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Application Integrated Deep Learning Networks Evaluation Methods of College English Teaching

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Abstract

INTRODUCTION: The construction of English evaluation methods in colleges and universities, as the essential part of English teaching in colleges and universities, is conducive to the improvement of the quality of English teaching in colleges and universities, which makes the existing English teaching more objective and reasonable, and makes the means of English teaching rich in science.
OBJECTIVES: Aiming at the current wisdom teaching evaluation design methods exist evaluation indexes exist objectivity is not strong, accuracy is poor, single method and other problems.
METHODS:Proposes a college English teaching evaluation method based on a deep learning network. First, the evaluation index system of English in colleges and universities is constructed by analyzing the principle of selecting evaluation indexes of English in colleges and universities; then, the deep learning network is improved through self-coder and integrated learning methods to construct the evaluation model of English teaching in colleges and universities; finally, the effectiveness and efficiency of the proposed method is verified through simulation experiment analysis.
RESULTS: The results show that the proposed method improves the accuracy of the evaluation model.
CONCLUSION: Solved the problems of low evaluation accuracy and non-objective system indexes of English teaching evaluation methods in colleges and universities.

Keywords: English teaching evaluation in higher education, deep learning network, self-encoder, integrated learning

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1. Introduction

The arrival of the information age has driven the deepening reform of higher education teaching, evaluation construction, and measures improvement. It has become the direction and theme of development in education [1]. At present, the increasing number of students in China's institutions of higher education with each passing day makes the demand for high-quality teaching in colleges and universities increase with each passing day. However, it still cannot meet the learning needs of students [2]. As an introductory course, English in colleges and universities is of great practical significance for students to communicate with the outside world, develop their horizons, and study deeply. As the essential part of English teaching in colleges and universities, the construction of college English evaluation methods is conducive to improving the quality of English teaching in colleges and universities, making the existing English teaching more objective and reasonable. It makes the means of English teaching rich in science. Therefore, it is essential to study the evaluation methods of English teaching in wisdom colleges and universities [3].
The College English evaluation method is the crucial technology of the college English teaching evaluation system, not only related to the teacher's teaching content, method, and the judgment standard of teaching effect [4]. To improve the quality of English teaching in institutions,

the scientificity, rationality, and principle of evaluation indexes and methods are becoming increasingly critical and have been studied and paid attention to by the government at all levels and experts in the field of education. Evaluation and control of English teaching in colleges and universities means that colleges and universities obtain feedback data on English teaching through management supervision, expert assessment, and student performance, evaluate the teaching level of English teachers, discover problems, analyze the teaching process, and put forward improvement measures promptly [5]. Currently, English teaching evaluation methods in colleges and universities include fuzzy comprehensive evaluation method [6], decision tree [7], support vector machine [8], shallow neural network [9], and deep learning methods [10]. Literature [11] uses the method of decision tree and neural network to construct an English teaching evaluation model, and proposes the potential causal relationship of each evaluation index; Literature [12] combines the convolutional neural network and the long and short-term memory network to build an online education evaluation method; Literature [13] proposes a distance teaching evaluation method for colleges and universities based on the decision tree algorithm, which improves the accuracy of the evaluation of the quality of teaching; Literature [14] constructs a method of distance teaching quality evaluation model and achieved better evaluation results; literature [15] used genetic optimization algorithm to improve neural network to complete teaching quality evaluation method, which has faster evaluation speed and accuracy; literature [16] used bottle sea squirt algorithm to optimize the hyperparameters of the support vector machine to construct the public teaching quality evaluation method of the university, which improves the evaluation accuracy; literature [17] improved the evaluation accuracy by dividing and extracting English teaching quality evaluation indexes, establishing the English teaching quality evaluation model based on krill swarm optimization algorithm optimization to enhance the kernel-limit learning machine, which provides new ideas for English teaching evaluation. For the analysis of the above literature, the existing English teaching evaluation methods have the following defects: 1) the evaluation indexes are not comprehensive enough; 2) the teaching quality evaluation method is single, not scientific and diversified; 3) the assessment is only from the perspective of teachers, which is limited [18].

