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International Journal of Earthquake Engineering
Anno XLIII - Num. 2 - 2026

Construction of College English Education Ecological System Based on Artificial Intelligence and Environmental Responsibility

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SUMMARY: *Data technology has improved the quality of life and education for all people around the world. With the ongoing spread of such technologies in education, the ways in which information is presented and used have also become more and more elaborate. This paper proposes improvements for web-based foreign language learning and optimises the distribution of foreign language teaching in a computer network environment. Specifically, it puts forward the proposal to use instructional frameworks to help integrate computer systems in foreign language courses and thus address structural imbalances and cognitive challenges in online language education. By applying educational standards and environmental principles, a model ecosystem was built to promote research and application in digital ecology for teaching foreign languages online. According to the experiments, the adaptive GA-BPNN model achieved convergence in as few as six iterations during training, with a stable network error sum of 0.19 and a 76% improvement in the convergence rate. In addition, the mean squared error dropped by 79%, and thus the adaptive GA-BPNN model could reach a good global optimum more quickly.*

KEYWORDS: *Multilingual Speech Signals, Embedded Systems, Neural Networks, System Compatibility*

1 Introduction

With the rapid development of science and technology, modern society has entered the information age, and now many core technologies of this new era are based on computer networks. With the progress of technology, people's ways of living and studying have changed significantly; thus, college English education is also undergoing changes. Although information technology has been introducing changes to education recently, to our knowledge, it has not been fully realised in the teaching of foreign languages yet. We need to explore college English education from a new perspective and use modern information technology in a network-based manner to transform the current model of college English education.

Previous research on college English education has shown some results, but it is not perfect. Zhang J put forward the concept of a college English informatization teaching evaluation index system and analyzed the reasons for ecological imbalance in college English teaching [1]; Wang H built an English education model based on artificial intelligence with a neural network [2]; Sumi S, Li and Joe also studied teaching scaffolding, hybrid teaching design and communicative grammar teaching model, respectively [3-5]. However, the above studies have not been put into practical application. Later, Zare M, Lifah N. I, Sukirman S, Li F, and Liu K, studied English ecological system models, topic development patterns,

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https://doi.org/10.65102/is2026938 Published: 30 April, 2026

academic vocabulary worksheets, teaching models from an educational ecology perspective, and MOOC-based English teaching systems [6-10]. However, due to traditional concepts of English education, these studies are unable to achieve high integration and demonstrate their advantages.

Based on the above analysis, this paper will conduct some new experimental research combining artificial intelligence (AI) in English teaching with relevant studies. Based on the theory of educational ecology, this paper studies the problems of teaching system failures in a computer network environment and designs optimised design models in accordance with its principles and laws. Methodologically, it applies system theory and a holistic view to study the various ecological elements of the teaching system, introduces technologies such as the entropy value method, traditional genetic algorithm, and BP neural network, and constructs and evaluates the ecological system for college English education to address the shortcomings of previous theoretical-only or poorly integrated studies.

This study has made many new contributions: Thematically, it has introduced an innovative combination of educational ecology theory and computer network-based foreign language teaching to provide a new theoretical system for dealing with the problem of ecological imbalance in college English education. Methodologically, it has used an empirical research mode and adopts an all-encompassing view to study various interactions among ecological subjects and their surroundings, rather than focusing on a single factor. In terms of practice, experiments have been conducted to verify the effectiveness of the constructed ecological system and provide an application plan for introducing information technology and artificial intelligence in college English classes; at the same time, it has laid the foundation for the continuous development of college English teaching ecology.

2 Building an English ecosystem

2.1 English Teaching Ecosystem

The best college English teaching experience will be produced by cooperation among teachers, students and the school environment. Therefore, this study can be considered an all-encompassing system that includes both a separate ecological focus and its related ecological environment (Figure 1).

