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An Empirical Study of Intelligent Algorithms for Evaluating English Teaching Effectiveness in Colleges and Universities

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ABSTRACT
Objective and comprehensive teaching effectiveness assessment is a strong guarantee for the quality of English teaching in colleges and universities. This paper establishes an index system for evaluating the teaching effectiveness of English in colleges and universities from the levels of students, teachers and classroom teaching. The particle swarm algorithm is used to optimize the convolutional neural network, the SGD formula is used to improve the calculation accuracy, the Adam optimizer is improved to improve the model operation efficiency, and the optimization algorithm of convolutional neural network, PSO-CNN, is proposed.The PSO-CNN algorithm is introduced into the system and the logic design is carried out to realize the evaluation of the teaching effect of English teaching and to build up the English teaching effect evaluation system based on the intelligent algorithm. Evaluation system based on intelligent algorithm. The performance of the system is examined and analyzed with the help of PCA method, which shows that the cumulative contribution rate of the first six indicators, such as learning acquisition and teaching ability, reaches 91.08%. In the mean square error of model training, the PSO-CNN algorithm applied in this paper's system has a lower mean square error than other algorithms after 35 iterations, and has better evaluation accuracy. In the application practice of English majors in a higher education institution in B city, after applying the system of this paper to evaluate the effectiveness of English teaching, the English test scores of the regular and experimental classes with improved teaching were significantly improved.

Keywords: particle swarm algorithm, convolutional neural network, intelligent algorithm, English teaching effectiveness evaluation

1. Introduction

In the context of informationization, information and data have become a major production factor, which not only has a great impact on the production methods and business models of traditional

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industries, but also promotes the transformation of the education industry and provides new development opportunities for education and teaching [1-2]. The use of information technology in college English teaching provides a brand new teaching method and platform for teachers. To make college English teaching keep pace with the times, it is necessary to combine with information technology, strengthen the construction of informatization teaching resources, enrich the English teaching methods, fully mobilize the students' enthusiasm for learning, and promote the innovative development of college English education [3-4]. College education, as an important field for training future pillars of society, has also ushered in the new wave of informatization. Especially in the educational process of English in colleges and universities, the adoption of information technology is not only in line with the natural trend of the development of the times, but also a powerful strategy to enhance the teaching effect and stimulate students' interest in learning [5-6].

Teaching evaluation system is one of the main components of professional English teaching in colleges and universities, which helps to assess and master the quality of teachers' teaching and students' learning, and provides an important basis for adjusting and improving teaching work [7-8]. Formative assessment mainly refers to the process and developmental assessment carried out during the English teaching period, which starts from the teaching objectives, flexibly uses different teaching assessment tools, dynamically tracks the teaching process, provides timely feedback on teaching information, and comprehensively evaluates the learning status of the students, so as to realize the all-round development of the students [9-11]. Formative assessment covers self-assessment, peer assessment, teacher assessment, assessment by relevant school departments, including classroom assessment, extracurricular activities assessment, network assessment and other forms of assessment, to record and supervise the learning process of students in an all-round way, in order to improve the effectiveness of student learning [12-14].

Comprehensive and meticulous records of students' learning and growth, emphasis on comprehensive literacy assessment, and active exploration of evaluation methods that help students develop, so as to continuously mobilize students to learn independently, be positive and work hard to develop. However, from the practical point of view, the evaluation system of professional English teaching in colleges and universities at this stage is still not sound, and it is common that a single summative evaluation is still adopted [15-17]. The traditional summative evaluation does not pay attention to the subjectivity of students in English learning, and it is difficult to stimulate the subjective initiative of students in English learning, which over time curbs the development of students' innovation and creativity, and this has become one of the important impediments to the reform of professional English teaching in colleges and universities [18-20]. Therefore, in the context of the new period, it is necessary to explore a diversified English teaching evaluation system based on the traditional professional English teaching evaluation methods [21].

Effective teaching evaluation is crucial for promoting student learning, guiding teaching improvement, and improving the quality of education. And artificial intelligence is regarded as an innovative means, and its introduction in the evaluation of English teaching in colleges and universities helps to improve the efficiency and quality of evaluation, and helps to provide reference and guidance for future educational innovation and practice [22-24]. At present, with the continuous development of the Internet and intelligent technology as well as the promotion of teaching reform in China, the traditional teaching mode and evaluation mode have been prompted to undergo significant changes. The traditional English teaching evaluation method is relatively single, usually obtaining evaluation results by comparison of grades and completion of practical teaching, etc. Although the expected evaluation effect can be accomplished, it is very susceptible to the influence of external teaching factors in the actual processing, and the final evaluation results of the English teaching effect obtained are not accurate and reliable [25-27].

Sultana, N introduced the concept of Linguistic Assessment Literacy (LAL) and examined the LAL performance of English teachers in Bangladesh, the study pointed out that unprofessional ELT performance of English teachers leads to their inability to practise teaching assessment effectively in teaching to improve their teaching and therefore targeted to give relevant suggestions [28]. Munna, A. S et al. combined reflective experimental research methods and theoretical analysis strategies in the form of literature to illustrate that positive and adequate feedback on formative and developmental learning assessments can help to enhance students' self-confidence and motivation to learn [29]. Uttl, B et al. with reference to the latest research on Student Evaluation of Teaching (SET) and using meta-analysis to sort out and analyze it, pointed out that SET does not have a significant effect on enhancing learning outcomes and assessing teachers' teaching standards, and concluded that the applicability of the SET teaching evaluation method can be abandoned [30]. Through experimental research, theoretical analysis and literature review, the above study has explored the practice of teaching assessment and its effects, and deepened people's knowledge and understanding of teaching assessment. It focuses on analyzing the characteristics, advantages and disadvantages of software-based teaching assessment, formative teaching assessment and traditional teaching assessment. Ghufron, M. A et al. based on a comparative teaching experiment study, learned that the instructional assessment feedback mechanism provided by the Grammarly software was effective in improving students' collaborative grammatical, punctuation, and wording errors, but not so effective in improving the content of the writing and the organization of the language [31]. Xiao, Y et al. empirically analyzed how formative assessment promotes students' independent learning in the process of English learning, and based on the analysis, they learned that based on the teacher's assistance and guidance, students actively participate in the formative assessment, which to a certain extent develops students' self-regulation ability and comprehension of the English language [32]. Vogt, K et al. discussed that teachers' teaching focuses on assessing students' English writing followed by speaking and also revealed that traditional methods of teaching assessment are limited to marking and short comments and that learners in the study agreed that the purpose of teaching assessment is to assist in supporting learners' learning [33].

