

## Research Article

# A Design Model of English Auxiliary Teaching System Using Artificial Neural Networks

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At present, the development of artificial intelligence has entered a new stage. In the next few years, human life will be greatly covered by artificial intelligence. Artificial intelligence (AI) is an intelligent technology that simulates the human brain for thinking operation. English is very difficult for Chinese students to learn. Moreover, at present, there are still many areas that need to be improved or improved in the design of English assistant instruction system (EAIS) in China. This study aims to study an EAIS based on AI. This study presents an algorithm combined with neural network. This study designs a system that can enable students' autonomous learning system, English teacher assisted teaching, AI expert intelligent diagnosis, and system administrator to manage and analyze data. And this study tests the actual effect of the system. By comparing the academic performance of two classes in the school, the results show that although the average score of students' monthly test fluctuates after using the AI EAIS, it tends to rise as a whole. Moreover, its initial score of 81.5 was 1.1 lower than that of the class without the teaching system and finally increased to 90.11. It is 6.89 points higher than the class that does not use the teaching system. This shows that the auxiliary system designed in this study has a certain effect on the improvement of students' English performance.

## 1. Introduction

The continuous development of computer information technology has brought many changes to people's life. Computer-assisted instruction (CAI) was first developed in the United States in 1950s, and then, it is widely spread all over the world. Until recently, more and more teachers began to understand its use in teaching.

Artificial intelligence is the study of making computers to simulate certain thinking processes and intelligent behaviors of people (such as learning, reasoning, thinking, and planning). Artificial intelligence calculations are faster and more accurate than the human brain. It mainly includes the principle of computer realization of intelligence and the manufacture of computers similar to human brain intelligence so that computers can realize higher-level applications.

Most IELTS courses offered online focus on improving test skills. Then, this study adopts the methods of test, teaching, and retest. At first, the diagnostic test is carried out,

followed by teaching intervention and post-test. The effectiveness of online courses is determined through interviews with teachers, students' feedback, the comparison of diagnostic test scores and exit level scores, and the use of corpus language method to check lexical and grammatical features.

The Internet's birth and expansion have provided education with a larger development space. It integrates contemporary information technology and education in a natural and organic way. That is, the use of artificial intelligence in modern education makes learning a lifetime process. The building of networked courses is becoming more common in colleges and universities. In many networked courses, how to incorporate intelligence in the teaching platform is a hot topic, and most existing intelligent products are still in the experimental and theoretical research stages. Intelligence is still in its infancy, and it has yet to gain widespread acceptance and use. As a result, the design of a network-based artificial intelligence-assisted teaching system in this research is of critical practical importance.

Mature intelligent writing evaluation systems have a supporting role for English writing teaching, such as PEG, IEA, E-rater, BETSY, Auto-mark, iWrite, Pigai Network, Bingo English, home, and abroad. This study chooses Pigai Network (<http://www.pigai.org>) as the experimental platform because it has relatively larger user base in China. In addition to the Pigai Network, two platforms, Chaoxing Learning (<https://i.chaoxing.com>) and Waiyan Reading (<https://edu.unistudy.top>), were also used to test students' English proficiency.

The innovation of this study is to design an intelligent English auxiliary teaching system combined with AI technology. In this study, the system is actually used and tested. The test results are compared with data and charts. The results can better reflect the advantages of this system. This system combines two aspects of students' autonomous learning and learning situation evaluation. It combines teaching evaluation and autonomous learning to strengthen the connection and interaction between teachers and students. It can better realize the purpose of auxiliary teaching.