Deep learning (DL) is a complex machine learning algorithm that has achieved speech and image recognition results far exceeding previous related techniques [19], automatically extracting high-dimensional data features and improving recognition classification accuracy. Integration learning combines multiple weakly supervised models to obtain a better and more comprehensive intensely managed model; the underlying idea of integration learning is that even if one weak classifier gets an incorrect prediction, other weak classifiers can correct the error [20]. The combination of deep learning and integrated learning makes the evaluation effective, which makes the research on the evaluation model of English teaching in colleges and universities based on deep learning algorithms become a hot spot of experts' analysis. Aiming at the problems existing in the current English teaching evaluation methods, this paper proposes a college English teaching evaluation method based on a deep learning network. The main contributions of this paper are (1) analyzing the principle of college English evaluation index selection and constructing a college English evaluation index system; (2) using stack self-coder to reduce the redundancy of college English evaluation indexes; (3) combining adaptive enhancement technology and deep neural network to improve the accuracy of English teachers' teaching quality evaluation; and (4) verifying the method of this paper through simulation to have a higher evaluation accuracy.

2. Evaluation System of English Teaching in Colleges and Universities

The evaluation system of English teaching in colleges and universities is constructed by analyzing the selection principle of the English teaching quality evaluation index system and mentioning the relevant influence indexes.

2.1 Principles of Evaluation Indicator Selection

To build a scientific and comprehensive English teaching evaluation index system, it is necessary to follow the following principles of selection of evaluation indexes:

(1) Principle of Openness

The evaluation indexes of English teaching in colleges and universities should be established in a democratic and open environment, including student feedback and guidance from higher leaders.

(2) Systematic Principle

Constructing an English teaching evaluation index system in colleges and universities is a comprehensive work that should consider the teaching content, methods, forms, effects, and other aspects.

(3) Quantitative Principle

Evaluating the quality of college English teaching requires qualitative and quantitative analysis in order to objectively reflect the quality of college English teaching.

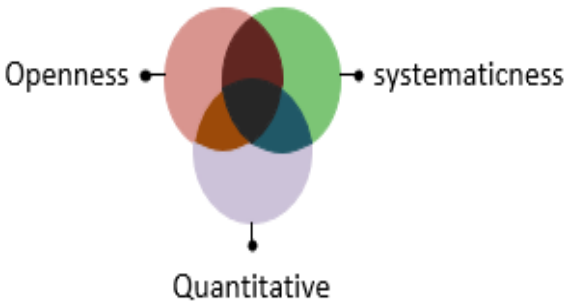


Figure 1 Schematic diagram of principle analysis

2.2 Evaluation Indicators of English Teaching in Colleges and Universities

The evaluation indexes of English teaching in colleges and universities are analyzed from five aspects of teaching content, teaching methods, teaching attitude, teaching effect, and teaching ability [21]:

(1) Teaching content

The direct reflection of teaching quality lies in whether the teaching content meets the curriculum standards, whether the content is rich, whether the structure is reasonable, and whether the operability is feasible. The evaluation indicators for teaching content should include meeting course standards P_1, rich content P_2, reasonable structure P_3, and operability P_4.

(2) Teaching methods

The implementation of teaching methods such as the safety of the teaching environment, diversity of teaching methods, expansion of teaching thinking, explanation of knowledge points, interactivity, and effectiveness of homework after class is conducive to the improvement of English teaching quality. Therefore, evaluation indicators for teaching methods should include a safe and pure teaching environment P_5, rich teaching methods P_6, expansion of teaching thinking P_7, thorough knowledge explanation P_8, emphasis on teacher-student interaction P_9, and appropriate and effective homework P_{10}.

(3) Teaching attitude

During the teaching process, teaching practice management, answering questions and resolving doubts, and class emotions affect the quality of teaching. It is necessary to use evaluation indicators such as a strong sense of time P_{11}, patience in answering questions and resolving doubts P_{12}, and enthusiasm for class P_{13} as English teaching evaluation indicators.

(4) Teaching Effect

The results of English teaching as feedback affect the quality of teachers' teaching. The teaching quality is evaluated through indicators such as improving students' learning interest P_{14}, improving students' academic performance P_{15}, and fully developing students' personalities P_{16}.

(5) Teaching ability

T Teachers' knowledge, organizational ability, self-learning ability, and research ability to a certain extent affect the quality of teaching. Therefore, four teaching abilities are selected as evaluation indicators for English teaching, including profound knowledge P_{17}, strong organizational ability P_{18}, strong self-learning ability P_{19}, and applying for research topic P_{20}.