In order to realize the objective and accurate assessment of English teaching effect in colleges and universities, this paper builds up an assessment index system of English teaching effect in colleges and universities with students, teachers and classroom teaching as the main dimensions, and then constructs an English teaching effect assessment system based on it and combined with intelligent algorithms. The intelligent algorithm introduces convolutional neural network, uses particle swarm algorithm to optimize the convolutional neural network, and proposes PSO-CNN, a convolutional neural network optimization algorithm based on particle swarm algorithm. For the problem of insufficient computational accuracy of convolutional neural network, the SGD calculation formula is used to solve the gradient disappearance and easy to fall into the local defects to improve the computational accuracy, and Adagrad is used to classify the number of times that each parameter change occurs in the convolutional neural network. At the same time, the gradient calculation mode of Adam optimizer is improved, and directional gradients and vectors are introduced to speed up the particle optimization to improve the training efficiency. Finally, the PSO-CNN algorithm is used to realize the evaluation of English teaching effect and complete the design of system environment architecture and operation logic. Performance experiments are carried out to test the performance of this paper's system, and the teaching effect survey data of English majors in a higher education institution in city B is used as the experimental object to explore the effect of teaching improvement after applying this paper's system to evaluate the effect of English teaching.

2. Indicator System for Evaluating the Effectiveness of English Teaching in Colleges and Universities

Based on the principles of scientificity, comprehensiveness and modernity, we aim to cultivate students' English application ability as the content of the index system, and construct the index system for evaluating the effectiveness of English teaching in the context of the reform of the college entrance examination at the student level, the teacher level and the classroom teaching level.

1) Student Level. Whether the teaching effect of English in colleges and universities really adapts to the trend of education reform, we only need to assess the quality of English teaching through the learning status and satisfaction of students. The Koch's four-level training evaluation model is applied here to make an

The model of Koch's four-level training assessment is applied here to analyze the quality of English teaching and learning. The assessment of teaching effectiveness of English in colleges and universities at the student level mainly includes three aspects: firstly, assessing students' satisfaction, secondly, evaluating students' learning acquisition, thirdly, examining the degree of students' application of knowledge, and fourthly, calculating the assessment of the results of creating benefits from learning.

2) Teacher Level. Based on the cultivation objectives of students' English utilization ability and students' problem-solving ability in actual workplaces, and to strengthen the guiding role of teaching evaluation, the evaluation at the teacher level is mainly carried out in terms of education and teaching ability, curriculum development and construction, teaching and research, and social service ability.

Among them, the social service ability is mainly reflected in the practical application ability of English education in colleges and universities, therefore, it is necessary to assess whether the teachers can cooperate with enterprises to develop curricula and teaching materials, and whether they have certain knowledge and skills training, technical guidance, counterpart support, and the ability to practice in enterprises.

3) Classroom Teaching Level. Classroom teaching is the central part of English teaching, and the effect of classroom teaching mainly depends on whether the classroom follows the needs of the students and the needs of the society, and whether it can really implement the cultivation of vocational literacy and the cultivation of problem-solving ability in English using jobs in the new environment, therefore, the evaluation of the teaching effect of the subject is mainly based on the teaching content, teaching methods, teaching organization and management, and the integration of industrial English and basic English. The situation.

By integrating the above assessment contents of teaching effectiveness of college English at the student level, teacher level and classroom teaching level, we have established an index system for the assessment of teaching effectiveness of college English, which is shown in Fig. 1.

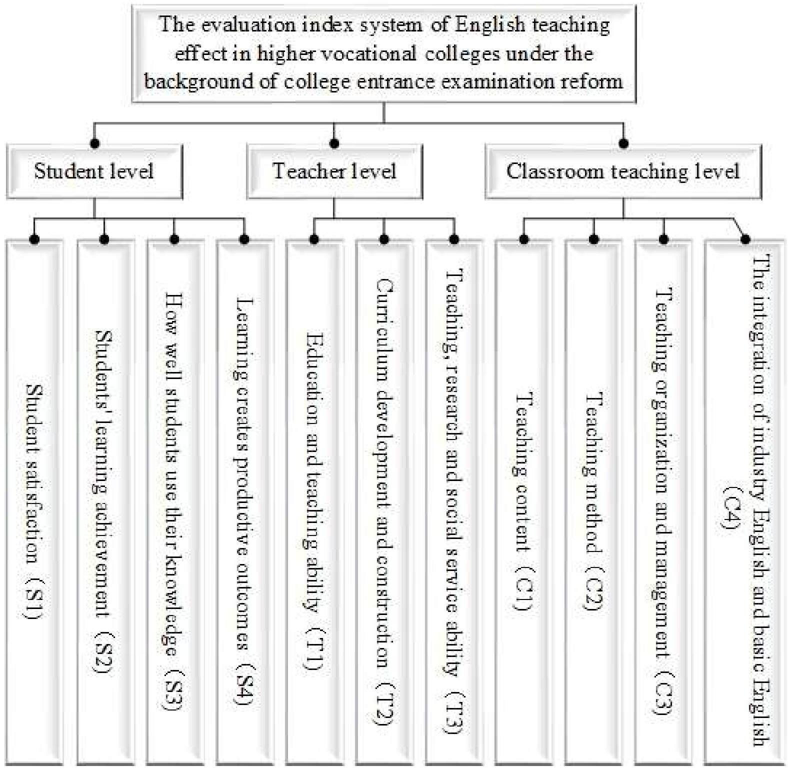


Fig. 1. Evaluation index system of college English teaching effect

3. English Teaching Effect Evaluation System Based on Intelligent Algorithm

At present, with the continuous development of the Internet, intelligent technology and the promotion of English teaching reform, the traditional teaching mode and evaluation mode have undergone significant changes. The traditional English teaching assessment methods are relatively single, usually using the results of comparison, practical teaching completion, etc. Although the expected assessment effect can be accomplished, but in the actual process of processing is very susceptible to the influence of external teaching factors, the final results of the assessment of the effectiveness of the English teaching is not accurate and reliable. In order to solve the above problems, this paper will build an evaluation system of English teaching effectiveness in colleges and universities based on the index system of English teaching effectiveness evaluation in colleges and universities proposed above and combined with intelligent algorithms. Intelligent algorithm mainly refers to the use of convolutional neural network and particle swarm algorithm in practice.

3.1. Principles of Convolutional Neural Networks

Convolutional Neural Network (CNN) is a concept of neural learning similar to biological systems [34]. It is based on the idea of visual sensing in animals and it is also the most basic deep learning model. The initial model is formed through the most basic perceptron neural layer, which first delivers the data from the input interface and then there are two network layers overlapping each other, which are simple and complex layers, where the simple layer consists of units (A) and the complex layer consists of units (B), where the A unit exists its own sensory region, and after transmitting the image features of the sensory region where it is located to the B unit, the B unit can produce different results based on the After transmitting the image features in the sensory region to the B unit, the B unit can produce different results according to different feature types, and output the same results for the same feature types. In this way, the features can be transformed into another form, and the features can be selected. The formation of convolutional neural networks was inspired by this principle.