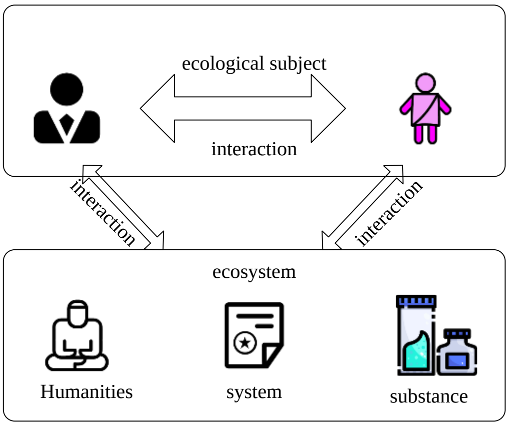

Figure 1: Display of Major Factors

The investigation of the ecological environment in this study does not consider the broader social and family background, and thus focuses only on the material, institutional and humanistic aspects of the school, as shown in Figure 1. The reasons for the above are relatively stable now. Education will also change the learning atmosphere for English in college, as shown in [11].

Natural trains mainly have understudies and educators. People are all different in various ways. There is competition and participation among the groups, as well as dependencies and limitations; there are many connections, but they are not all good ones. In a particular area, there are a few such meetings that occur frequently at the same time [12]. In the school English showing biological system, the understudy local area and the educator local area form a typical local area, and within it, there are different educational and learning elements for educators and understudies. Subsequently, the two gatherings are in harmony and provide the best way to build a magnificent school English educator local area and promote the supportable improvement of the school English teaching environment.

2.2 Ecosystem Assessment Model

The first technologies and theories of assessment for ecological system teaching are entropy method, traditional genetic algorithms and BP neural networks.

(1) Entropy value method

According to the literature [13], the idea of the thermodynamic entropy growth principle in physics is where the entropy technique originated. Entropy is a state function, and an irreversible process is needed for the entropy of an isolated system to increase. In addition, the entropy of the independent system will not change after this operation; the formula for calculating information entropy is given in (1).

$$H_s(p_1,\dots,p_N) = -K\sum_{i=1}^{N} p_i \log p_i \tag{1}$$

(2) Genetic algorithm

The first work that proposed a genetic algorithm inspired by natural selection and inheritance in the field of computation is listed in [14]. Selection of the best solution through competition and "eliminating the worst of the good" will be used. Figure 2 shows the flowchart of the traditional genetic algorithm:

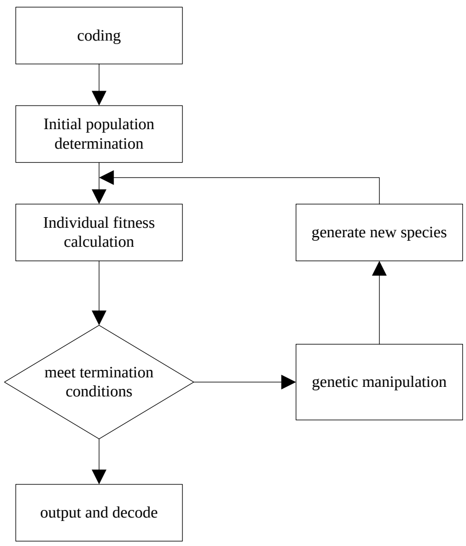

Figure 2: Standard Genetic Algorithm Flowchart

As shown in Figure 2, the purpose of inheritance calculation should be to promote the progress of the people by organising arbitrary data trade and reforming the structure of society. Through the three hereditary activities of choice, hybridisation and change, the people have been continuously revitalised in their work on quality and have moved towards the global ideal arrangement.

Standard Genetic Algorithms need to be modified according to the actual situation of the English-teaching environment in higher education. English teaching involves multi-dimensional dynamic data, such as teachers' teaching strategies, students' learning behaviour, and the allocation of teaching resources; therefore, traditional genetic algorithms are likely to experience "premature convergence" in the process of handling multi-objective optimisation problems and get stuck in a local optimum rather than achieving global optimisation of the complex interactions within the teaching ecosystem.

