Situational Teaching Based Evaluation of College Students' English Reading, Listening, and Speaking Ability

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Abstract—To effectively enhance college students' English Reading, Listening, and Speaking (RLS) ability, it is important to explore the teaching contents, teaching methods, and the factors affecting the development of college students' English RLS ability. The existing literature has not clearly defined college students' English RLS ability, or selected a proper method to evaluate the ability scientifically. To solve the problems, this paper tries to evaluate college students' English RLS ability based on situational teaching. Firstly, the authors analyzed the teaching idea of college students' English RLS courses, and established an evaluation index system (EIS) for their RLS ability. After examining the evaluation method, the backpropagation neural network (BPNN) was optimized by genetic algorithm, and used to construct an evaluation model for college students' English RLS ability. The feasibility of the model was demonstrated through experiments.

Keywords—situational teaching, college English learning, evaluation of reading, listening, and speaking (RLS) ability

1 Introduction

As an important aspect of college English teaching, the course teaching of English reading, listening, and speaking (RLS) aims to train the listening and speaking ability of college students [1-3]. With the development of language, psychology, and other related disciplines, as well as the advancement of online learning platforms, more and more scholars have turned their attention to the training of college students' English RLS ability [4-8]. The effective enhancement of college students' English RLS ability becomes a major issue among foreign language educators at home and abroad [9-11]. To effectively enhance college students' English RLS ability, it is important to explore the teaching contents, teaching methods, and the factors affecting the development of college students' English RLS ability [12, 13]. Therefore, it is especially important to develop a theoretical system suitable for different teaching situations, and feasible principles for teaching practice.

Liang et al. [14] explored the quality and effect of situational English teaching, and carried out a questionnaire survey on college English courses, which focuses on the application of set in college English teaching. The empirical analysis shows that the set-based new model can improve students' learning interest and comprehensive use of English, and significantly enhance English teaching quality. Multimedia teaching is popular in college English classrooms, thanks to its integration of audio-visual instruction, standard media, and various resources. Xia [15] surveyed the English majors who participated in autonomous online listening and speaking practices in the past two years, analyzed their responses to the survey questionnaire, and found that autonomous online learning has a positive effect on the listening and speaking ability of English learners, owing to the horizontal design, network resources, and language anxiety easement in the online environment. They also highlighted the importance of fully utilizing online resources to the training of autonomous learning ability and the evaluation of online language learning. Similar results were reached by Yu and Chen [16]. By questionnaire survey, Ma [17] collected the responses from the students who learned listening and speaking autonomously online, and observed that the online learning environment improves the listening and speaking ability of learners, due to the multi-level design, superiority of the Internet, and the alleviation of language anxiety. For native Chinese speakers, the Chinese language has certain interference on their English learning, especially in listening and speaking. Drawing on English teaching experience, Zhao [18] compared the English language with the Chinese language, investigated the influence of negative transfer of the Chinese language over the training of students' English listening and speaking ability, and discussed the corresponding countermeasures.

In the current literature, the research on the training of college students' English RLS ability mainly tackles standard oral and listening tests. Few researchers have explored how to adopt proper teaching methods in course teaching of English RLS, and to enhance he RLS ability of students. In addition, there is a controversy over the evaluation standard/approach for college students' English RLS ability under a specific teaching method. Some scholars have examined the application of situational teaching in courses like English RLS practice activities. But there is little report on the evaluation of college students' English RLS ability after receiving situational teaching of the relevant courses. After all, it is difficult to clearly define college students' English RLS ability, or select a proper method to evaluate the ability scientifically.

To solve the above problems, this paper tries to evaluate college students' English RLS ability based on situational teaching. Section 2 analyzes the teaching idea of college students' English RLS courses, and establishes an evaluation index system (EIS) for their RLS ability, which includes 22 secondary indices. After examining the evaluation method, Section 3 optimizes the backpropagation neural network (BPNN) by genetic algorithm, and uses the improved BPNN to construct an evaluation model for college students' English RLS ability. The feasibility of the model in evaluating English RLS ability of college students based on situational teaching was demonstrated through experiments.