2.3 Construction of English Teaching Evaluation Index System in Colleges and Universities

The evaluation system of English teaching in colleges and universities takes the critical elements of teaching content, teaching methods, teaching attitude, teaching effect, and teaching ability [22] as the first-level indexes. It takes conformity with the curriculum standard, rich content, reasonable structure, operability, safe and pure teaching environment, rich teaching methods, expanding the teaching thinking, thorough explanation of knowledge, attaching importance to the teacher-student interactions, appropriate amount of homework and practical homework, robust concept of time, answering questions and solving problems, patience, enthusiasm in class, and student's interest in learning. Tolerance, confidence in class, improvement of students' interest in education, improvement of students' learning performance, full development of student's personality, profound knowledge, strong organization, strong self-learning ability, declaration of scientific research projects, and other 20 influencing factors as the secondary indicators [23], which fully embodies the whole process of college English teaching, and constructs a scientific, objective, and comprehensive assessment system of English teaching in colleges and universities, and the specific diagram is shown in Figure 2.

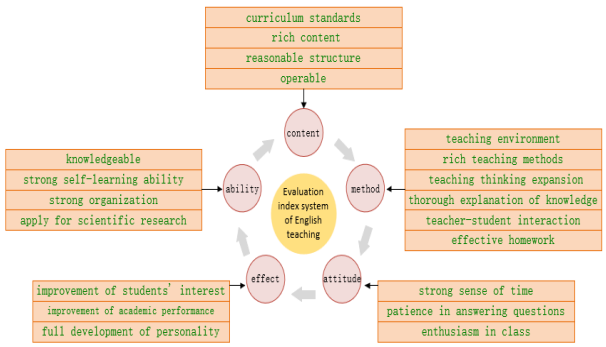


Figure 2 Evaluation index system of English teaching in higher education institutions

3 Deep Learning Network

3.1 Stacked Self-Encoder

A self-encoder is a feed-forward neural network used to reconstruct the input data. This network can use unsupervised learning to extract low-dimensional feature vectors from the original input vectors for data dimensionality reduction [24]. The standard autoencoder

is a three-layer network with input, hidden, and output layers, and its structure is symmetric and can be divided into two parts: encoder and decoder. The current autoencoders include Stack Self-Encoder, Sparse Self-Encoder, Noise Reduction Self-Encoder, Variational Self-Encoder, and Shrinkage Self-Encoder. Stacked AutoEncoder (SAE) is based on the original autoencoder, increases the depth of its hidden layer, and has obtained better feature extraction ability and training effect. The specific structure of SAE is shown in Figure 3:

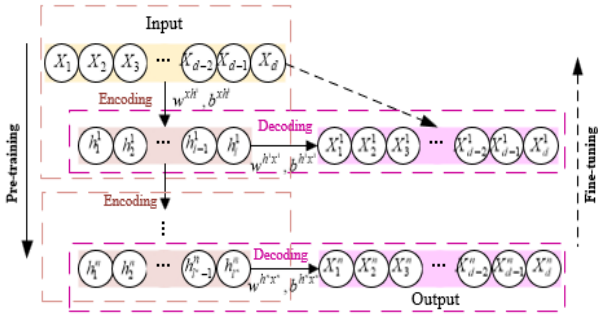


Figure 3 Stacked self-encoder structure

The whole training process of SAE can be divided into unsupervised training (Pre-training) and supervised fine-tuning (Fine-training) process. The specific steps are as follows:

Step 1: In the unsupervised training process, use the gradient descent method to train the weights and biases of each self-encoder layer by layer;

Step 2: On the dataset with labels, retrain the SAEs using the back-propagation algorithm so that the weights and biases of the SAEs are fine-tuned.

3.2 Convolutional Neural Network

A convolutional neural network (CNN) [19] is an artificial neural network that consists of one or more convolution layers, i.e., at least one layer of the neural network that uses convolution operations instead of the usual matrix multiplication operations. The structure of CNN is shown in Figure 4. The convolution layer analyzes each small piece of the input sample more deeply to obtain features with a higher degree of abstraction; the pooling layer does not change the depth of the output of the previous layer and can reduce the size of its matrix, thus achieving the purpose of minimizing the parameters in the actual neural network; the fully connected layer is mainly used to complete the classification task, and the learned feature representations are weighted and summed to get the scores of each category; the last layer of the general classification problem is the Softmax layer, which is used for classification problems. The softmax layer maps the scores of the previous layer to the sample labeling space. The features of CNN include sparse connectivity, weight sharing, and pooling.