Therefore, the adaptive crossover and mutation probabilities of the standard genetic algorithm are introduced in this study. When the similarity among individuals in a population is relatively high, a higher mutation rate is employed to increase the diversity of the population and avoid neglecting essential optimisation goals, such as the distribution of teaching resources and patterns of teacher-student interaction. When the population dispersion is relatively large, to enhance the speed of convergence to a good solution for the entire population and find the main parameters of the balanced teaching ecosystem efficiently, a lower mutation rate is often set.

The optimised genetic algorithm can better handle the changes and complexity of the English education system and thus provide a stable base for building a teaching ecosystem evaluation model with BP neural networks later on. Help to identify the lack of balance in the teaching ecosystem, such as teacher-student role incongruence and uneven distribution of teaching resources, and provide more scientific algorithmic support for ecosystem optimisation.

(3) Backpropagation (BP) neural network

As shown in Figure 3, the three levels of the BP brain network are, from top to bottom: the input layer, the stowed-away layer, and the result layer [15, 16].

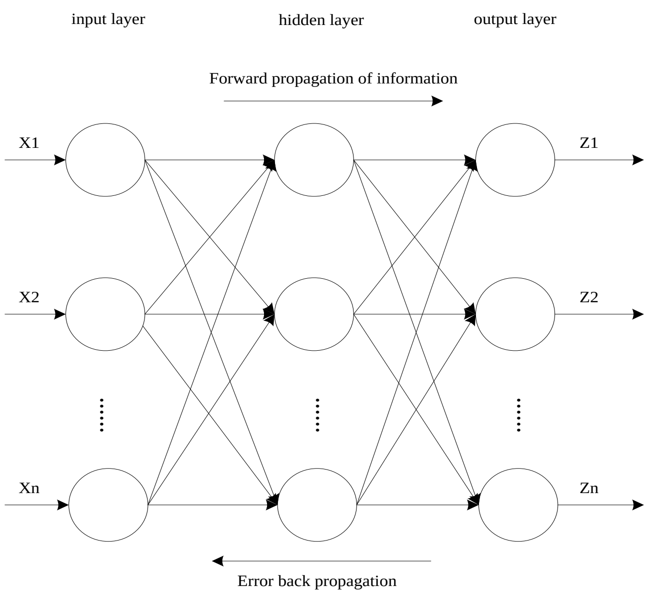

Figure 3: BPNN Architecture

The steps of the BP algorithm are shown in the network in Figure 4 as an example:

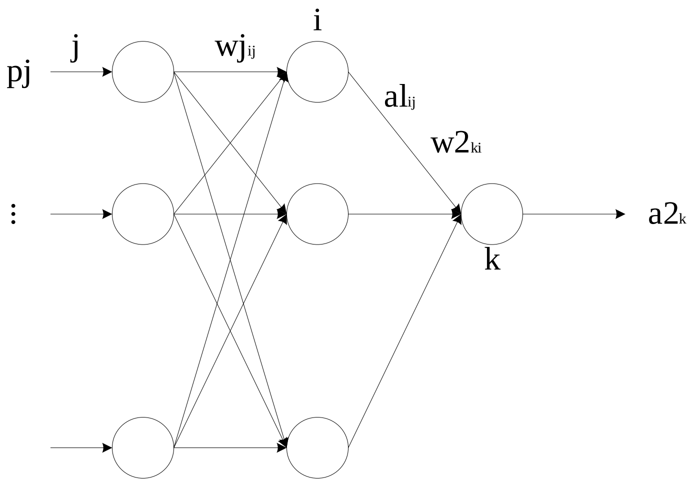

Figure 4: Simplify network Structure

To enhance the recognition accuracy and noise immunity of multilingual recognition systems based on artificial intelligence embedded technology in complex environments, the EM-AGA-BP model can be introduced. Use the EM algorithm to optimise the data distribution, and adjust the parameters of a BP neural network with the AGA algorithm. Accurately model multilingual speech signals, enhance noise immunity, and meet the low-power and small-size demands of embedded platforms.