2 EIS construction

Figure 1 shows the main research goals of this paper. It can be seen that the training strategy for college students' English RLS ability was revised based on the evaluation results on the ability. The teaching model with relatively high ability score needs to be selected. Based on situational teaching, the course teaching of college students' English RLS helps students to extract valuable information from audios and videos by improving their vision and hearing, and promote their language communication ability. The situational teaching-based course teaching of college students' English RLS emphasizes the students' ability to recognize speech, capture the key words and central ideas, and record and retell contents.

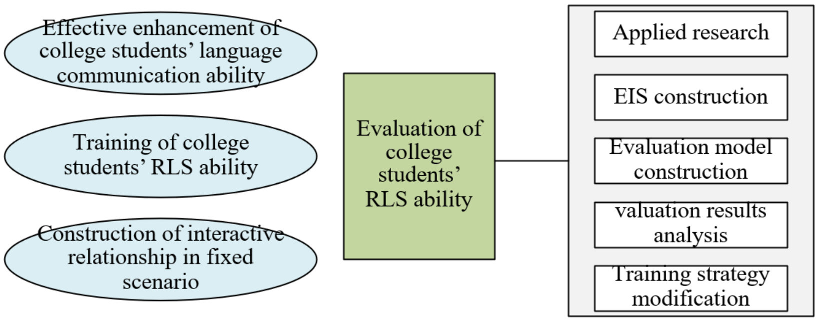

Fig. 1. The main research goals

Situational teaching intends to establish the interactive relationship of course teaching of college students' English RLS under a fixed scenario. The specific interactive relationship includes the interactive relationship between teachers and students, that between students, that between RLS teaching contents and actual fixed scenario, that between theoretical knowledge and actual application, that between situational teaching process and classroom teaching management, and that between RLS teaching standard and the actual fixed scenario. The establishment of the above interactive relationships guides students to participate in English RLS course teaching, highlights their learning interest and emotions, and ensures the teaching effect.

In situational teaching, the significance of interactive activities goes far beyond the theoretical knowledge of English learning. It makes the students more willing to communicate in speaking English, master the accurate English expressions facing different objects in various teaching scenarios, and learn how to interact with others in actual scenarios of speaking English communication.

Drawing on the principles of EIS construction, the experience of course teaching of college students' English RLS, and the factors affecting that ability, this paper puts forward an EIS for college students' English RLS ability (Figure 2). Five types of factors were selected preliminarily: language factors, pragmatic factors, communication factors, listening factors, and observation factors. Without loss of generality, four of these five types of factors were compiled into four primary indices. After analyzing the factors affecting college students' English RLS ability, and sorting out the reference indices, the EIS was finalized with 22 secondary indices:

Layer 1:

LSL={college students' English RLS ability};

Layer 2 (primary indices):

$LSL=\{LSL_1, LSL_2, LSL_3, LSL_4\}$={English language ability, English communication ability, English listening, visual observation ability};

Layer 3 (secondary indices)

$LSL_1=\{LSL_{11}, LSL_{12}, LSL_{13}, LSL_{14}, LSL_{15}, LSL_{16}, LSL_{17}, LSL_{18}, LSL_{19}, LSL_{110}, LSL_{111}, LSL_{112}, LSL_{113}\}$={pronunciation, tone, degree of pitch, rhythm, vocabulary, vocabulary use accuracy, word use properness, grammatical form accuracy, syntax structure richness, syntax structure complexity, language coherence, language fluency, discourse length};

$LSL_2=\{LSL_{21}, LSL_{22}\}$={flexibility, appropriateness};

$LSL_3=\{LSL_{31}, LSL_{32}, LSL_{33}, LSL_{34}\}$={ability to summarize the contents of a topic, ability to grasp the connections between information, ability to master the background of a conservation, ability to infer the intent of speaker};

$LSL_4=\{LSL_{41}, LSL_{42}, LSL_{43}\}$={ability to judge the intent of a scenario, ability to determine the sequence between scenarios, ability to discover details of a scenario}.