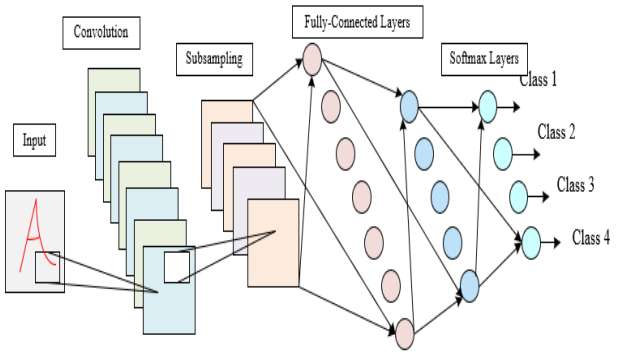


Figure 4 Convolutional neural network structure

The convolution operation of a convolutional layer is defined as follows:

$$z_j^{(l)} = \sum_{i=1}^{I} w_i^{(l)} a_{i+j-1}^{(l-1)} + b^{(l)} \tag{1}$$

Where. $a_{i+j-1}^{(l-1)}$ is the index of the convolution kernel, the flag indicates the current convolution layer, the previous layer, and the convolution kernel's size. It shows the feature value of this convolutional layer after the convolutional operation, indicates the shared weights, is the activation output value of the previous layer, and is the bias of the convolutional layer.

After going through each forward propagation calculation, the gradient of the loss function concerning the weights and biases must be back-propagated through the neural network. In this paper, the optimization algorithm for weights and preferences is the Adam optimization algorithm.

4. Integration of deep learning network

The convolutional neural network based on SAE (SAE-CNN), to build an integrated deep neural network. Assume that the set of training samples of the posture description parameters, where n is the number of samples, d is the dimension of the air combat posture description parameters, and the base evaluator SAE-CNN denoted as the number of base evaluators, is. The specific algorithm is described as follows:

Step 1: Initialize the weight distribution of the samples, and the weight of each sample is calculated as follows:

$$\omega_{1,i} = \frac{1}{n}, i = 1, 2, \cdots, n \tag{2}$$

Step 2: For iteration rounds, use the training sample base evaluator with the current distribution;

Step 3: Calculate the prediction error of the base evaluator on the set of training samples:

$$\varepsilon_t = \sum_{i=1}^{m_s} \omega_{t,i} e_{t,i} \tag{3}$$

$$e_{t,i} = \begin{cases} 1 & y_i \neq h_t(x_i) \\ 0 & y_i = h_t(x_i) \end{cases} \tag{4}$$

where $e_{t,i}$ is the error of the ith sample on the t base evaluator, denotes an error of 1 when supervised signaling, and an error of 0 when supervised signaling.

a_t Step 4: Calculate the weight coefficients of the base evaluator:

$$a_t = 0.5 \lg \frac{\varepsilon_t}{1-\varepsilon_t} \tag{5}$$

Step 5: Update the sample distribution of the training sample set until the maximum number of iteration rounds is reached.

$$\omega_{t+1,i} = \omega_{t,i} e^{-a_t y_i^2} \tag{6}$$

Step 6: Linearly combine the individual base evaluators to finally obtain the strong evaluator, the integrated deep neural network (SAE-CNN with AdaBoost, SAE-CNN-Ada):

$$f_{RF-ada}(X) = round\left(\sum_{t=1}^{T} \left(\ln \frac{1}{a_t} \right) G(X) \right) \tag{7}$$

where $G(X)$ is the median of all, denotes rounding.

5. Ideas of English teaching evaluation methods in colleges and universities based on integrated deep learning network

Combining AdaBoost and SAE-CNN, this section proposes a college English teaching evaluation model method based on an integrated deep neural network. The evaluation model is mainly based on the mapping relationship between indicators and evaluation values, with the evaluation indicators of English teaching in colleges and universities as inputs and evaluation values as outputs. The teaching evaluation model based on an integrated deep neural network is shown in Figure 5. The specific steps are as follows:

Step 1: Acquire the college English teaching evaluation samples; preprocess the acquired samples and adopt the sparse smoothing data processing method;

Step 2: Initialize the AdaBoost parameters. Initialize the weights and bias of each self-coder network of the weak classifier and randomly initialize the weights and inclination of the CNN; set the number of weak classifiers; initialize the distribution weights of the training samples;

Step 3: Train the weak classifier SAE-CNN.

