeps tracking the individual extremes and global extremes in the solution space for searching until it reaches the specified maximum number of iterations or is less than the specified error criterion.

4.2. BP Neural Network Optimization

The BP algorithm uses the gradient descent method to correct the front layer weights and thresholds, using the formula omitted. The gradient descent-based BP algorithm converges slowly, is very easy to fall into local extremes, and is extremely sensitive to parameters such as the initial weights of the network, its own learning rate and momentum, which need constant training to be fixed gradually, and excessive training can lead to overfitting phenomena, which affects the generalization ability of the network. The PSO algorithm has fast convergence, high robustness, strong global contraction capability, and does not require the help of special information (such as gradient) of the problem itself. Combining PSO with neural networks, the PSO algorithm to optimize the connection parameters.

4.3. PSO training BP-type neural networks

The BP model is a multilayer feedforward network. In addition to the input node layer and output node layer, there are one or more implicit layers. when the desired output of output node is, the actual output, the forward output of the BP network is calculated as.

1. The output of the hidden node

$$y_i = f\left(\sum_j S w_j - \theta_j\right) E = \frac{1}{2}\sum_j (t_i - o_j) \tag{4}$$

2. Output of the output node

$$O_i = f\left(\sum_j T_{ij} y_t - \theta_t\right) E = f(net_l) \tag{5}$$

   Where: the neuron node function is often taken as an -type function

$$f(x) = \frac{1}{1 + \exp(-x + \theta)} \tag{6}$$

   Where: x-the node input vector, θ-the threshold value. for each cell in the hidden layer, and the error is used to correct the previous layer weights and thresholds.

3. The error formula of the output node

$$E = \frac{1}{2}\sum_l (t_i - o_i)^2 \tag{7}$$

The BP algorithm uses the gradient descent method to correct the front layer weights and thresholds, using the formula omitted. The gradient descent-based BP algorithm converges slowly, is very easy to fall into local extremes, and is extremely sensitive to parameters such as the initial weights of the network, its own learning rate and momentum, which need constant training to be fixed gradually, and excessive training can lead to overfitting phenomena, which affects the generalization ability of the network.

The PSO algorithm has fast convergence, high robustness, strong global contraction capability, and does not require the help of special information (such as gradient) of the problem itself. Combining PSO with neural networks, the PSO algorithm to optimize the connection parameters.

4.4. PSO training BP-type neural networks

The PSO algorithm optimizes the neural network by replacing the gradient descent method to train the weights and thresholds of the network. The key is to establish the mapping relationship between the dimensional space of PSO particles and the neural network connection weights and thresholds. From the analysis in this paper, it is clear that the neural network learning process is mainly the updating process of weights and thresholds, and the PSO search process is mainly the change of its speed and position in different dimensions. Thus the weights and thresholds in the BP algorithm should correspond to the positions of the particles. The fitness function of the particles is the minimum mean squared error

$$E = \frac{1}{2}\sum_{i=1}^{P}\sum_{i=1}^{N}(t_i - o_i)^2 \tag{8}$$

Generate the optimal solution. When the algorithm stops iterating, the global extremes corresponding to the neural network weights and connection structure are the optimal solutions of the training problem. From the above description, it can be seen that the values of each element of the particle vector are composed of the weights and thresholds in the BP network; the fitness function of the particles is also obtained according to the mean square error of the BP algorithm, which realizes the integration of the PSO algorithm and the BP algorithm.

5. Experimental results

5.1. Neural network training

The neural network model for PSO optimization was designed to determine 16 input neurons, representing l6 indicators, 20 neurons in the hidden layer, and 1 neuron in the output layer. The dimensionality of each particle of PSO is $361(16 \times 20 + 20 \times 1 + 20 + 1)$ dimensions, the population size is $30, w_{\max} = 0.9, w_{\min} = 0.4, p1 = 2, P2 = 2$, the connection weights $[-5, 5]$, the mean square error is less than $1e - 5$, or the maximum number of iterations is 10000. the first 10 sets of data in Table 1 are selected in this paper after normalized, as training samples, and the training results are shown in Table 2.