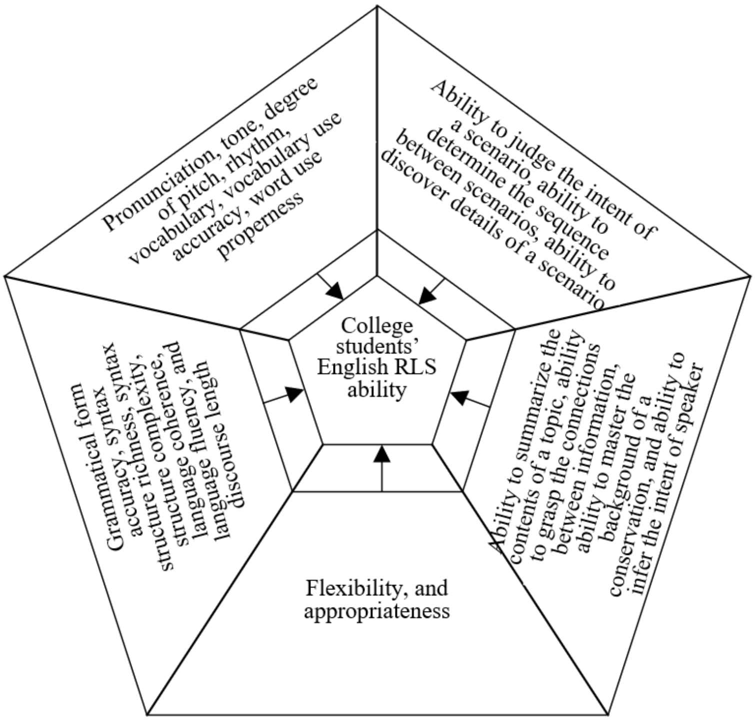

Fig. 2. Structure of our EIS

3 Model construction

This section mainly tries to build up an evaluation model for college students' English RLS ability. After studying the evaluation method, the BPNN optimized by genetic algorithm was adopted to construct that model. The modeling flow is shown in Figure 3.

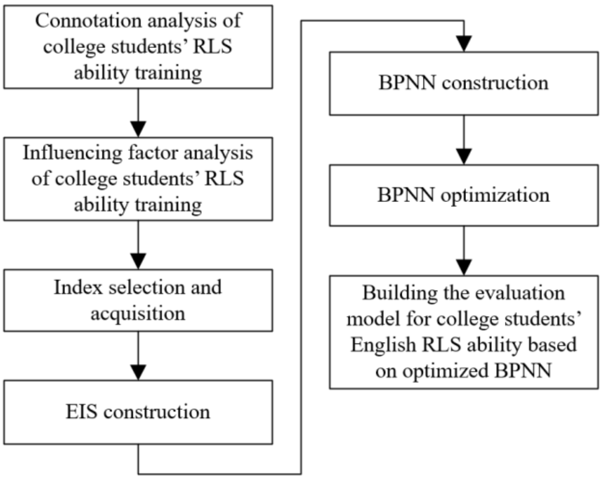

Fig. 3. Construction flow of our model

Suppose the proposed BPNN has *m*, *u*, and *v* nodes on the input layer, hidden layer, and output layer, respectively. Let *y*, *sl*, and *sj* be the input vectors of the input layer, hidden layer, and output layer, respectively; *zl*, *zj*, and *ej* be the output vectors of the input layer, hidden layer, and output layer, respectively; g_{ls} and g_{sj} be the connection weights between input and hidden layers, and between hidden and output layers, respectively; a_l and a_s be the thresholds of hidden layer nodes and output layer nodes, respectively. The weights and thresholds of the above network parameters were initialized as small random numbers. The *k*-th sample was selected randomly for training. Figure 4 shows the structure of the proposed BPNN.