(1) In the unsupervised training process, input the evaluation indexes of English teaching in colleges and universities and use the gradient descent method to train the weights and biases of SAE layer by layer;

(2) Supervised fine-tuning of SAE and training of CNN. input the dimensionality-reduced evaluation indexes of English teaching in colleges and universities, and with the corresponding evaluation values constitute the new training sample set of CNN, optimize the weights and bias of CNN by Adam optimization algorithm; meanwhile, propagate the error between the outputs in the opposite direction and the outputs of the CNN to fine-tune the SAE;

Step 4: Calculate the weight coefficients as well as update the sample distribution; train the weak classifier until the end of the iteration rounds and output the robust classifier SAE-CNN-Ada;

Step 5: Evaluate the teaching quality using the trained strong classifier and output the corresponding evaluation value.

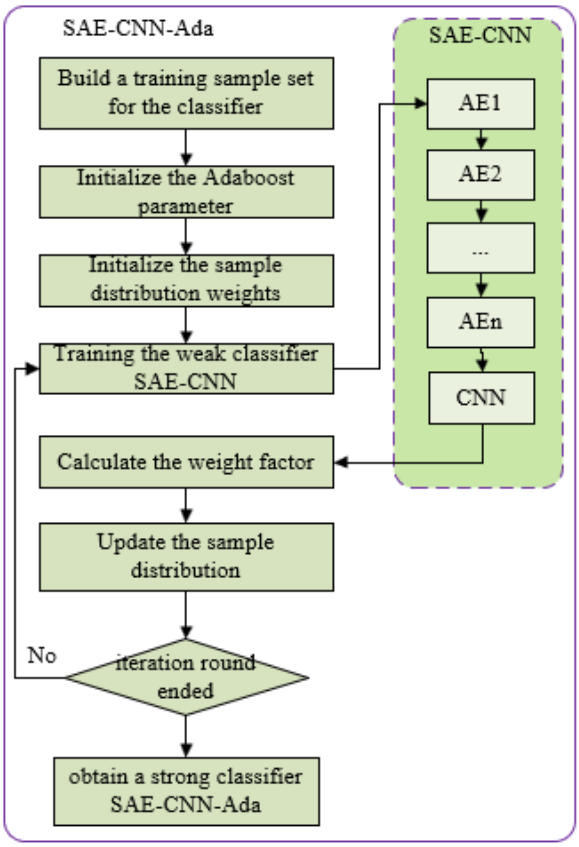


Figure 5 Flow chart of English teaching quality evaluation

6. Experiment and Result Analysis

To verify the accuracy and timeliness of the English teaching quality assessment model proposed in this paper, five assessment algorithms were selected for comparison, and the specific parameter settings of each algorithm are shown in Table 1. The training data and test data are mainly from the sample of the case college's quality assessment questionnaire; the training samples are 400, and the test samples are 40. The experimental simulation environment is Windows 10, with a CPU of 2.80GHz, 8GB RAM, and the programming language Matlab2018b.

Table 1 Parameter settings of English teaching quality evaluation methodology

Algorithm	Parameter setting

RF	N_tree=500, m_try=floor(80.5)
SAE-RF	The self-encoder hidden layer node number is 4; other parameter settings are the same as the RF.
BP	the layer is 50, and the activation function is the radial basis function.
CNN	Convolutional layer (30 convolutional kernels, Relu activation), Maximum pooling layer, Fully connected layer (10 nodes, Relu activation), softmax layer, Output layer; Weights are initialized with Gaussian distribution, Training algorithm is Adam's algorithm, Learning rate is 0.001, L2 regularization coefficient is 0.004, MaxEpochs is 100, Minimum batch size is 20. MaxEpochs is 100, and the minimum batch size MiniBatchSize is 20;
SAE-CNN	The number of hidden layer nodes of the self-encoder is 4; other parameters are the same as those of CNN.
SAE-CNN-Ada	The number of weak classifiers is 5; other parameter settings are the same as SAE-CNN.

6.1 Parameter setting analysis

To analyze the impact of the SAE-CNN-Ada algorithm on model performance, this paper examines the parameters of the SAE-CNN-Ada algorithm.

Figure 6 gives the effect of different self-encoder node numbers and convolution kernel numbers on the performance of the college English teaching assessment model based on the SAE-CNN-Ada algorithm. From Figure 6(a), it can be seen that with the increase of the number of self-encoder nodes, the test accuracy of the assessment model increases, but the change is not significant; with the rise in the number of convolutional kernels, the test accuracy of the assessment model does not change much. From Figure. 6(b), it can be seen that the number of convolutional kernels and the number of self-encoded nodes increase, and the prediction time tends to increase slightly, but the change is not significant. Therefore, for careful consideration, the convolution kernels are 30, and the self-encoded nodes are 4.