## 2. Related Work

About the AI-assisted teaching, at present, many scholars have carried out relevant research on AI-assisted English teaching system. Du et al. put forward the implementation of AI-based CAI system. The practice shows that the system can effectively improve students' autonomous learning ability [1]. In order to reduce the burden of English teachers' composition correction and improve their writing ability, Guo and Wang have studied and implemented computer-assisted English writing scoring system from the perspective of English Writing Teaching for China's college students. Guo and Wang combined the characteristics of Chinese college English writing teaching, the current situation of intelligent correction, and the needs of auxiliary teaching. He researched and designed a computer-assisted English writing composition scoring system suitable for college English writing teaching. It ended with an initial implementation of the system. At the same time, in order to improve the learning effect of students and optimize the system engine, Guo and Wang had researched and implemented the corresponding recommendation algorithm and engine optimization scheme. The research showed that the system is more reasonable, suitable for College English writing teaching, and it has good application prospects and research significance [2]. Zhang et al. discussed and analyzed the feature selection methods (TF-IDF, IG, and CHI). Zhang et al. studied the impact of automatic essay scoring from a linguistic point of view, using multiple regression methods to evaluate the final score. The features considered by Zhang et al. mainly included simple language features and complex language features. Finally, he conducted performance analysis of the algorithm model by setting control experiments. The results show that the proposed algorithm model has a certain effect [3]. Bochari et al. used the descriptive qualitative method to analyze errors made by the fourth semester of a college English education research program in preparing English passive sentences [4]. CAT is computer-

aided translation technology. As an important auxiliary means, it has been widely used in software localization and translation of scientific and technological works. This need for reality has drawn increasing attention to the development and use of CAT tools. The application of CAT translation teaching in China is still in its infancy. Yao introduced the status quo of CAT technology in China's translation teaching [5]. Narayanan examined the participants' perceptions and performance of an online IELTS (The International English Language Testing System, which is one of the well-known international English standardized proficiency tests. The IELTS test was established in 1989 and is jointly administered by the British Council, Cambridge University Examinations Committee and the Australian Education International Development Agency (IDP)) course offered by MS Teams in an online teaching platform. It shows that students without enthusiasm perform poorly, while students with good grades are those who engage in self-study and are autonomous learners to some extent. Although the above research has promoted the development of EAIS in China to a certain extent, most of the research must be based on theory. It has less practical design and application of the system, especially the research on the combination of AI technology and EAIS. Therefore, the following EAIS designed with AI has great value and reference significance.

## 3. Design Method of EAIS Based on AI

*3.1. AI Technology.* With the increase in AI research, more and more AI-related applications [6–8] are increasingly appearing in everyday life. The research of AI has permeated practically every sphere of life, for example, intelligent sweeping robots, intelligent speakers, personal assistants, and face payment. A lot of relevant research studies have been done in the sectors of finance, medical treatment, automated driving, education, and so on. Figure 1 depicts the increase of AI teaching research literature on relevant literature search engines in China, indicating that AI technology is now being researched with earnest. These practical studies have made people's lives more easier. The advancement of AI has now progressed to a new level. In the coming years, AI will have a significant impact on human life. It is critical for individuals to grasp and master AI technology as quickly as feasible in this environment. There is a lack of some courses related to AI and computer science and technology in primary and secondary schools, even at the preschool level, as well as the research and planning of some education and teaching schemes and strategies in terms of AI application research in the field of education at this stage. As a result, developing and researching a set of universal AI education and teaching systems are crucial. The research contents of artificial intelligence include artificial intelligence theoretical system, generalized knowledge model, associative knowledge base, self-organizing inference engine, knowledge acquisition tools, expert system development environment, high-intelligence robot and its application research [9, 10], new generation artificial intelligence machine, high performance brain model,

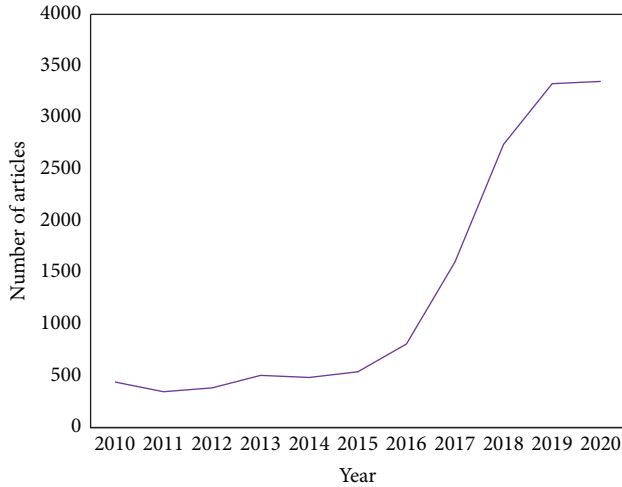


FIGURE 1: Growth of research literature on AI teaching in China.

highly intelligent expert system, and intelligent instrumentation.