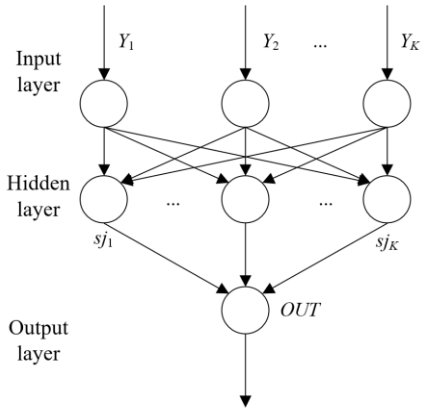

Fig. 4. Proposed BPNN

Let Y_k be the learning sample randomly inputted to evaluate college students' English RLS ability, where $k \in \{1, 2, 3, ..., K\}$; K be the total number of samples. The input and output of hidden layer nodes can be respectively expressed as:

$$sl_s(k) = \sum_{l=1}^{m} g_{ls} r_j(k) - a_s \quad s = 1, 2, ..., u \tag{1}$$

$$sj_s(k) = Q_1\left[\sum_{l=1}^{m} g_{sj} y_l(k) - a_s\right] \quad s = 1,2,...,u \tag{2}$$

The input and output of output layer nodes can be respectively expressed as:

$$zl_j(k) = \sum_{s=1}^{u} g_{sj} sj_s(k) - a_s \quad s = 1,2,...,v \tag{3}$$

$$zj_j(k) = Q_2\left[\sum_{s=1}^{u} g_{sj} sj_s(k) - a_s\right] \quad s = 1,2,...,v \tag{4}$$

The global error can be calculated by:

$$AE = \frac{1}{2n}\sum_{k=1}^{n}\sum_{j=1}^{v}\left(a_j(k) - z_j(k)\right)^2 \tag{5}$$

Then, the weights and thresholds of each layer in the BPNN are modified by gradient descent:

$$g_{sj}^{P+1} = g_{sj}^{p} + v\mu_{js}(k) sj_s(k) \tag{6}$$

$$g_{ls}^{P+1} = g_{ls}^{P} + v\mu_s(k) x_l(k) \tag{7}$$

Finally, whether the global error *AE* reaches the preset error is checked. If yes, the learning is terminated; otherwise, the learning process is started all over again from the computing of hidden layer input and output.

Currently, there is no unified standard for determining the number of hidden layer nodes in BPNN. This paper determines that number in our model by empirical formulas. Let m, m_S, and n be the number of nodes in the input layer, hidden layer, and output layer, respectively; b be a constant in the range of [1, 10]. Then, the empirical formulas can be expressed as:

$$m_S = \sqrt{m+n} + b \tag{8}$$

$$m_S = \sqrt{m+n} \tag{9}$$

$$m_S = \frac{m+n}{2} \tag{10}$$

$$m_S \leq \sqrt{n \times (m+3)} + 1 \tag{11}$$

$$m_S = log_2 n \tag{12}$$

The transfer function on each layer of the model is usually monotonically increasing. The commonly used transfer functions include sigmoid function log sig, tangent sigmoid function tan sig, and linear function purelin:

$$log\ sig(m) = \frac{1}{1+exp(-m)} \tag{13}$$

$$tan\ sig(m) = \frac{2}{1+exp(-2m)} - 1 \tag{14}$$

$$purelin(m) = m \tag{15}$$

The common error formulas for BPNN are standard error (SE), global cumulative error (GCE), and mean squared error (MAE). Let d be the number of training samples; $p^d{}_k$ and $OUT^d{}_k$ be the desired output and actual output, respectively. Then, the SE, GCE, and MAE can be respectively computed by:

$$SE_u = \frac{1}{2}\sum_{k=1}^{K}\left(p_k - OUT_k\right)^2 \tag{16}$$

$$GCE = \frac{1}{2}\sum_{d=1}^{D}\sum_{k=1}^{K}\left(p_k^d - OUT_k^d\right)^2 \tag{17}$$

$$MSE = \frac{1}{md}\sum_{d=1}^{D}\sum_{k=1}^{K}\left(p_k^d - OUT_k^d\right)^2 \tag{18}$$

The genetic algorithm can optimize BPNN in three aspects: network parameters, network structure, and network learning rules. This paper mainly relies on genetic algorithm to optimize the weights and thresholds of the proposed BPNN. The optimization flow is shown in Figure 5.