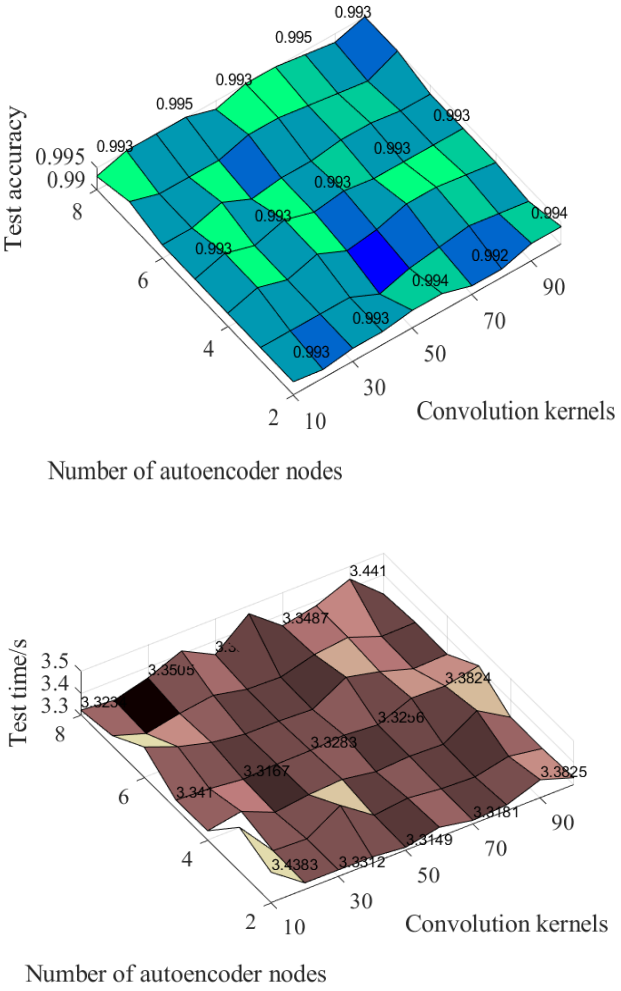


Figure 6 Effect of different numbers of self-encoder nodes and number of convolutional kernels on the performance of SAE-CNN-Ada evaluation

Figure 7 shows the effect of different convolutional kernels and weak classifiers on the performance of the English teaching evaluation model based on the SAE-CNN-Ada algorithm. From Figure 7(a), it can be seen that as the number of weak classifiers increases, the accuracy of the posture evaluation model does not change much, and the test time increases significantly. Therefore, the number of weak classifiers is selected as 5 for comprehensive consideration.

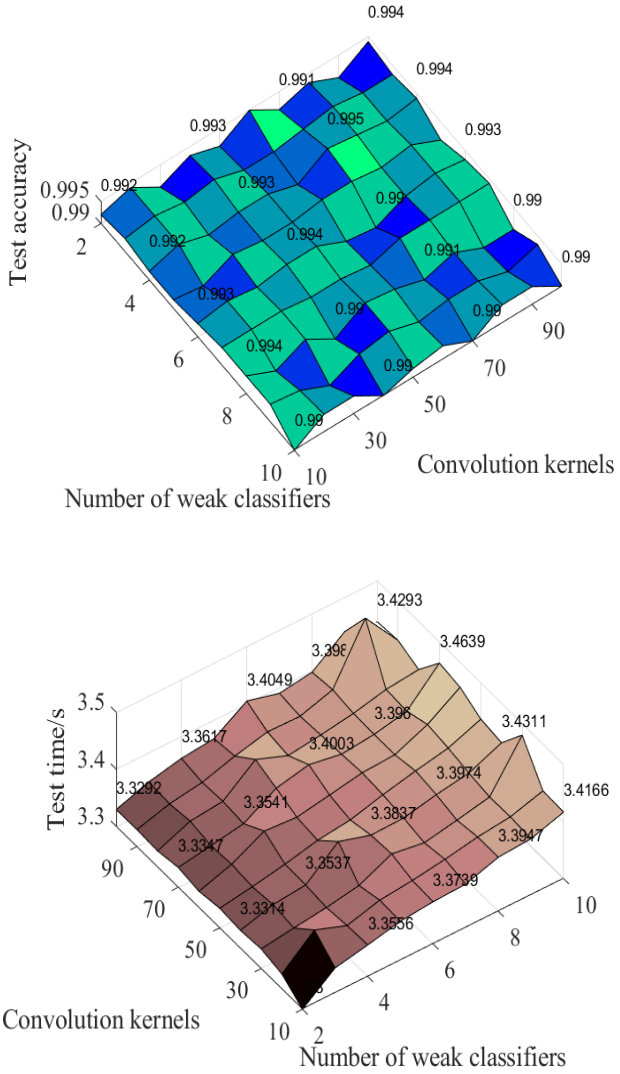


Figure 7 Effect of different numbers of convolutional kernels and number of weak classifiers on the performance of SAE-CNN-Ada evaluation