Convolutional neural networks rely on a variety of functional neural network layers. Generally, a convolutional neural network has an input layer, a convolutional layer, a pooling layer, an activation layer, a loss layer, a fully connected layer, etc. By combining these layers, a convolutional neural network is able to produce the same result. Convolutional neural networks form different models with different functions by combining these layers in order of their functions. The next section explains the functions of each layer.

1) Input layer. The function of this layer is to input the processed images or data into the convolutional neural network, so the position of the input layer is usually at the very beginning of the convolutional neural network. However, the disadvantages of neural networks with only an input layer are very obvious, firstly, it may cause the data structure is not sound, such as the form of the data is not uniform; secondly, it will take a lot of time for training, which will lead to the problem of slow convergence; and finally, if the range of the data is too large or too small, it may lead to the uneven impact of neural networks on the function of data processing. Therefore, the data can not be input into the neural network at the beginning, a certain degree of processing needs to be carried out, in the input layer may need to be carried out on the data first, such as data standardization, normalization, de-mean whitening and other operations so that the data can produce very high arithmetic efficiency.

2) Convolutional Layer. Convolutional layer is mostly used to extract features from pictures, when the picture is fed into the convolutional neural network through the input layer, the picture features are extracted in the convolutional layer by performing convolution operation on the picture or data. Convolutional layer consists of multiple convolution kernels, convolution kernels are used to realize the important way to extract features from the picture convolution, the size and number of convolution kernels also determine the role of the picture feature extraction. During the training process, the value of the convolution kernel can be updated continuously through training. If the input image is more than one channel, the number of convolution kernels will be more than one, in general the number of convolution kernels is equal to the number of channels, and a set of filters is composed of multiple convolution kernels, the number of filters is equal to the number of output channels of the convolution layer. Therefore, if convolution is to be useful, the first thing to consider is the size of the filter. The feature x_i is obtained in the previous layer, which is weighted by the convolution kernel $kermel_{ij}$ and subsequently solved. As shown in Eq:

$$x_j^l = f(\sum_{i=M} x_i^{l-1} \times kernel_{ij}^l + B^l) \tag{1}$$

where B^l represents the bias corresponding to the j^i rd shown M feature maps of the lnd layer, f represents the activation function, x_j^l represents each feature map of the output of the convolutional layer (the number of which is determined manually), $kermeli_{ij}^l$ represents the convolutional kernel between the ith kind of feature maps of the input of the lth convolutional layer and the j th middle feature map of the output, and M_j represents the collection of localized images of the input convolutional kernel selected.

3) Pooling layer. After convolution, the parameters contained are too complex and may be overfitted or consume a lot of training time during the iteration process, so after the convolution layer, the pooling layer is used for downsampling. This reduces the parameters of the neural network and allows further extraction of features to prevent overfitting. Normally, as the number of convolutional layers increases, the higher the depth at which features are extracted, the more semantic information is obtained. By setting a region, the operation of aggregating statistics within this region is called pooling. Pooling is generally divided into two types, one is average pooling, the average value in the set region

as the feature information in this region, and the other is maximum pooling, the maximum value in the set region as the feature information in this region.

4) Activation function layer. After the convolutional layer, all the operations are still linear, and there is no way to improve the training of the model, and can not fit the real situation through continuous learning. In addition, the vast majority of classifications in reality cannot be linear. Therefore, a way is needed to make nonlinear changes so as to better improve the ability of features to extract semantic information. Currently the commonly used activation functions are Sigmoid activation function, Tanh activation function and Relu activation function.

The formula of Sigmoid activation function is as follows:

$$\sigma(x)=1/(1+e^{-x}) \tag{2}$$

Sigmoid activation function (also known as Logistic function), which is able to map all real numbers between 0 and 1, is easy to derive and has very good coherence. However, the use of Sigmoid activation function may be due to the upper function is too large or too small in the process of the reverse iteration of the gradient disappearance problem.

The Tanh function is formulated as follows:

$$\tanh(x)=(1-e^{-2x})/(1+e^{-2x}) \tag{3}$$

Since this function is symmetric at the origin and has a small gradient, it does not converge quickly, so it can be a good solution to the shortcomings encountered by the Sigmoid function, effectively solving the problem of vanishing gradient.

The Relu function is currently the most commonly used activation function with the following formula [35]:

$$\mathrm{Relu}(x)=\{0, x<0 @ x, x\geq 0\} \tag{4}$$

The reason why Relu function is most widely used is because it requires less computational power, so the convergence speed is fast, because the convolutional neural network contains thousands of parameters, so an activation function that can speed up the activation speed is naturally widely sought after. However, as can be seen from the above formula, the result is 0 at $x<0$, and since its gradient is 0 so the activation function will not play any role for the convolutional neural network at this time. Therefore, it is possible to set the value of the learning rate, adjust its value to a lower value at the same time so that the mean value of the Relu function is not zero.

5) Loss function layer. The loss function can be calculated by calculating the direct loss value of the predicted value and the label value, according to the size of the loss value, and then back-propagation to adjust the parameters, so as to achieve the purpose of optimizing the structure of the network, in the training process, the larger the value of the loss function, proving that the model is poorer, and vice versa, the model is better.

3.2. Convolutional neural network optimization algorithm based on particle swarm algorithm

3.2.1. Particle Swarm Algorithm:

1) The basic idea of particle swarm algorithm. Particle swarm algorithm is in nature, by observing the characteristics of the movement of biological groups, and observe the characteristics of their behavior, and use mathematical formulas to express this behavior, and apply it to the group model as a model constraints, which is the idea of the group intelligence optimization algorithm to establish the group model [36]. Particle swarm is a kind of swarm intelligence algorithm, swarm intelligence algorithm for the collection of group intelligence, through the simulation of group behavior and information sharing,

so as to analyze the problem to solve the problem. Particle Swarm Optimization method i.e. PSO algorithm is evolved from Hepner's model and is based on population evolution search method.

2) Particle swarm algorithm update rules and process

(1) Algorithm update rules. The overall number of particle swarm is set to M, i to mark the first particle that is the particle position, d is the search dimension where the particle is located:

$$X_i = (x_{i1}, x_{i2}, \cdots x_{id}) \quad i = 1, 2, \cdots M \tag{5}$$

The particle velocity can be expressed as:

$$V_i = (v_{i1}, v_{i2}, \cdots v_{id}) \quad i = 1, 2, \cdots M \tag{6}$$

Example update via Eq. (7) and Eq. (8):

$$v_{id}^{k+1} = wv_{id}^{k} + c_1 r_1 (pbest_{id}^{k} - x_{id}^{k}) + c_2 r_2 (gbest_{d}^{k} - x_{id}^{k}) \tag{7}$$

$$x_{id}^{k+1} = x_{id}^{k} + v_{id}^{k+1} \tag{8}$$

where, $pbest_{id}^{k}$ is the value of the particle iterated k times in the network training with a search dimension of d dimensions; is the local optimum of the particle ith dth dimension component for the kth iteration; $gbest_{d}^{k}$ is the optimum of the particle iterated k times in the network training for the global particle; w is the weight; c_1, c_2 is the factor; and r_1, r_2 is taken from between 0 and 1.