Compared with the west, the research of AI in the field of education in China began relatively late. However, in recent years, due to the promotion of relevant policies and social research upsurge, research on the combination of AI and education has gradually emerged. From 2014 to 2016, the application of AI in the field of education was still in the basic research stage, and no in-depth and specific research was carried out in a specific field. In terms of the current development of the combination of AI and education, the existing research in the field of AI education is mainly divided into two parts. One kind of research focuses on the application level of education and teaching. The other focuses on the research on the strategy and scheme of the combination of basic teaching and AI. Figure 2 shows the literature retrieval classification of AI teaching on relevant literature search websites in China [11].

The statistics of high-frequency keywords can be expressed as follows:

$$M = 0.749\sqrt{N_{\max}}, \quad (1)$$

where  $N_{\max}$  represents the highest frequency and  $M$  is the high-frequency threshold.

The ranking of the top 9 AI-related high-frequency keywords in foreign countries and China is obtained, as shown in Tables 1 and 2. These keywords illustrate the current research hotspot of AI education or teaching.

The research on the strategy and scheme of the combination of basic teaching and AI mainly focuses on the construction and improvement of the basic knowledge system of the audience, the scheme and strategy setting of the education and teaching system, etc. This level of research can be subdivided into two types. One is the integration of AI with a specific discipline or academic stage, such as AI with music education, vocational education, medical research, and future education. The other is to combine the basic knowledge system and key technology of AI. Starting from the most essential basic knowledge of AI, it inspires the

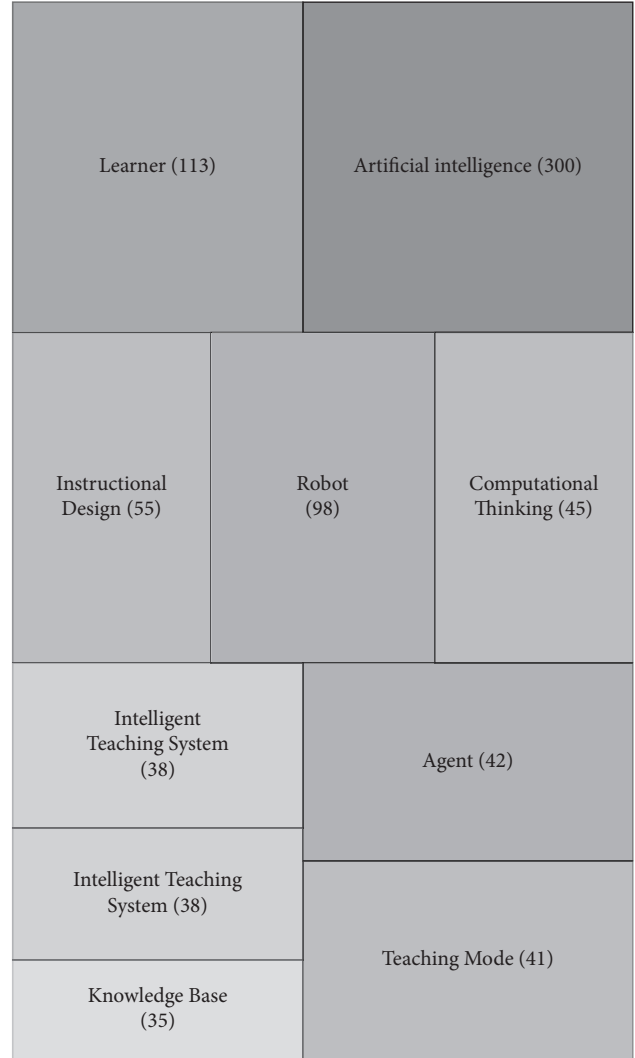


FIGURE 2: Literature retrieval and classification of AI teaching in China.

learning interest of the audience and exercises the thinking mode of the audience. It makes sufficient preparations for the follow-up development of AI [12, 13]. At the same time, by combining each student’s own learning style and characteristics, they can formulate personalized education and teaching methods. It more intelligently recommends relevant learning resources and learning paths to the snow [14, 15]. Figure 3 shows the application form of AI in the teaching system. In addition, some data mining systems applied in the field of education can also provide strong support for the transformation of school management and teaching methods.