Serial number	1	2	3	4	5	6	7	8	9	10
Expert evaluation	0.474	0.417	0.265	0.939	0.443	0.357	0.000	0.828	0.026	1.000
Network output	0.4725	0.4163	0.2638	0.9365	0.4423	0.3582	-0.0009	0.8348	0.0279	0.9941

Table 2. Neural network training output results

5.2. Neural network testing

After the training of the network, the last 4 sets of data were used for testing, and then the error between the output evaluation target and the actual evaluation target was checked to see if the requirements were met. The normalized values of the last 4 sets of data in Table 1 are listed in Table 3. The output results calculated by the neural network are compared with the evaluation targets obtained

Sample number	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
1	0.928	0.728	1.000	0.919	0.687	0.801	1.000	0.819	0.726	0.755	0.734	0.802	1.000	0.888	0.901	0.901
2	0.715	0.546	0.802	0.918	0.755	0.702	0.889	0.274	0.728	0.668	0.802	0.902	0.728	1.000	0.802	0.802
3	0.359	0.185	0.402	0.585	0.562	0.502	0.779	0.819	0.365	0.334	0.202	0.000	0.275	0.334	0.201	0.200
4	0.502	0.365	0.802	0.752	0.689	0.502	0.668	0.638	0.185	0.502	0.468	0.202	0.275	0.445	0.402	0.300

Table 3. Normalized test values

after the inverse normalization process and the actual evaluation targets, and the testing error of the network can be obtained, as shown in Table 4. The results obtained from the test are very close to the

original data, that is, the model can determine the teaching effect more accurately according to each evaluation index.

Actual Output	Network Output	Error
93	92.3775	-0.6227
92	92.2686	0.2686
84	83.3760	-0.6240
86	85.9907	0.0093

Table 4. Test error

5.3. Teaching Effect

The aim is to improve the effectiveness and quality of university English teaching in applied colleges students' independent learning ability and comprehensive language application ability. The teaching effect is shown in Figure 1.