(2) Particle swarm algorithm specific process. First, initialize the flight speed and position of the population particles, initialize the current optimal $pbest$ that each particle can find, and initialize the optimal $gbest$ that the population can find;

Second, evaluate the particles by fitness in the search space;

Third, through continuous iterative updating, the particles are compared by comparing with the population optimal $gbest$ and individual particle optimal $pbest$, if the current particle is better than the population optimal $gbest$, save $gbest$, if the current particle is better than the individual optimal $pbest$, save $pbest$;

Fourth, update the particle velocity and position as equation (7) and equation (8), by comparing whether the stopping condition is satisfied, if it is satisfied, end the computation, if not, according to equation (7) and equation (8) to determine whether the condition is satisfied, if it is satisfied, the algorithm ends the computation, if it is not satisfied, repeat the steps of 2 for further iteration.

3.2.2. Convolutional Neural Network Optimization Algorithm Based on Particle Swarm Algorithm:

1) Principle of Convolutional Neural Network Adam Optimizer Calculation. The choice of convolutional neural network optimizer has a great impact on the accuracy of the results and the improvement of network training efficiency. Ordinary convolutional neural networks use the gradient descent method in the training process, which is easy to fall into local extremes. Problems such as affecting the calculation accuracy of convolutional neural networks [37].

By SGD calculation formula to solve the gradient disappearance and easy to fall into the local defects, improve the convolutional neural network model calculation accuracy problems, SGD formula (9):

$$\theta = \theta - \eta \cdot \nabla_{\theta} J(\theta; x^{(i)}; y^{(i)}) \tag{9}$$

where, θ is the parameter to be optimized, $\theta \in R^d$; $J(\cdot)$ is the loss function; and η is the learning rate.

Adagrad categorizes the number of times each parameter change occurs in the network model, with different learning rates assigned for different frequencies, Adagrad equations (10) to (12):

$$g_{t,i} = \nabla_{\theta_t} J(\theta_{t,i}) \tag{10}$$

$$\theta_{t+1,i} = \theta_{t,i} - \frac{\eta}{\sqrt{G_{t,ii} + \varepsilon}} \cdot g_{t,i} \tag{11}$$

$$\theta_{t+1} = \theta - \frac{\eta}{\sqrt{G_t + \varepsilon}} \odot g_t \tag{12}$$

where $g_{t,i}$ is the gradient; $G_t \in R^{d\times d}$ is the matrix with element $i \times i$; ε is the smoothing term and $\odot$ is the vectorized multiplication.

RMSprop is the addition of decay coefficients to Adagrad, which prevents the learning rate from decreasing, RMSprop equations (13) and (14):

$$E[g^2]_t = 0.9E[g^2]_{t-1} + 0.1g_t^2 \tag{13}$$

$$\theta_{t+1} = \theta_t - \frac{\eta}{\sqrt{E[g^2]_t + \varepsilon}} \cdot g_t \tag{14}$$

In this paper, the advantages of the above three formulas are borrowed to improve the learning rate, dynamically adjusting the first-order moment estimation and second-order moment estimation to update the gradient formula to improve the learning rate, so that the Adam optimizer avoids the phenomenon of reduced learning rate arising from the square of the denominator cumulative gradient, and sets constraints to improve the efficiency of the model operation.Adam formulas (15) to (19):

$$m_t = \beta_1 m_{t-1} + (1-\beta_1) g_t \tag{15}$$

$$v_t = \beta_2 v_{t-1} + (1-\beta_2) g_t^2 \tag{16}$$

$$\theta_{t+1} = \theta_t - \frac{\eta}{\sqrt{\hat{v}_t} + \varepsilon} \hat{m}_t \tag{17}$$

$$\hat{m}_t = \frac{m_t}{1-\beta_1^t} \tag{18}$$

$$\hat{v}_t = \frac{v_t}{1-\beta_2^t} \tag{19}$$

where $E[\cdot]$ is the finding of the mean; m_r is the first-order moment estimate of the gradient, v_t is the second-order moment estimate of the gradient, $\hat{m}_t$ is the correction for m_t, $\hat{v}_t$ is the correction for v_t; and $\beta_1 = 0.9, \beta_2 = 0.999, \varepsilon = 10^{-8}$.

2) Particle swarm algorithm to optimize Adam optimizer. As the second-order moment estimation of the Adam optimizer will continue to accumulate, the learning rate and thus produce changes in the learning rate will lead to the results fall into the local extremes can not converge, in order to solve this problem, combined with the particle swarm algorithm, optimization of the Adam optimizer, to improve the easy to fall into the defects of local extremes.

Improve the Adam optimizer gradient calculation formula, the introduction of direction gradient and vector, accelerate the particle optimization, improve the training efficiency, the principle is shown below:

Adaptation function formula (20):

$$MAE = \frac{1}{n}\sum_{i=1}^{n} | f(x) - y | \tag{20}$$

Particle-seeking optimization updates Eqs. (21) to (24):

$$v_{id}^{k+1} = wv_{id}^{k} + c_1 r_1 (pbest_{id}^{k} - x_{id}^{k}) + c_2 r_2 (gbest_{d}^{k} - x_{id}^{k}) + grad_{id}^{k} + grad_{d}^{k} \tag{21}$$

$$x_{id}^{k+1} = x_{id}^{k} + v_{id}^{k+1} \tag{22}$$

$$\Delta_{id}^{k+1} = pbest_{id}^{k} \cdot w \cdot rand() \cdot grad_{id}^{k}, \Delta_{id}^{k+1} \in [v_{\min}, v_{\max}] \tag{23}$$

$$\Delta_{d}^{k+1} = gbest_{d}^{k} \cdot w \cdot rand() \cdot grad_{d}^{k}, \Delta_{d}^{k+1} \in [v_{\min}, v_{\max}] \tag{24}$$

where $pbest_{id}^{k}$ is the value of the particle in the network training k iterations, the search dimension is d dimensions; w is the weight; rand(-) is a value between 0 and 1, the value is random; $grad_{id}^{k}$ and $grad_{d}^{k}$ are the gradient of the particle direction in k iterations; Δ_{id}^{k} and Δ_{d}^{k} are the amount of change of the particle's local optimum and the amount of change of the particle's global optimum, both are k iterations; x_{id}^{k} and x_{d}^{k} are the particle's local optimal position and the global optimal position, both are k iterations.