To address the uneven distribution of multilingual speech signal features, the EM algorithm iteratively optimizes the posterior probability and corrects the statistical distribution of feature parameters. Let's assume the speech feature sample set is $\{x_1, x_2, ..., x_N\}$ and the latent variable is z_i.

Step E (Expected Calculation): Calculate the posterior probability of the latent variable, that is, the probability that sample x_k belongs to language category k :

$$P(z_i = k | x_i, \theta^{(t)}) \tag{2}$$

where $\theta^{(t)}$ is the model parameter at iteration t, and k is the number of language categories.

Step M (parameter update): Maximize the expected log-likelihood function and update the mean μ_k and covariance $\sum_k$ of the Gaussian distribution:

$$\mu_k^{(t+1)} = \frac{\sum_{i=1}^{N} P(z_i = k | x_i, \theta^{(t)}) x_i}{\sum_{i=1}^{N} P(z_i = k | x_i, \theta^{(t)})} \tag{3}$$

The BP network optimised by AGA classifies the speech features after EM processing. The hidden layer output and output layer prediction are as follows:

$$hj = \sigma(\sum_{i=1}^{I} w_{ij}x_i + b_j) \tag{4}$$

$$y_k = soft\max(\sum_{j=1}^{J} w_{jk}h_j + b_k) \tag{5}$$

Among them, σ is the Sigmoid activation function, I is the number of input layer nodes, and J is the number of hidden layer nodes. The cross entropy loss is minimized through back propagation to complete the model iterative training.

Figure 5 is the creation process.