After determining the coding method and initializing the population for the genetic algorithm, this paper designs the fitness function based on the error function of BPNN:

$$Q = \frac{1}{MSC} = \frac{nd}{\sum_{d=1}^{D}\sum_{k=1}^{K}\left(p_k^d - OUT_k^d\right)^2} \tag{19}$$

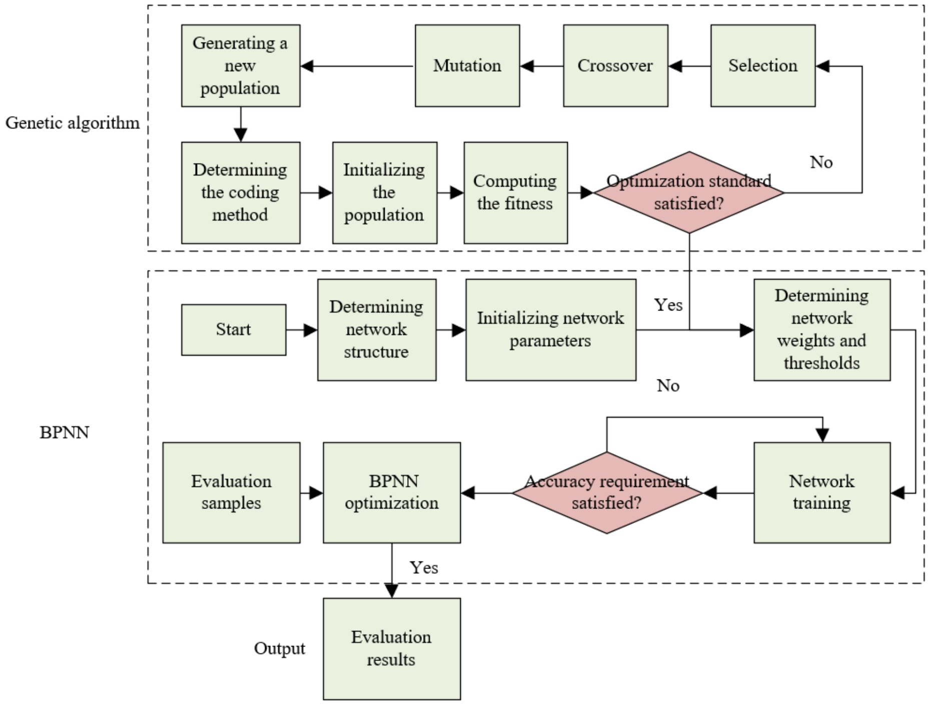

Fig. 5. Optimization flow

The optimal weights and thresholds are determined through the selection and crossover of genetic algorithm.

Roulette wheel strategy is adopted to select elite individuals from the parent population. The high fitness individuals are selected at a high probability. The probability of individual i being selected can be calculated by:

$$\Omega_l^{'} = \frac{Q_l}{\sum_{l=1}^{M} Q_l} \tag{20}$$

Then, the cumulative probability of each individual can be calculated by:

$$\Omega_l = \sum_{w=1}^{l} \Omega_w^{'} \tag{21}$$

Finally, a random number γ is chosen from the range [0, 1]. If $\Omega_{l-1}<\gamma<\Omega_l$, then individual l will be selected. This process is repeated until all individuals to be retained in the next generation are identified. After that, crossover is carried out based on the real number coding results. Some information of the selected two individuals is swapped, and new individuals are produced through recombination. The crossover and selection of genetic algorithm are performed cyclically until the network outputs the optimal chromosome meeting the preset optimization standard. The output results will be imported to the BPNN for training and testing as the optimal initial weights and thresholds.