The original particle update gradient formula (17) is changed to formula (25), the direction gradient and vector are introduced, and the example updates formula (25):

$$\theta_{t+1} = \theta_t - \frac{\eta}{\sqrt{v_t} + \varepsilon} m_t + \Delta_{id}^{k+1} + \Delta_{d}^{k} \tag{25}$$

3.3. System environment architecture design

Since the particle swarm algorithm-based convolutional neural network optimization algorithm (PSO-CNN) is introduced into the college English teaching effectiveness evaluation system designed in this paper, it is necessary to stratify the data involved in the evaluation and transfer them between the various layers. In order to ensure the integrity of the data transfer process and provide a reliable data base for the evaluation results, this paper firstly takes CoreTile Express board as the core and utilizes Versatile™ Express as the development means to design the system environment architecture.

3.4. System operation logic design

3.4.1. Analysis of data on teaching and learning in the Civics program. Before evaluating English language teaching, relevant data need to be analyzed, and this paper develops an analysis of English language teaching data from the perspectives of both the delivery side and the receiving side of teaching, respectively.

Clear educational objectives and expected learning outcomes are important foundations for ensuring that teaching and learning can be systematically advanced. Therefore, the system designed in this paper needs to determine whether the educational objectives fit with the goals and expectations of student learning when evaluating the objectives of English education. Its calculation formula is:

$$p_s = \frac{x(k+\lambda)}{(1-a)d} * \frac{x}{x'} \tag{26}$$

In the formula, p_5 is the degree of fit between English teaching objectives and students' learning objectives and expectations; x is the formulated objectives of Civic and Political Education; k is the individual students' demand for English education; λ is the social demand for English education; a is the coefficient of variation of students' learning ability; d is the students' learning objectives; and x' is the deviation between the objectives and the formulated contents of the English teaching objectives at the stage of the actual implementation. Eq. (26) can be seen that the educational objectives, while covering important educational needs, need to give full consideration to the ability to buy in the actual implementation process, combined with the social and personal needs for English teaching and learning to make a reasonable design.

The analysis of students' behavior and commitment, to some extent, the students' learning outcomes are the most direct data to evaluate the degree of accomplishment of the teaching objectives. And it can be subdivided into learning attitude, learning behavior, effort, teacher-student interaction and student-student interaction. Therefore, this paper constructs the comprehensive index parameters of students' behavior and input, which are calculated as follows

$$\gamma = \alpha_1 b_a + \alpha_2 b_b + \alpha_3 b_h + \alpha_4 b_t + \alpha_5 b_s \tag{27}$$

In the formula, γ is the parameter of comprehensive index of students' behavior and commitment, $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ and α_5 are the correlation coefficients of learning attitude, learning behavior, effort, teacher-student interaction and student-student interaction with students' behavior and commitment, respectively; b_a, b_b, b_h, b_t and b_s are the actual learning attitude, learning behavior, effort, teacher-student interaction and student-student interaction, respectively. In this way, the analysis of student behavior and engagement was achieved.

Combining the results of the above two data analyses provides a data base for English teaching evaluation.

3.4.2. Convolutional neural network based teaching evaluation. On the basis of the above, this paper uses the convolutional neural optimization network based on particle swarm algorithm to realize the evaluation of English teaching.

According to the results of the above analysis, the state of English teaching objectives and the learning state of students are sampled, and the input layer infuses the information into the convolutional neural network and compares it with the expected results of education, and when there is a difference between the two, it indicates that there are non-conventional factors in the teaching process. At this time, this paper uses the first convolutional layer to obtain a large number of students' state information and differentially assign each learning parameter, which is calculated as:

$$w_i = \frac{b_i}{b_a + b_b + b_h + b_t + b_s} \tag{28}$$

where w_i is the result of the assignment. By doing so, the differentiated assignment of learning parameters is completed.

On this basis, the application of convolutional network model is utilized to train it, and the trained results are input to the second convolutional layer, and the mapping relationship between it and the expected results is established, which is calculated as:

$$\chi = e^{[w_i b_i, p_i]} \times 100 \tag{29}$$

where χ is the fit between the student feedback data and the expected results of teaching Civics. In this paper, the embodiment of the evaluation results is realized in a percentage system, so it is multiplied by 100 and the corresponding results are sent to the output level.

In this way, the evaluation of English teaching is realized.

4. Experiments on the Performance of English Teaching Effectiveness Evaluation System

In this paper, based on the index system for evaluating the teaching effect of English in colleges and universities, a system for evaluating the teaching effect of English is built with the particle swarm algorithm's convolutional neural network optimization algorithm (PSO-CNN) as the logical principle of the system's operation. In this chapter, the performance of English teaching effect assessment system in colleges and universities will be examined in an all-round way.

In this experiment, 500 sets of English teaching effectiveness evaluation data were collected during the period of 2013-2023, and a test dataset was constructed. Among them, there are 50 sets of data in each year, 45 sets of data as training data and 5 sets as test data in one year.

4.1. Analysis of Indicators for Assessing the Effectiveness of English Language Teaching

Using PCA method, we analyze the data of 500 groups of teaching indicators of English teaching evaluation, and select the indicators with higher contribution to the evaluation of English teaching effectiveness in colleges and universities through dimensionality reduction, and the specific results are shown in Fig. 2. As can be seen from the figure, the cumulative contribution rate of the first 6 indicators to the evaluation of English teaching effectiveness in colleges and universities has reached 91.08%. The results show that the first six indicators can represent all the indicators to evaluate the English teaching effectiveness, which cover the students' learning acquisition, educational and teaching ability,curriculum development and construction,teaching content,etc.It further shows that the English teaching effectiveness evaluation index system proposed in this paper is reasonable.