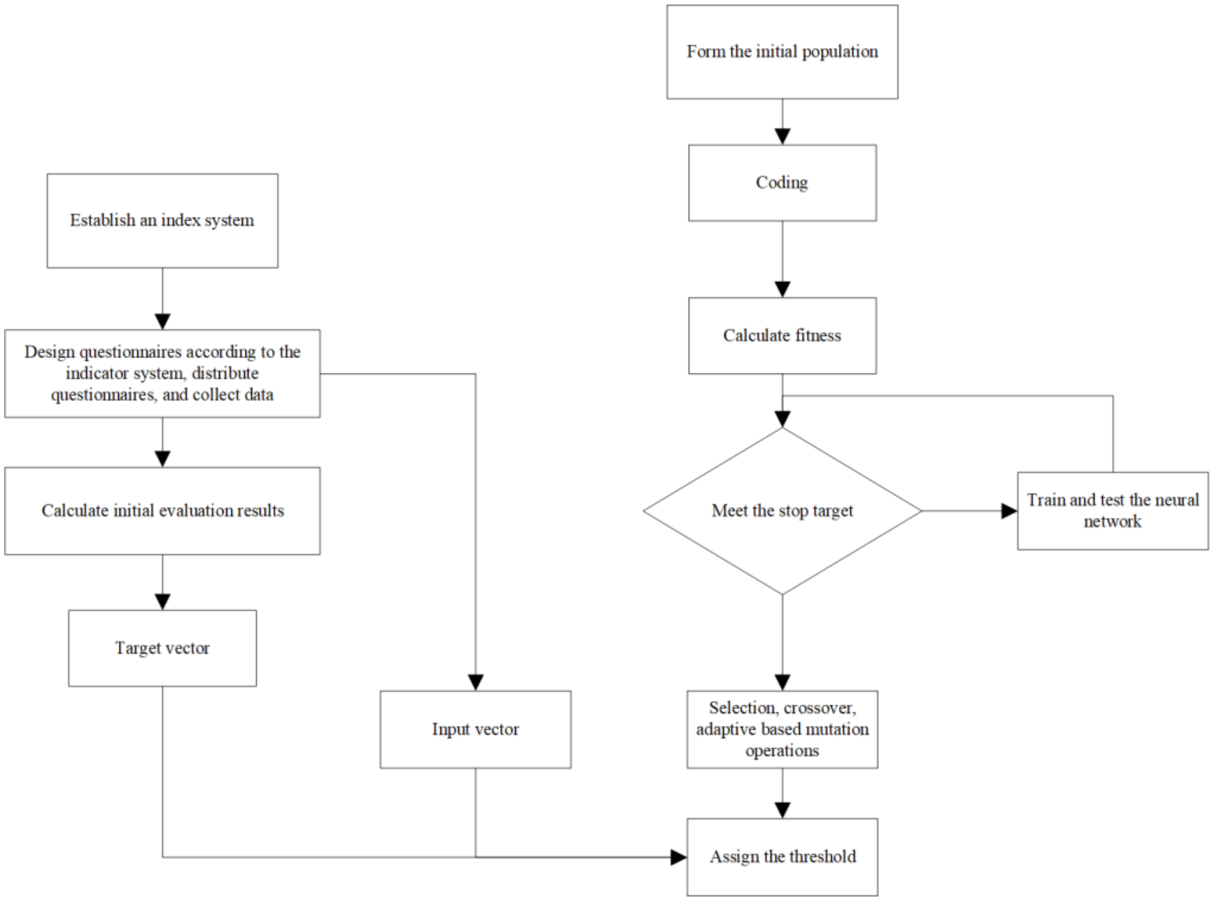

Figure 5: Evaluation Model of Teaching System

In short, the evaluation model of the university English teaching ecosystem presented in this paper is an all-encompassing system composed of many technologies. First, the entropy method will be used to determine the weights of all modules in the teaching ecosystem and find the factors that affect this distribution the most. An improved genetic algorithm is then used to optimise the parameters of the BP neural network and address the problem of traditional BP networks easily getting stuck in local optima. An EM algorithm will also be employed in this paper to iteratively optimise the statistical distribution of multilingual speech signal features and improve the accuracy of signal modelling in adverse conditions. Finally, the EM-AGA-BP model can accurately recognise and classify speech signals, and by using the entropy method for indicator weight analysis, an all-round teaching system evaluation model is thus constructed. The method will assess the teaching ecosystem quantitatively, and

AI will be used to boost the accuracy of speech recognition and parameter optimisation. A closed-loop mechanism of "indicator quantification - signal optimisation - model evaluation" has been introduced to provide scientific and practical support for the subsequent tests and optimisation of the university English education ecosystem, effectively linking theoretical analysis with the application demands of actual teaching situations.

3 English Ecosystem Test

3.1 Embedded Intelligent Speech Recognition

Embedded intelligent speech recognition systems are used in smart homes, in-vehicle interaction, industrial control and other areas by either hardware embedding or software overlay as the main integration methods, and they are relatively small, low-power and capable of real-time response. Based on experimental data from the field, this paper investigates the current situation and shortcomings of intelligent speech recognition through field-based technical measurements and scenario-based experiments.

Table 1 shows the performance indicators of the embedded and intelligent speech recognition systems:

Table 1: Comparison of Technical Indicators for Embedded and Intelligent Speech Recognition Systems

	Embedded Systems	Intelligent systems	Experimental Conditions
General scene recognition accuracy	93.20%	96.50%	Quiet environment (0 dB), Chinese-English bilingual samples
English word recognition rate	95.80%	97.90%	Standard English pronunciation samples (5000)
Dialect recognition rate (Cantonese)	82.50%	91.30%	Dialect samples (1000, including accent differences)
Response latency	0.42s	0.87s	Local command recognition (e.g., "Turn on the lights")
Continuous operation power consumption	8.6W	45.2W	Continuous recognition state (1 hour)

The scenario experiment of the embedded speech recognition system is shown in Table 2.