Figure 4 shows the impact of AI on the design of teaching system, and the research on the strategy level of basic teaching scheme is mostly aimed at a specific population. For example, the courses set up by universities and relevant subjects set up by some training institutions require participants to have a certain basis of relevant technical knowledge. Therefore, there is an urgent need to design a universal AI education and learning system that can cover all

TABLE 1: Foreign AI-related high-frequency keywords.

Keywords	Frequency of occurrence
AI	81
AI education	34
E-learning	36
Intelligent tutoring systems	25
Knowledge management	19
Higher education	17
Robotics	18
Machine learning	16
Science education	12

TABLE 2: High-frequency keywords related to AI in China.

Key words	Frequency of occurrence
AI	401
AI education	51
Intelligent education	42
Smart education	39
AI technology	30
Robot	32
Education informatization	24
Future education	28
Machine learning	17

people, so as to facilitate the in-depth study and research of AI [16].

*3.2. Current Situation of English Teaching System.* All multimedia classrooms in many schools can connect to the campus network and the Internet at any time. It is vital to make full use of the network resources of the campus network and the Internet to actualize the links between teaching assessment and students' learning in order to transform traditional teaching modes and increase students' interest in learning. It improves students' learning ability and adapts to educational reform by enriching instructional formats and sharing high-quality resources on the network. Nowadays, a large proportion of students' basic English understanding is inadequate, and this has created a bottleneck impeding students' comprehensive English quality progress [17].

Students' grammatical basis is poor, according to a language learning assessment of professional freshman in several schools. Students do not master the comprehensive basic knowledge of language, such as vocabulary, grammar, and sentence structure, as evidenced by the graded English test for freshmen. In addition, in the foreign language department of several schools, tutoring programs for CET4 have been established up. The teachers discovered that many students' lack of basic vocabulary, grammar, and sentence structure influenced teachers' tutoring effects, which in turn influenced students' learning outcomes. As a result, we need to develop multiple learning plans based on the learning needs of various pupils, i.e., we need a more intelligent auxiliary teaching system [18]. Figure 5 depicts the intelligent English teaching application hierarchy.

In addition, at present, most schools begin to use the teaching materials required by the new curriculum reform,

and each unit is taught according to the modules of speaking, listening, reading, and writing. It completely abandoned the previous teaching mode of grammar as the key link and translation as the method and moved from one extreme to the other, resulting in many students being unable to translate sentences and poor basic grammar knowledge, which seriously affected students' English learning and improvement [19].

### 3.3. Design of English Teaching System

*3.3.1. Student Autonomous Learning System.* Knowledge base maintenance, diagnosis practice, knowledge point strengthening practice, and improvement practice are the four core modules of the autonomous learning system. The fulfillment of its function can perform autonomous learning based on the AI neural network's [20] learning mode (it is a distributed parallel information processing algorithmic mathematical model that mimics the behavioral properties of animal brain networks). This network adjusts the interconnected relationship between a vast number of internal nodes to meet the goal of processing information, depending on the system's complexity. Symbolic functions and their numerous approximations, parallelism, fault tolerance, hardware implementation, and self-learning properties are all used in neural network methods. The structure of neural network is shown in Figure 6.

(1) *Knowledge Base Maintenance.* The users of the sample maintenance module are only English experts. After the network structure of neural network is determined, the design and adjustment of connection weight is very important, which is usually completed by learning samples. Therefore, the maintenance of samples determines the characteristics and functions of neural networks. Experts in English field input samples, knowledge engineers initialize the network, and the system trains the neural network according to the samples. It constantly modifies the network weights and thresholds and finally obtains the network structure parameters for students to diagnose themselves. When the network does not adapt, experts can add, modify, and delete samples, and knowledge engineers can adjust the network structure and optimize the network.

(2) *Diagnostic Exercise.* After logging into the system, it can learn multiple knowledge points in the sample question bank. There are 150 questions to practice. After the exercise is completed, they can make a self-diagnosis of their problem-solving situation.