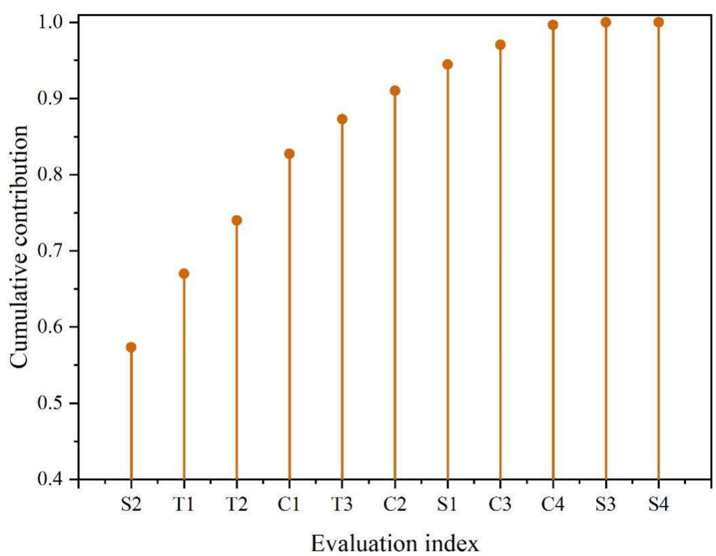


Fig. 2. Accumulative contribution rate

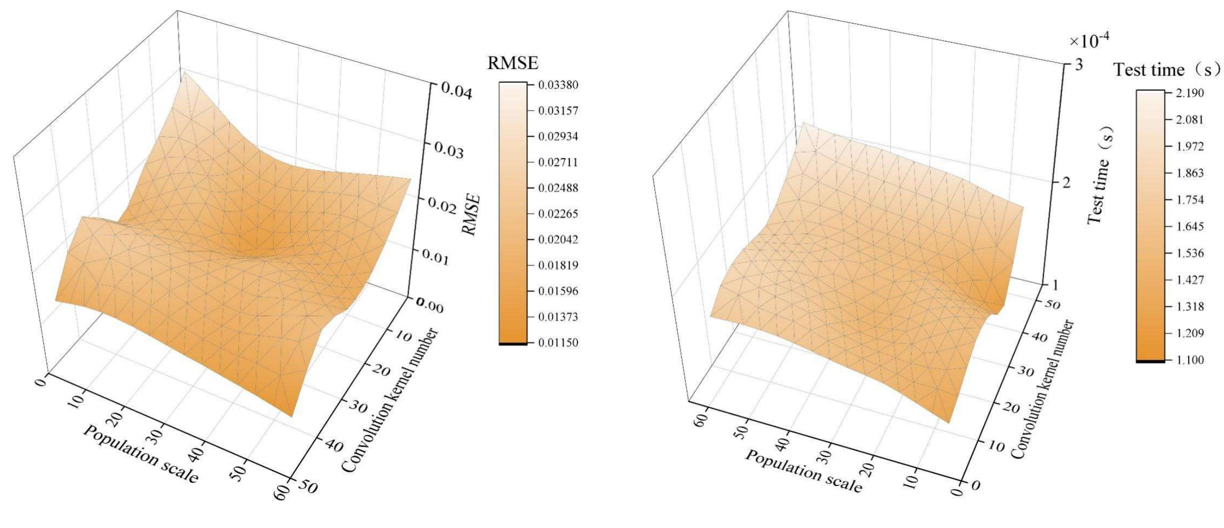
4.2. Comparative Analysis of Evaluation Methods of English Teaching Effectiveness

In order to find the optimal effect of the English teaching effectiveness evaluation system based on PSO-CNN algorithm, the PSO-CNN parameters are set. In order to reflect the superiority of the PSO-CNN algorithm proposed in this paper, the evaluation method based on PSO-CNN algorithm in this paper is compared with other evaluation models.

In order to verify the accuracy and timeliness of this paper's English teaching effectiveness evaluation method based on PSO-CNN algorithm, five evaluation methods are selected for comparison, including BP, FOA-BP, KH-KELM, CNN, GA-CNN and PSO-CNN, and the experimental simulation environment is Windows 10, with a CPU of 2.80GHz, 8GB of RAM, and a programming language of Matlab.

1) Impact analysis of PSO-CNN evaluation performance. In order to investigate the impact of the population size of PSO algorithm and the number of CNN convolution kernels on the performance of PSO-CNN English teaching effect evaluation model, the evaluation data after dimensionality reduction was used to test the teaching effect evaluation method and to count the RMSE and evaluation time

under different combination parameters. The results of the influence of different population sizes and number of convolution kernels on the performance of PSO-CNN-based evaluation model are specifically shown in Fig. 3. Figures (a) and (b) show the evaluation error results and test time results, respectively. As can be seen from the figures, the RMSE slightly tends to decrease as the particle population size increases, and it also decreases as the number of convolutional kernels increases. With the increase of population size, the evaluation time of the test sample set after dimensionality reduction has a slight tendency to increase, and with the increase of the number of convolutional kernels, the evaluation time of the test samples increases. In summary, the PSO population size is 30 and the number of CNN convolutional kernels is 20 in this experiment.



(a)RSME (b)Test time

Fig. 3. RSME and test time

2) Analysis of teaching effect evaluation results. According to the above parameters, this subsection compares the performance of BP, FOA-BP, KH-KELM, CNN, GA-CNN, PSO-CNN methods using the test set. All methods are evaluated using data from the test set of English teaching effectiveness evaluation, and the mean square error change curve during model training is shown in Fig. 4. From the figure, it can be seen that PSO algorithm can effectively improve the evaluation performance of CNN network and avoid falling into local optimum, and its mean square error is lower than other algorithms after 35 iterations, which indicates that PSO algorithm can improve the evaluation accuracy of the model.

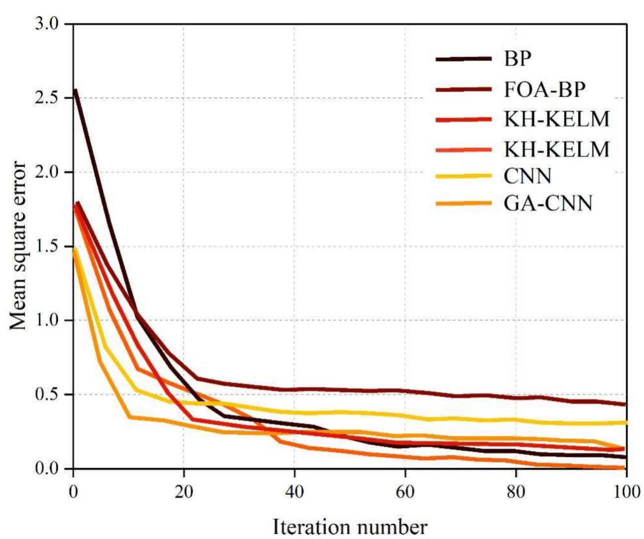


Fig. 4. Mean square error variation curve

5. English Teaching Effectiveness Evaluation System Application Practice

The experiment is based on the teaching effect survey data of English majors in a higher education institution in city B. After the English teaching effect survey data are organized, 800 training samples of teaching effect survey data are obtained. 500 samples are used as the training samples of English teaching effect evaluation system based on PSO-CNN algorithm, and 300 samples are used as the test samples. Matlab software is applied to simulate the teaching effectiveness evaluation process of this system. The performance of this system is verified when it is used to evaluate the teaching effectiveness of English.

When the system is applied to evaluate the teaching effectiveness of English, when the actual evaluation value is [0.4,0.6), the evaluation grade is passing. When the value range is [0.6,0.8], the evaluation grade is medium; when the value range is [0.8,0.9], the evaluation grade is good. If the value range is 1, the evaluation grade is excellent; if the value range is lower than 0.4, the evaluation grade is fail. Applying the system of this paper to the English teaching effect data of this university to evaluate the English teaching effect of some of the teaching effect evaluation results obtained, specifically as shown in Table 1. As can be seen from the table, the system of this paper can well accomplish the evaluation of English teaching effect, and the network training value is very close to the actual training value, which verifies the feasibility and reliability of the system of this paper in the evaluation of English teaching effect.