Table 2: Scenario-based Experimental Verification Results of the Embedded Speech Recognition System

Experimental scenarios	Experimental Design	Recognition accuracy	False trigger rate
Smart home (voice-controlled lighting)	Simulated home environment (30 dB background noise), 1000 command tests	94.50%	0.80%
In-vehicle interaction (navigation commands)	Simulated vehicle noise (60 dB engine noise), 800 navigation commands	87.30%	2.10%
Industrial control (robot commands)	Simulated factory noise (90 dB mechanical noise), 500 control commands	68.20%	5.70%
Portable devices (wristband interaction)	Simulated mobile environment (walking), 600 short commands (e.g., "time").	92.10%	1.20%

According to the above results, the embedded system has achieved a very low noise level (≤30dB) and a simple command model (e.g., smart homes and mobile devices), with recognition accuracy exceeding 92% and a false trigger rate of less than 1.2%. It also has the advantages of a small size and low power consumption; it meets the demand for a "lightweight interaction", and is not suitable for high-noise environments (≥80 dB) of the embedded system. According to the experiments, the recognition accuracy in a 90dB-noisy environment is 25% lower than in a quiet one, and the frequency of interruptions has risen. The embedded platform does not have strong support for the above noise-reduction algorithms. The system also has poor support for dialect and minority languages; Cantonese recognition is only at 82.5%.

3.2 Calculation of Intelligent Speech Recognition System

The four links in the computation process of an intelligent speech recognition system are signal preprocessing, feature extraction, model calculation and output. The two measures of the computational method's effectiveness are shown below: MFCC feature optimisation and neural network model performance validation.

Table 3 shows the experimental comparison results of wavelet transform denoising and the corresponding model performance.

Table 3: Comparison of Wavelet Transform Denoising and Model Performance Experiments

Experimental Variables	No noise reduction processing	Wavelet transform denoising	Experimental conditions
Recognition Accuracy in 80 dB Noise	72.30%	89.50%	Chinese-English bilingual samples
Recognition Accuracy in 120 dB Noise	51.80%	76.30%	Factory machinery noise environment
Model Computation Time	0.35s	0.52s	Single speech sample processing
False Positive Rate (Non-speech Signal)	6.80%	2.10%	Ambient noise samples

As shown in Table 3, the wavelet transform denoising method proposed in this paper removes high-frequency noise by hard thresholding, and under 80 dB and 120 dB of noise, the accuracy is improved by 17.2% and 24.5%, respectively; at the same time, the false positive rate has also been significantly reduced and exhibits good robustness in complex environments.

3.3 Model Training and Test

A total of 1,000 datasets were available, and 900 of them were used for training. The evaluation results of the teaching ecosystem for datasets 901-1000 are shown in Figure 6:

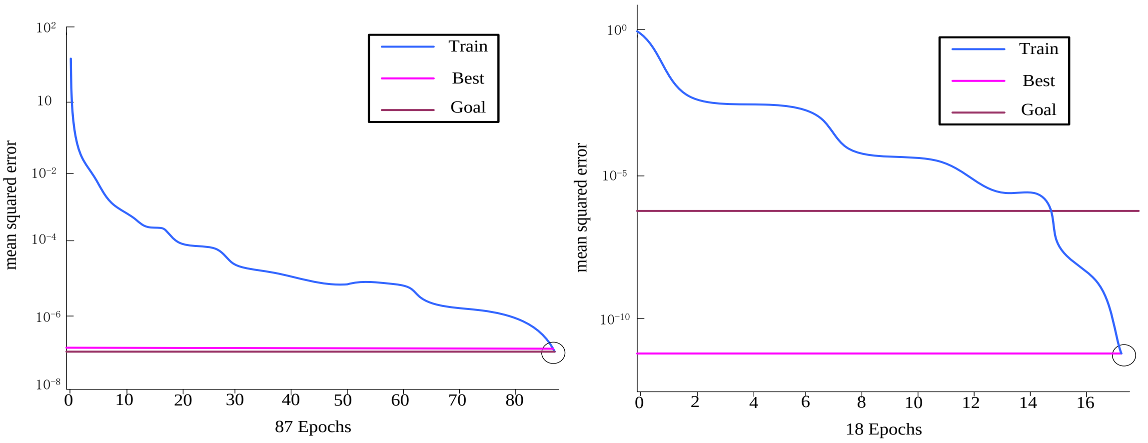

Figure 6: Mean Squared Error Statistics Plot

As shown in Figures 6(a) and 6(b), the traditional variational hereditary figuring smoothed-out cerebrum network model is faster in the main cycle. It has been shown that the redesigned BPNN with a multifunctional variational hereditary figure may not only speed up the construction at any speed of association but also further improve the expectation accuracy of the model [17, 18].