4 Experiments and results analysis

Before training the optimized BPNN, it is necessary to initialize the structural parameters of the network, and to normalize the samples for evaluation of college students' English RLS ability. The maximum number of iterations of the optimization algorithm was set to 100, the normalized samples were imported to the algorithm, and the sample data were trained on MATLAB Toolbox. Figures 6 and 7 present the SSE curve and fitness curve, respectively. It can be seen that, with the growing number of iterations, SSE and fitness changed in opposite directions. After 40 iterations, the change of the two parameters tended to be stable. Table 1 shows the training results of the optimized BPNN. Figure 8 displays the linear regression plot of the training results.

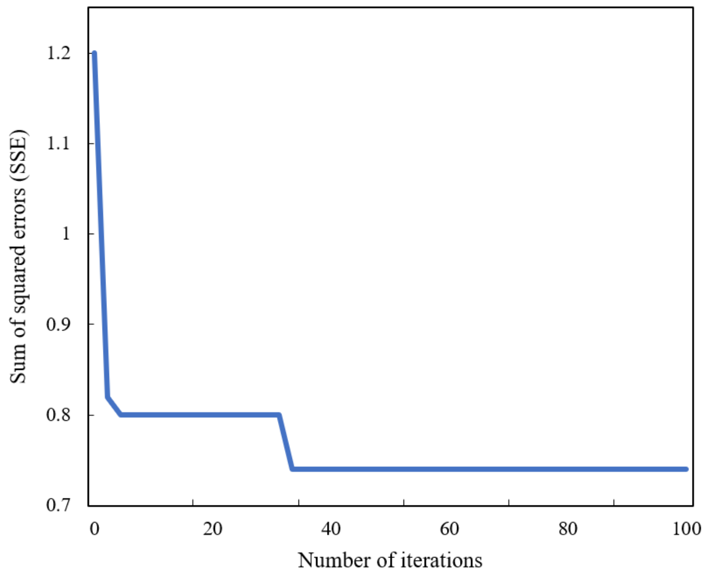

Fig. 6. SSE curve

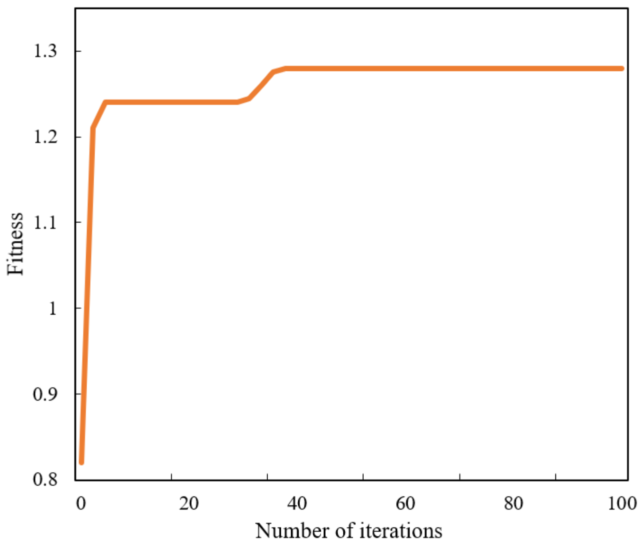

Fig. 7. Fitness curve

Table 1. Training results of the optimized BPNN

Sample	**1**	**2**	**3**	**4**	**5**
Desired output	0.62	0.68	0.74	0.79	0.42
Training output	0.5248	0.6219	0.7206	0.7625	0.4628
Absolute error	0.0002	0.0001	0.0003	0.0001	0.0004
Grade	Ⅱ	Ⅰ	Ⅱ	Ⅲ	Ⅱ
Sample	6	7	8	9	10
Desired output	0.72	0.77	0.64	0.43	0.75
Training output	0.7138	0.7918	0.6958	0.4827	0.6928
Absolute error	0.0001	0.0003	0.0001	0.0002	0.0001
Grade	Ⅰ	Ⅲ	Ⅱ	Ⅱ	Ⅲ