Table 1. Evaluation result

Number	Network training value	Actual evaluation	Order of evaluation
1	0.711	0.7	Moderate
2	0.99	1	Excellent
3	0.715	0.7	Moderate
4	0.505	0.5	Passing
5	0.429	0.4	Passing
6	0.61	0.6	Moderate
7	0.982	1	Excellent
8	0.681	1	Excellent
9	0.485	0.5	Passing
10	0.514	0.5	Passing
11	0.703	0.7	Moderate
12	0.311	0.3	Worse
13	0.907	0.9	Good
14	0.688	0.7	Moderate
15	0.889	0.9	Good

The English test scores of different class types after not using the system of this paper for the evaluation of the effectiveness of English teaching are counted, as shown in Fig. 5. It can be seen that when the system is not used to evaluate the effectiveness of English teaching, in the 11 consecutive English test records, the English test scores of the two types of classes are not particularly high, and although the oral and written test scores of the experimental class can reach 80 and above most of the time, there are not many cases in which the test scores exceed 85 or reach 90. The English test scores of the regular classes mostly stayed at around 70.

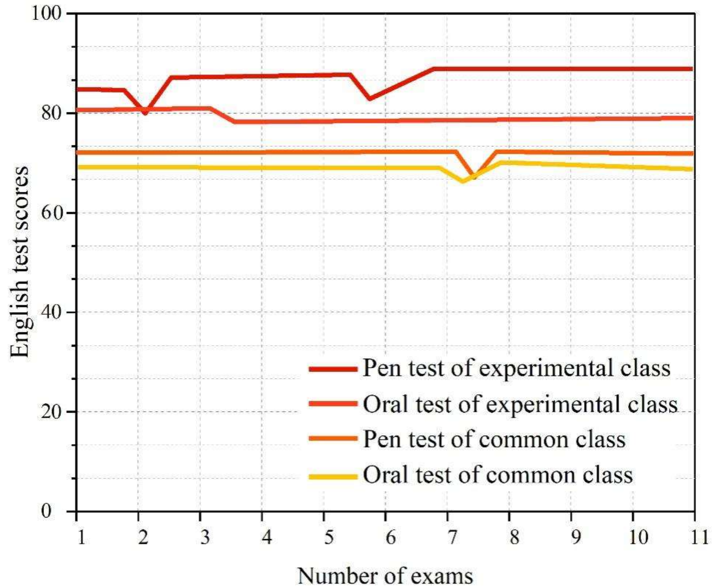


Fig. 5. The English test scores of different classes before the experiment

The English test scores of different class types that were subjected to teaching improvement after applying this paper's system to evaluate the effectiveness of English teaching are specifically shown in Figure 6. Obviously, the English test scores of the English majors in this school have been significantly improved. In 11 consecutive English test records, the English test scores of the two class types are very high in both oral and written tests, and the score curves hardly fluctuate in the 11 tests, and the overall test scores of the experimental class in both oral and written tests can reach 85 and above, and the scores of the general class in both oral and written English tests can reach 80.

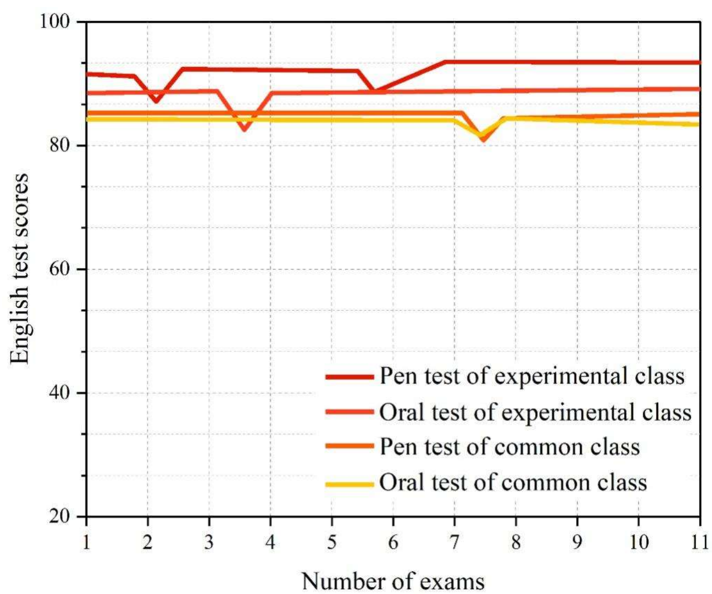


Fig. 6. The English test scores of different classes after the experiment

The experiment shows that the application of the English teaching effect evaluation system constructed in this paper to evaluate the teaching effect of English in colleges and universities has a better teaching evaluation effect, and the improvement of teaching methods according to the obtained teaching evaluation effect can significantly improve the students' English performance.

6. Conclusion

Before constructing the English teaching effectiveness evaluation system, this study first establishes the evaluation index system of English teaching effectiveness in colleges and universities on the three main levels of students, teachers and classroom teaching, and clarifies the specific indexes for evaluation. Using convolutional neural network and introducing particle swarm algorithm to optimize it, we propose PSO-CNN algorithm and use it as the core to realize the design of environment architecture and operation logic design of English teaching effect evaluation system, so as to realize the evaluation of English teaching effect in colleges and universities.

The performance of the system in this paper is examined, and the reasonableness of the indicators of English teaching effectiveness assessment is analyzed with the help of PCA method. The cumulative contribution rate of the first six indicators, such as students' access to learning, educational and teaching ability, and curriculum development and construction, has reached 91.08%, which proves the applicability of the English teaching effectiveness evaluation index system used by the system. Selecting BP, FOA-BP, KH-KELM, CNN, GA-CNN and other algorithms as a comparison, the PSO-CNN algorithm adopted in this paper's system has a lower mean square error than all the comparative algorithms after 35 iterations during the training process, and it has a better evaluation accuracy.

The teaching effect survey data of English majors in a higher education institution in city B is chosen as the research object in the application practice of this paper's system to explore the practical utility of this paper's system. When the system is applied to evaluate the effectiveness of English teaching, the network training value is very close to the actual training value. In addition, the changes in English test scores of different classes after the application of the system for English teaching effectiveness evaluation and the improvement of teaching based on the evaluation results have been counted. The statistical results show that in 11 consecutive English test records, both written and oral English test scores have been significantly improved in both experimental and regular classes. The former's oral and written test scores can reach 85 and above, while the latter's oral and written English test scores also reach 80.

Overall, the English teaching effectiveness evaluation system based on intelligent algorithm constructed in this paper can provide effective assistance for the improvement of English teaching in colleges and universities, provide guidance for the direction of teaching improvement, and significantly contribute to the improvement of students' English performance.

References

[1] Fei, D. E. N. G. (2020). The optimization research on college English classroom teaching under the network environment—based on the feedback report of college English stratified teaching in SASU. *Sino-US English Teaching*, 17(10), 297-300.

[2] Azhar, K. A., & Iqbal, N. (2018). Effectiveness of Google classroom: Teachers' perceptions. *Prizren Social Science Journal*, 2(2), 52.