(3) *Intensive Practice of Knowledge Points.* The system is classified into insufficient knowledge points, good knowledge points, and untested knowledge points. Students can choose and practice the corresponding modules according to their own learning needs.

(4) *Improve Practice.* In this part, it is mainly aimed at skilled users among student users. Every time students practice on the system, the system database will be saved. In this module,

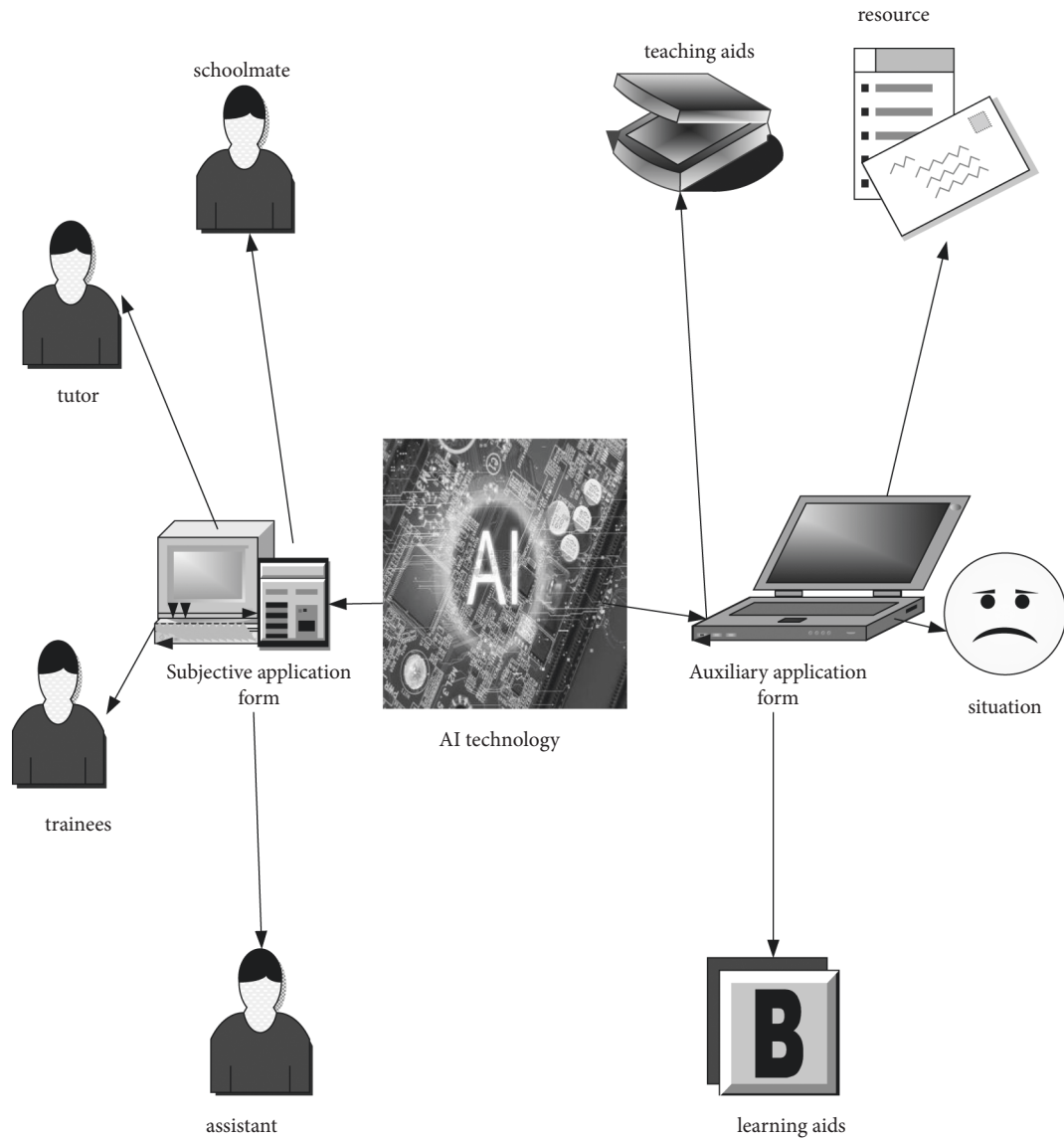


FIGURE 3: Application form of AI in teaching system.

the user’s practice will be listed by date and time period for students’ reference. At the same time, the system gives students’ learning conclusions according to the historical practice and lists the corresponding exercises for each knowledge point that needs to be consolidated according to the law of memory and forgetting. It enables users to consolidate knowledge points, improve learning efficiency, strengthen interest in English learning, and realize intelligent management in English learning.