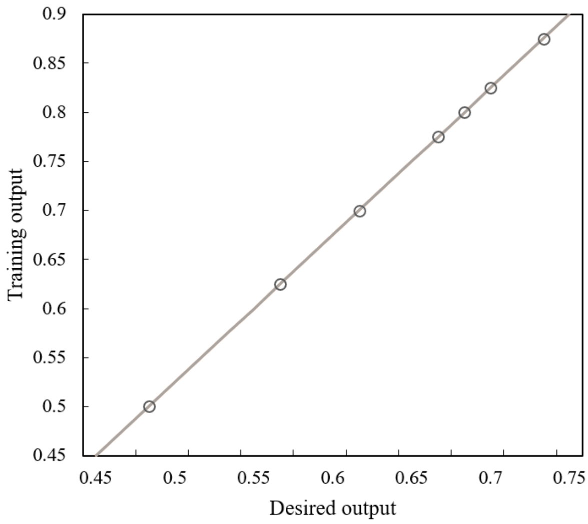

Fig. 8. The linear regression plot of the training results of the optimized BPNN

As shown in Figure 8, the training output was basically consistent with the desired output. The error meets the requirement. It can also be seen that the correlation coefficients of our model were relatively large, and the desired output was close to the actual training output. The high correlations and small error manifest the strong regression ability and generalization ability of our model. Hence, our model can effectively evaluate college students' English RLS ability.

Next, this paper compares the evaluation results on college students' English RLS ability obtained under different settings. The varied improvements of the ability under different scenarios were evaluated by Tamhane's T2. Table 2 compares the evaluation results under different situational teaching scenarios. Under the same scenario, the four metrics of the said ability between different groups had significant differences. Under different scenarios, the same metric did not exhibit significant difference between the said ability.

Table 2. Comparison of the evaluation results under different situational teaching scenarios

Variable		Scenario 1			
Metric		LSL_1	LSL_2	LSL_3	LSL_4
Mean difference		-2.372^{**}	-1.852^{*}	-1.648^{*}	1.352^{*}
Standard error		3.264	3.517	2.954	3.065
Significance		0.01	0.04	0.01	0.01
Confidence interval	Lower bound	-3.618	-2.187	-2.528	4.718
	Upper bound	-2.315	-4.628	-9.748	2.152
Variable		**Scenario 2**			
Metric		LSL_1	LSL_2	LSL_3	LSL_4
Mean difference		2.647^{*}	1.445^{*}	1.147^{*}	1.527^{*}
Standard error		3.162	3.629	3.485	3.662
Significance		0.02	0.01	0.01	0.02
Confidence interval	Lower bound	2.2625	7.158	3.625	-2.674
	Upper bound	3.628	2.614	2.026	-7.152

Table 3 provides the descriptive statistics under different student sources. Through single factor analysis of variance, the significance was far greater than 0.05. Hence, there was no significant difference in English RLS ability between groups of students of different sources.

Table 3. Descriptive statistics under different student sources

Class number		1	2	3	4	5	6
Number of students		95	102	97	104	85	116
Mean difference		52.684	55.281	54.728	54.165	54.127	54.824
Standard error		10.265	11.412	10.417	11.214	10.628	11.308
Mean Difference		1.023	1.087	1.104	1.235	1.048	9.637
Confidence interval	Lower bound	51.274	53.172	52.638	52.317	53.694	50.957
	Upper bound	55.267	58.165	55.263	58.424	56.381	55.246
Minimum		28.12	24.50	36.29	23.57	33.24	24.05
Maximum		77.42	77.85	76.21	77.92	76.28	75.15

5 Conclusions

This paper explores the training of college students' English RLS ability based on situational teaching. Firstly, the teaching idea of college students' English RLS courses was clarified, and an EIS was set up for the English RLS ability of college students. Next, the BPNN was optimized by genetic algorithm, and used to build an evaluation model for college students' English RLS ability. Through experiments, the SSE and fitness curves were obtained, which demonstrate the good execution performance of our model. Then, the training output of the optimized BPNN was obtained, and the linear regression of the training output was plotted. These results confirm the feasibility and effectiveness of our model in evaluating the college students' English RLS ability. Finally, the evaluation results under different situational teaching scenarios were compared, and the descriptive statistics were obtained for students from different sources.

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