[3] Chen, S., & Wang, J. (2019). Effects of Task-Based Language Teaching (TBLT) Approach and Language Assessment on Students' Competences in Intensive Reading Course. *English Language Teaching*, 12(3), 119-138.

[4] Zhang, J. (2020). The Construction of College English Online Learning Community under ADDIE Model. *English Language Teaching*, 13(7), 46-51.

[5] Wang, Z. (2022). Integration and sharing of college English teaching resources using cloud computing platform. *Mobile Information Systems*, 2022(1), 8202229.

[6] Xu, Z., & Shi, Y. (2018). Application of constructivist theory in flipped classroom-take college English teaching as a case study. *Theory and Practice in Language Studies*, 8(7), 880-887.

[7] Al'Adawi, S. S. A. (2017). Exploring the Effectiveness of Implementing Seminars as a Teaching and an Assessment Method in a Children's Literature Course. *English Language Teaching*, 10(11), 1-14.

[8] Renandya, W. A., Hamied, F. A., & Nurkamto, J. (2018). English language proficiency in Indonesia: Issues and prospects. *Journal of Asia TEFL*, 15(3), 618.

[9] Motallebzadeh, K., Ahmadi, F., & Hosseinnia, M. (2018). The relationship between EFL teachers’ reflective practices and their teaching effectiveness: A structural equation modeling approach. *Cogent Psychology*, 5(1), 1424682.

[10] Ernawati, E., Tsurayya, H., & Ghani, A. R. A. (2019). Multiple intelligence assessment in teaching English for young learners. *REID* (Research and Evaluation in Education), 5(1), 21-29.

[11] Phongsirikul, M. (2018). Traditional and Alternative Assessments in ELT: Students' and Teachers' Perceptions. *REFLections*, 25(1), 61-84.

[12] Goldhaber, D., Cowan, J., & Theobald, R. (2017). Evaluating prospective teachers: Testing the predictive validity of the edTPA. *Journal of Teacher Education*, 68(4), 377-393.

[13] Chien, S. Y., Hwang, G. J., & Jong, M. S. Y. (2020). Effects of peer assessment within the context of spherical video-based virtual reality on EFL students’ English-Speaking performance and learning perceptions. *Computers & Education*, 146, 103751.

[14] Van der Kleij, F. M. (2019). Comparison of teacher and student perceptions of formative assessment feedback practices and association with individual student characteristics. *Teaching and Teacher Education*, 85, 175-189.

[15] Stronge, J. H. (2018). Qualities of effective teachers. *Ascd*.

[16] Mellati, M., & Khademi, M. (2018). Exploring teachers' assessment literacy: Impact on learners' writing achievements and implications for teacher development. *Australian Journal of Teacher Education* (Online), 43(6), 1-18.

[17] Burroughs, N., Gardner, J., Lee, Y., Guo, S., Touitou, I., Jansen, K., ... & Schmidt, W. (2019). A review of the literature on teacher effectiveness and student outcomes. *Teaching for excellence and equity: Analyzing teacher characteristics, behaviors and student outcomes with TIMSS*, 7-17.

[18] Widiastuti, I. A. M. S., & Saukah, A. (2017). Formative assessment in EFL classroom practices. *Bahasa dan Seni: Jurnal Bahasa, Sastra, Seni, dan Pengajarannya*, 45(1), 5.

[19] Bardach, L., & Klassen, R. M. (2020). Smart teachers, successful students? A systematic review of the literature on teachers’ cognitive abilities and teacher effectiveness. *Educational Research Review*, 30, 100312.

[20] Kim, L. E., Jörg, V., & Klassen, R. M. (2019). A meta-analysis of the effects of teacher personality on teacher effectiveness and burnout. *Educational psychology review*, 31, 163-195.

[21] Kim, L. E., Dar-Nimrod, I., & MacCann, C. (2018). Teacher personality and teacher effectiveness in secondary school: Personality predicts teacher support and student self-efficacy but not academic achievement. *Journal of educational psychology*, 110(3), 309.

[22] Abduh, M. Y. M. (2021). Full-time online assessment during COVID-19 lockdown: EFL teachers’ perceptions. *Asian EFL Journal*, 28(1.1), 26-46.

[23] Darling-Hammond, L. (2020). Accountability in teacher education. *Action in teacher Education*, 42(1), 60-71.

[24] Baliyan, S. P., & Moorad, F. R. (2018). Teaching Effectiveness in Private Higher Education Institutions in Botswana: Analysis of Students' Perceptions. *International Journal of Higher Education*, 7(3), 143-155.

[25] Alhujaylan, H. (2019). An assessment of the effectiveness of CALL in teaching English language writing skills in Saudi Arabia. *Arab World English Journal (AWEJ) Special Issue on CALL*, (5).

[26] Archana, S., & Rani, K. U. (2017). Role of a teacher in English language teaching (ELT). *International Journal of Educational Science and Research (IJESR)*, 7(1), 1-4.

[27] Tosuncuoglu, I. (2018). Importance of Assessment in ELT. *Journal of education and training studies*, 6(9), 163-167.

[28] Sultana, N. (2019). Language assessment literacy: An uncharted area for the English language teachers in Bangladesh. *Language Testing in Asia*, 9(1), 1.

[29] Munna, A. S., & Kalam, M. A. (2021). Teaching and learning process to enhance teaching effectiveness: a literature review. *International Journal of Humanities and Innovation (IJHI)*, 4(1), 1-4.

[30] Uttl, B., White, C. A., & Gonzalez, D. W. (2017). Meta-analysis of faculty's teaching effectiveness: Student evaluation of teaching ratings and student learning are not related. *Studies in Educational Evaluation*, 54, 22-42.

[31] Ghufron, M. A., & Rosyida, F. (2018). The role of Grammarly in assessing English as a Foreign Language (EFL) writing. *Lingua Cultura*, 12(4), 395-403.

[32] Xiao, Y., & Yang, M. (2019). Formative assessment and self-regulated learning: How formative assessment supports students' self-regulation in English language learning. *System*, 81, 39-49.

[33] Vogt, K., Tsagari, D., Csépes, I., Green, A., & Sifakis, N. (2020). Linking learners’ perspectives on language assessment practices to teachers’ assessment literacy enhancement (TALE): Insights from four European countries. *Language Assessment Quarterly*, 17(4), 410-433.

[34] Liu Yun. (2022). Improved Convolutional Neural Networks for Course Teaching Quality Assessment. Advances in Multimedia.

[35] Bai Yuhan. (2022). RELU-Function and Derived Function Review. SHS Web of Conferences.

[36] Safarik Jakub & Snasel Vaclav. (2023). Acceleration of Particle Swarm Optimization with AVX Instructions. Applied Sciences(2),734-734.

[37] Jingyi Zhang,Tongtian Sheng,Pan Gu,Miao Yu,Jiaxin Yan,Jianqun Sun & Shanhe Liu. (2024). Dynamics Power Quality Cost Assessment Based on a Gradient Descent Method. Energies(9).