**3.3.2. System Database Design.** There are many data tables used in the database of the system. User information table: it saves all types of users of the system, and there are subtables of relevant detailed information under the category. Here, we introduce the main data tables including user name, password, and user category. User static knowledge table: save English static knowledge, which can be maintained only

by domain experts. There are multiple static knowledge tables, which record all the knowledge points of English vocabulary and grammar hierarchically. It includes the category of knowledge points, the name of knowledge points, and the table of knowledge points related question bank: save the English test questions provided by domain experts, including question stems, options, and answers. Rule knowledge-based table saves the domain knowledge of domain experts. Only domain experts can maintain it. It stores the knowledge and experience of domain experts into the knowledge base according to the established format of the developer, including topic number, knowledge point number, and certainty.

Sample database table refers to the training samples of AI learning network, including name and sample serial number. Group analysis result table: save the analysis of the developed student group after the English teacher uploads the test results each time, including the test number,

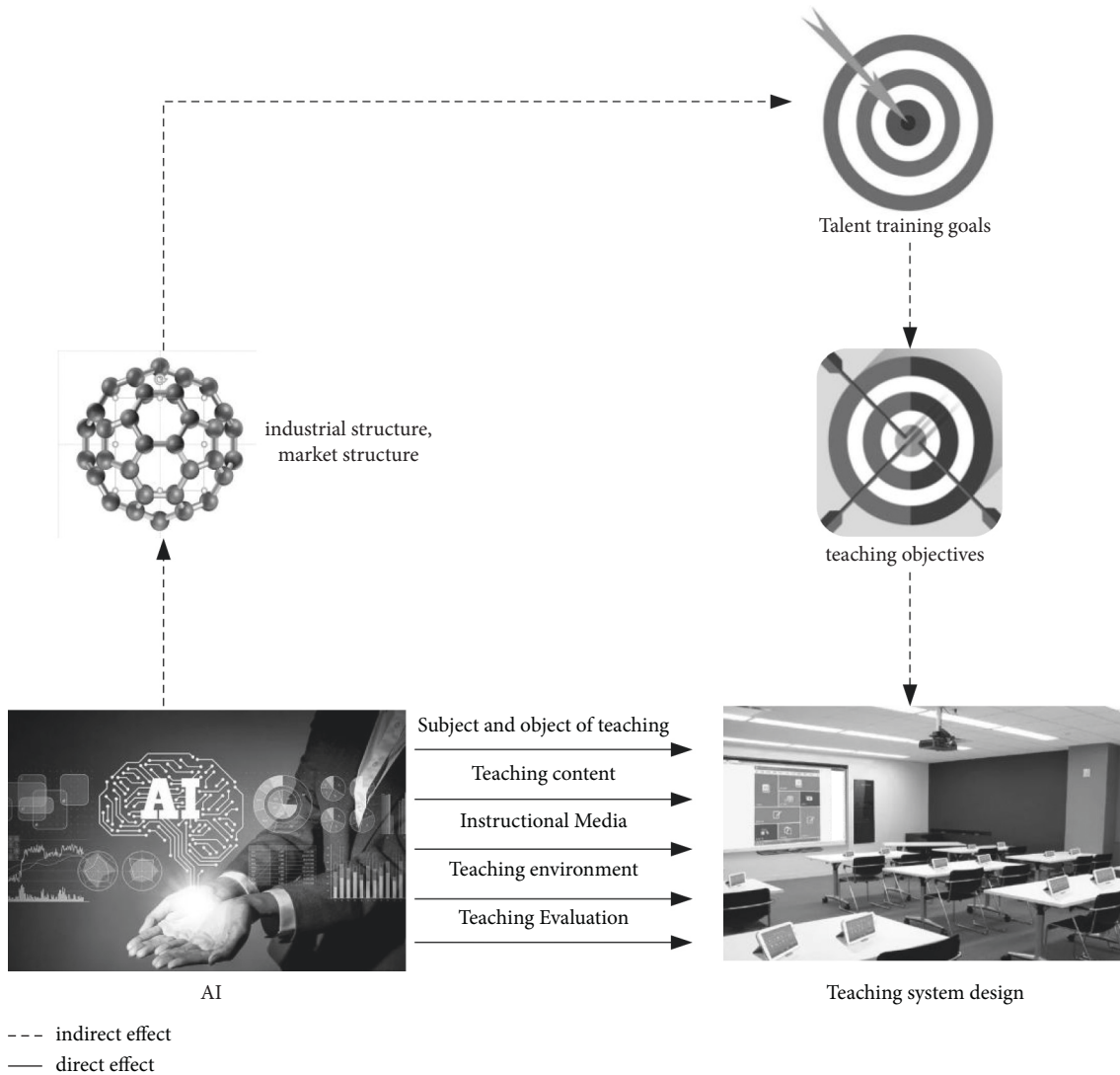


FIGURE 4: The influence of AI on the design of teaching system.

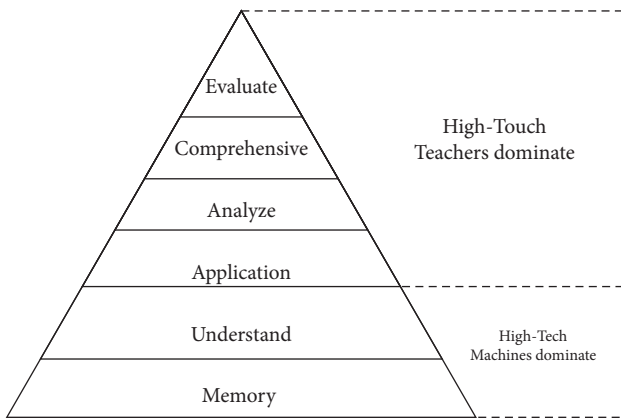


FIGURE 5: Application hierarchy of intelligent English Teaching.

knowledge point number, mastery, and certainty. Sample management database table: save the specific contents of learning samples, including sample serial number, topic serial number, knowledge point serial number, and

certainty. Weight management library table: save the weight distribution of each sample after learning, including sample serial number and weight. Student history exercise database table: save the results of each exercise, including serial number, date, title serial number, and correctness. Student history exercise analysis table: save the result analysis of students after each exercise, including exercise time, knowledge point serial number, and knowledge point mastery [21].

#### 4. Practice and Test of AI English Teaching System

4.1. AI Intelligent Operation Model. In digital signal processing, normalization processing is carried out:

$$\sin c(x) = \frac{\sin(\pi x)}{\pi x} \tag{2}$$

The purpose of introducing sinc function is that the sinusoidal function is a rectangular pulse with amplitude of 1