6.2 Experimental Analysis

To verify the effectiveness and superiority of the English teaching evaluation method based on SAE-CNN-Ada, SAE-CNN-Ada is compared with five other models, and the evaluation results and evaluation relative errors of each model are shown in Figure 8. By comparing the evaluation results in Figure 8, the evaluation results of SAE-CNN-Ada are closer to the actual values, thus indicating that the performance of the SAE-CNN-Ada English teaching evaluation model is better than that of the RF, SAE-RF, BP, CNN, and SAE-CNN models; by comparing the results of the CNN, SAE-CNN, and SAE-CNN-Ada algorithms, the self-encoder and adaptive enhancer makes the performance of English teaching evaluation further improved.

From the relative errors in Figure 9, it can be seen that the evaluation error of SAE-CNN-Ada English teaching evaluation model is in the range of 0.02, the evaluation error of RF algorithm and SAE-RF algorithm is in the field of 0.1, the evaluation error of BP algorithm is in the range of 0.15, the evaluation error of CNN algorithm is in the range of 0.08, and the evaluation error of SAE-CNN algorithm is in the field of 0.05. In summary, the SAE-CNN-Ada model error is the smallest overall.

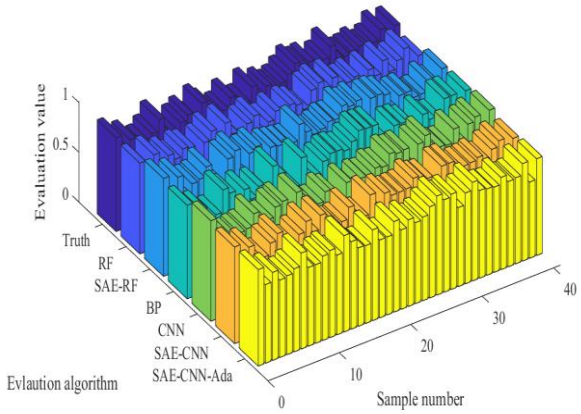
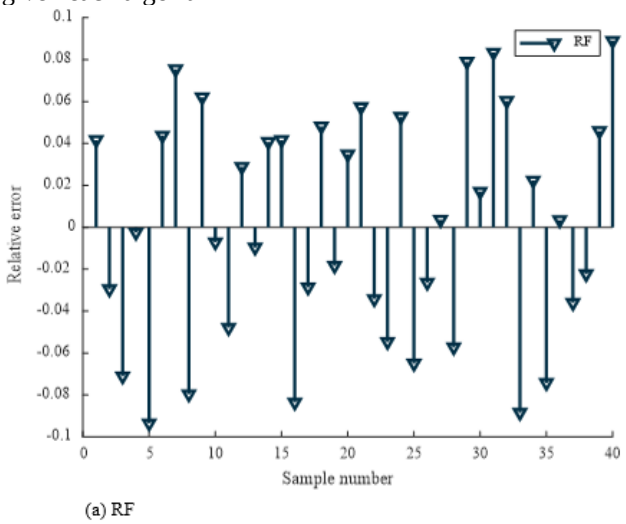
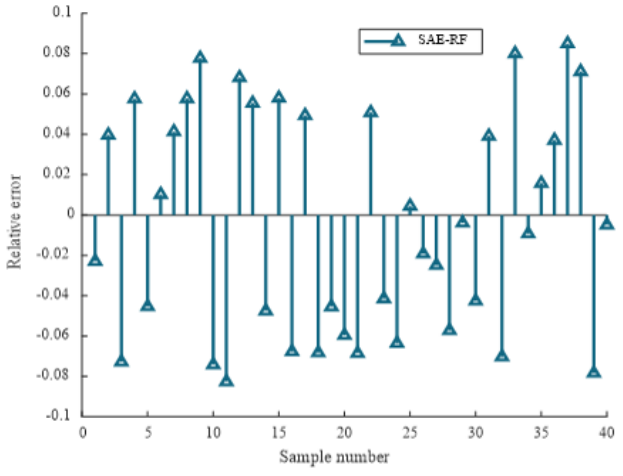