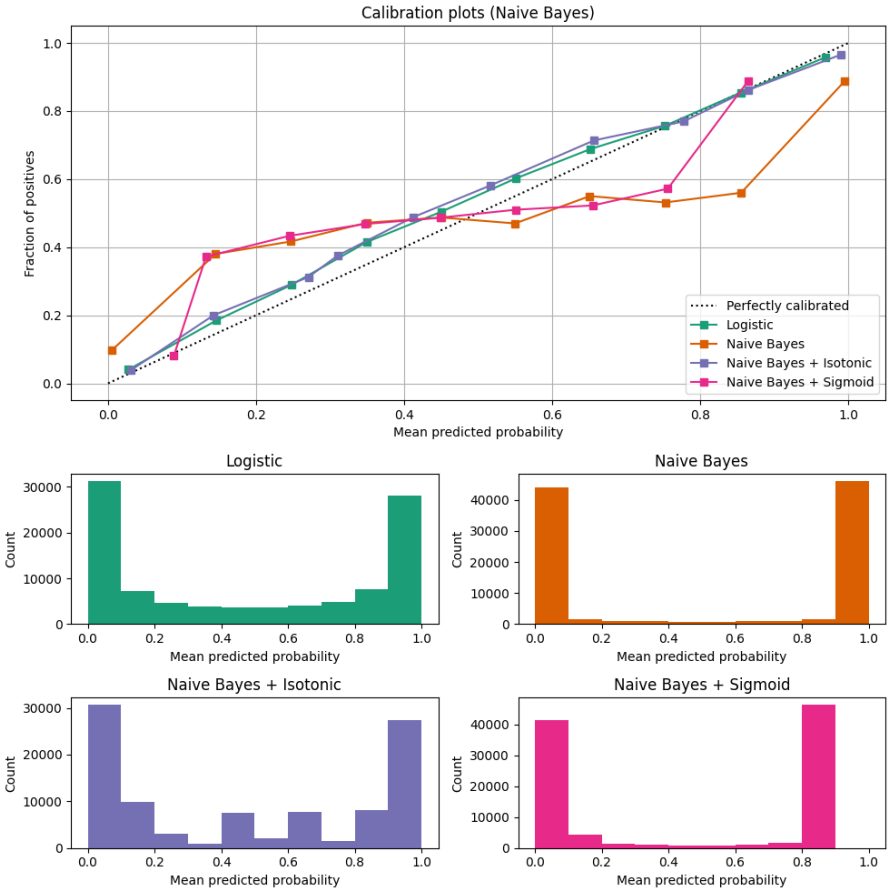

Figure 1. Teaching effect of different methods = effect

As shown in Figure 2, under the IT-based hybrid teaching model, teachers can adopt a diversified evaluation method combining formative evaluation, performance evaluation and summative evaluation to comprehensively evaluate the whole process of student learning, and teachers can use advanced digital information technology to monitor and grasp the dynamic data of students in the whole teaching process in real time, which is helpful for teachers to analyze and study students' knowledge mastery, actual learning difficulties and needs, and various ability development needs in a comprehensive manner. This helps teachers to analyze and study students' knowledge mastery, actual learning difficulties and needs, and various competency development needs in order to fully understand students' overall learning situation and effects, and adjust teaching methods and strategies in response

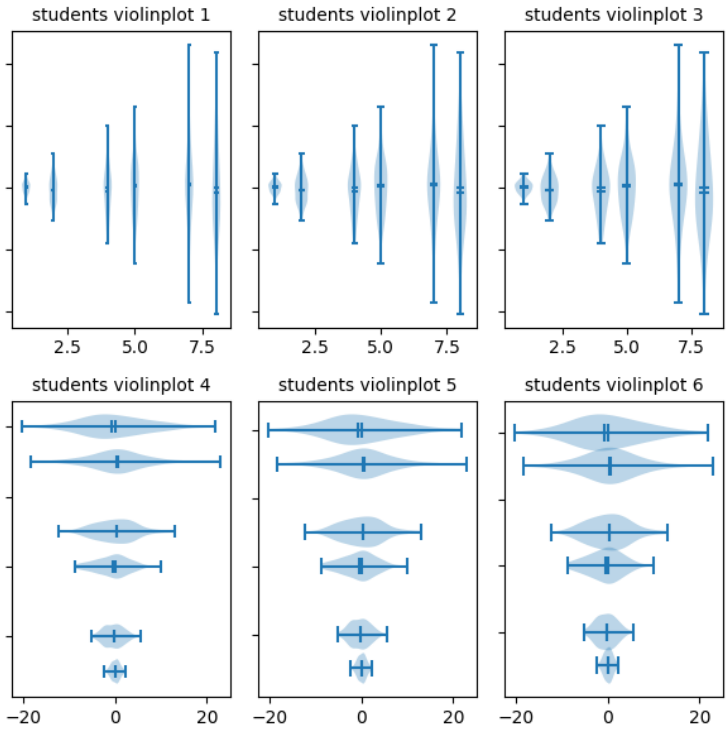

Figure 2. Student learning effect of hybrid classroom teaching

to problems in order to improve teaching effectiveness [30, 31]. The diversified teaching evaluation tools throughout the teaching process can reflect the students' comprehensive learning situation and effect more truly, which is conducive to teachers' deeper understanding of students' knowledge and skills, learning methods, emotional attitudes and values, etc., and improve the effectiveness of teaching evaluation, and also help teachers to provide reference basis for future teaching design.

6. Conclusion

To address the problems in the previous teaching quality evaluation system, this paper uses neural networks trained by particle swarm optimization algorithm (PSO) to establish a mathematical model for teaching quality evaluation. The experimental results show that the use of artificial neural network can better establish a comprehensive evaluation system, which is used to meet a wider range of systematic comprehensive evaluation. It effectively improves students' independent learning ability of college English and cultivates applied and complex high-quality talents with high English application ability.

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Conflict of interest

The authors declare no conflict of interests.

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