Next, a detailed analysis of the sum of squared errors and its fluctuations for the adaptive GA-BPNN will be presented in Figure 7.

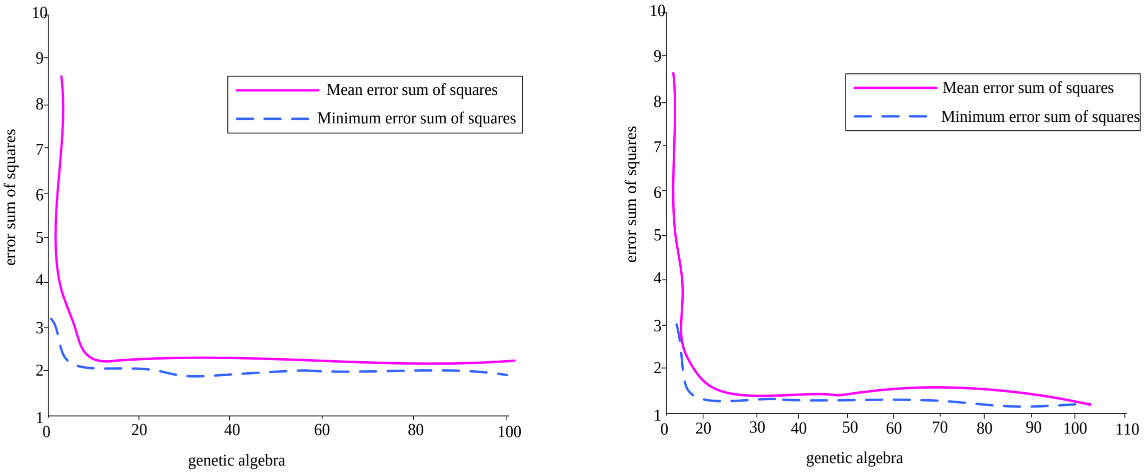

Figure 7: Error sum of squares statistic

As shown in Figure 7, after adding the essential component from Article 25, the number of incorrect squares is still around 0.9. The hybrid speedup is 76%, the number of squares with normal errors has been reduced by 79%, the number of squares with mistakes in the organisation is flawless, and the number of squares with errors is uniformly 0.19. The general variant GA-BPNN adds only six necessary locations. The above data show that a general GA-BPNN modification can be applied broadly around the world to achieve similar results.

4 Strategies for Enhancing the Ecological System of English Education in Higher Education

To address the existing imbalances and optimisation requirements in the ecological system of college English education, and to promote its sustainable and harmonious development, targeted enhancement strategies need to be formulated from the perspective of ecological subjects and the humanistic environment, focusing on strengthening the core driving force of the system and optimising the interactive environment.

4.1 Discussion

4.2 Educational Subject

The ecological subjects of college English education are teachers and students, who are the main participants and driving forces of the teaching ecosystem. Their Quality and Development Status will directly affect the operating efficiency and balance of the system.

4.2.1 Prioritizing the Development of English Teachers

High-quality teachers can plan more suitable teaching strategies and ways to boost students' English learning ability effectively and promote harmonious development of teaching. Therefore, it is necessary to focus on the development of individual teachers and teacher groups: strengthen the training of teachers' professional skills (such as English language proficiency, curriculum design, and the application of artificial intelligence teaching tools); at the same time, pay attention to building an English teacher community, clarify the ecological status of individual teachers within the group and the ecological status of the group in the entire teaching system, and form a mutually supportive and collaborative development environment for teachers to improve the overall ecological status of the teacher group and promote stable development of the college English teaching ecosystem.