Figure 8 Evaluation values of English teaching quality given each algorithm



(a) RF



(b) SAE-RF

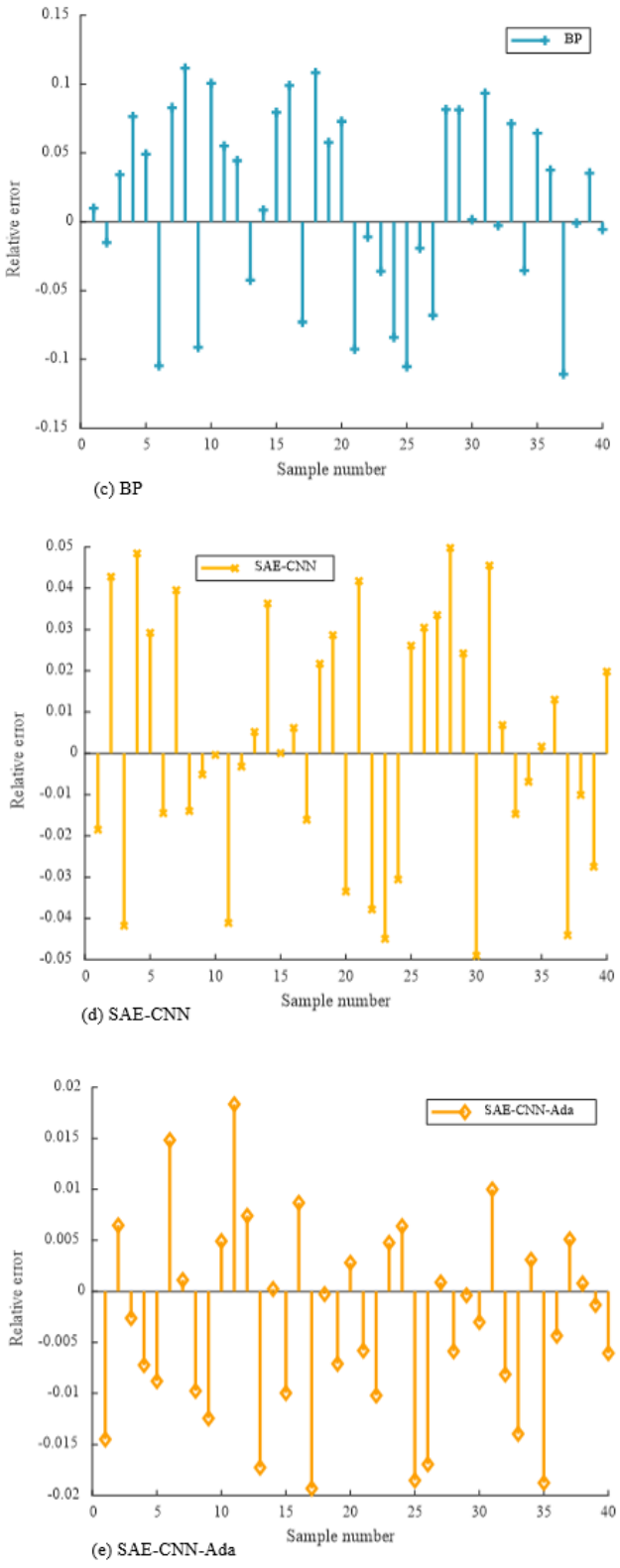


Figure 9 The real value of the assessment of the quality of English teaching and the relative error value of the evaluation based on each methodology

7 Conclusion

To accurately evaluate teachers' teaching quality in real-time from the data of English evaluation indexes in colleges and universities, this paper adopts the integrated deep learning network algorithm to construct the evaluation model of English in colleges and universities. The method makes the college English evaluation index system by analyzing the college English evaluation index selection principle. Based on a convolutional neural network, the stack self-coder is utilized to reduce the redundancy of college English evaluation indexes. Combined with adaptive enhancement technology, the deep neural network is improved to increase the precision of teachers' teaching quality evaluation. The evaluation is carried out using teacher teaching quality evaluation data, and the results show that the method proposed in this paper is better than other evaluation models in terms of evaluation accuracy under the premise of satisfying real-time. In the subsequent research, the English teaching evaluation model is embedded in the teacher teaching quality evaluation system to enhance the autonomy and intelligence of teacher quality evaluation.

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