4.2.2 Improving the Comprehensive Quality of Students

Only positive learning motivation, such as curiosity about English culture, the need for future career development, and the sense of achievement in learning English, can motivate students to take the initiative in their studies, actively complete learning tasks, and better assimilate and absorb knowledge, according to the perspective of learning motivation as the internal driving force for students' learning. At the same time, students should expand their learning horizons beyond what is presented in English textbooks, learn about the culture behind the English language, explore knowledge in other fields such as international trade and cross-cultural communication, and gain a desire to learn about these topics in other subjects. In addition, students need to form a self-monitoring mechanism, regularly review the progress and results of their English learning, strengthen the understanding and assimilation of classroom knowledge, and achieve an integrated state of efficient learning, knowledge expansion, and interest cultivation.

4.3 Optimizing the Humanistic Environment of English Education

A humanistic environment will also be created to support teachers and students in interaction and other ways. A high-quality humanistic environment can promote the positive interaction of ecological subjects and provide a good guarantee for the operation of the system.

4.3.1 Reconstructing the Teacher-Student Relationship

Teachers and students should be able to communicate well for the sake of creating a positive learning environment, so their roles and relationships need to be optimized. Teachers need to change their traditional "leading" role, consider the current learning needs and development goals of their students as a starting point, adjust teaching objectives, methods and activities in a timely manner, and help students integrate new and old knowledge to reconstruct their knowledge systems. Students need to be proactive in learning and actively take part in class; when facing difficulties in their studies, they should feel free to speak up to their teachers and classmates for help, and through discussion, practice and learning from one another, enhance their ability to use English. Teachers and students need to continuously adjust their positions and clarify their respective roles in the interaction process, such as teachers being guides and collaborators, students taking the lead, fully exercising their functional responsibilities, finding a good ecological position within the English teaching system, and working together to maintain the dynamic balance of this ecosystem.

4.3.2 Strengthening External Support for English Learning

An external support system can create a large-scale learning area outside the classroom to reduce the restrictions of classroom teaching. Schools and teachers can take several measures: Before formal classes, have students prepare individual or group presentations on particular topics in English (such as "Cross-cultural Differences in Daily Communication") or write English news commentaries on current affairs to create a pre-class learning atmosphere; with the school's approval, regularly invite well-known foreign language teachers from other schools or experts in the field of English application to conduct demonstration classes or special lectures to expand the horizons of teachers and students and stimulate students' enthusiasm for learning English; in combination with teaching tasks, arrange for professional tutors to guide students in English-related practical internships (such as assisting with international conference translation, handling foreign trade documents) to help students grasp the practical value of English and motivate them further. The above measures will help to build a multi-dimensional English-learning environment and provide strong support for the development of the college English education ecological system.

5 Conclusions

This paper aims to enhance the foreign language teaching strategies in a computer network environment to promote the all-round development of English education at schools and universities. Theoretical research on the application of network technology in foreign language teaching has been steadily expanding in recent years. Educational ecology provided the theoretical support for this study and put forward basic ideas and ecological laws. The three directions of investigation were the character traits of individuals, the ecology of the human group, and the systemic conditions, and based on them, an ecological teaching model was proposed. However, there are still some shortcomings; due to restricted data sources and limited distribution of the survey, this study has not been able to construct an all-encompassing ecological system for English education.

Competing Interests

The authors have no conflicts of interest and hereby declare it.

Financing

Project Name: Application Research on International Communication of Henan’s Iconic Intangible Cultural Heritage of Traditional Medicine— “Pingle Guo’s Orthopedics” Empowered by Digital Intelligence

Project Number: 262400410031

Project Type: Soft Science Research Project of Henan Province

Affiliation: Henan Vocational College of Tuina (Henan Vocational Education Center for Persons with Disabilities)

Sponsor: Department of Education, Henan Province

Data Availability Statement

Data sharing is not applicable to this paper because no datasets were generated or analysed in the current study.

About the Author

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