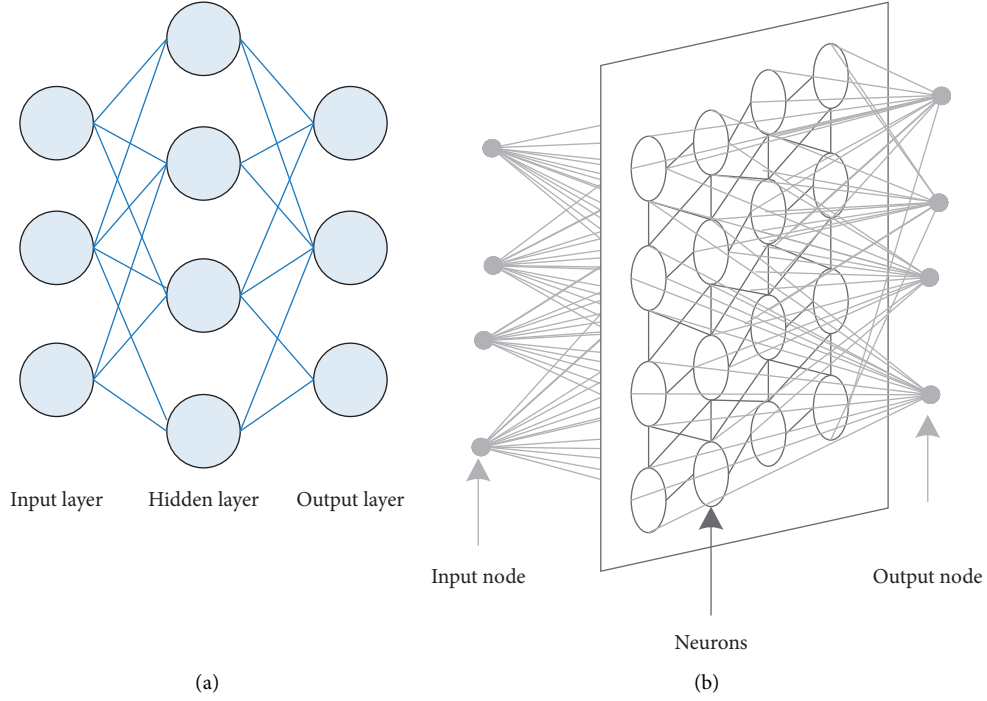


FIGURE 6: Neural network structure diagram: (a) schematic diagram; (b) structure diagram.

after Fourier transform (Fourier transform means that a function that satisfies certain conditions can be expressed as a trigonometric function (sine and/or cosine function) or a linear combination of their integrals. It is a basic operation in digital signal processing and is widely used in the field of representation and analysis of discrete time domain signals). The rectangular bandpass filter in the frequency domain can be expressed as

$$G[n, f_l, f_h] = \text{rec}\left(\frac{f}{2f_h}\right) - \text{rec}\left(\frac{f}{2f_l}\right), \quad (3)$$

where  $f_l$  and  $f_h$  refer to low frequency and high frequency, respectively.

$G$  function can be obtained by inverse Fourier transform:

$$g[n, f_l, f_h] = 2f_h \sin c(2\pi f_h n) - 2f_l \sin c(2\pi f_l n). \quad (4)$$

Therefore, the expression of feature extraction is

$$y[n] = x[n] * g[n, f_l, f_h], \quad (5)$$

where  $x[n]$  is signal input and  $y[n]$  is output.

The smoothing coefficient is introduced into the original function to obtain

$$g_\omega[n, f_l, f_h] = g[n, f_l, f_h] * \omega[n]. \quad (6)$$

And  $\omega$  can be expressed as

$$\omega[n] = 0.54 - 0.46 \cdot \cos\left(\frac{2\pi n}{L}\right). \quad (7)$$

After feature extraction and neural network processing of the input signal, the probability of the corresponding feature scalar can be obtained by analyzing the output vector  $y_t^k$ :

$$p(k, t|x) = \frac{\exp(y_t^k)}{\sum_{k'=1}^k \exp(y_t^{k'})}, \quad (8)$$

where  $k$  represents the  $k$ th data signal.

Then, the probability of transcription  $\phi$  is

$$p(\phi|x) = \prod_{t=1}^T p(\phi_t, t|x). \quad (9)$$

By accumulating the probabilities of all output sequences that can be mapped to the real label, we obtain

$$p(l|x) = \sum_{\phi \in B^{-1}} p(\phi, |x). \quad (10)$$

The recognizable functions in the English speech model are

$$L(x) = -\log p(l'|x). \quad (11)$$

For one to many cases, it can be expressed as

$$p(\text{"right"}) = \prod_{n=1}^n y_m^n, \quad (12)$$

where  $n$  represents the position of the horizontal data matrix and  $m$  represents the vertical signal.

When the calculation is repeated by merging and when there are two adjacent characters in the corresponding label that are identical, the sum of the probability of passing through all prefix subpaths of node  $\theta$  at time  $t$  can be expressed as

$$\alpha_t(\theta) = (\alpha_{t-1}(\theta) + \alpha_{t-1}(\theta-1) \cdot y_\theta^t). \quad (13)$$



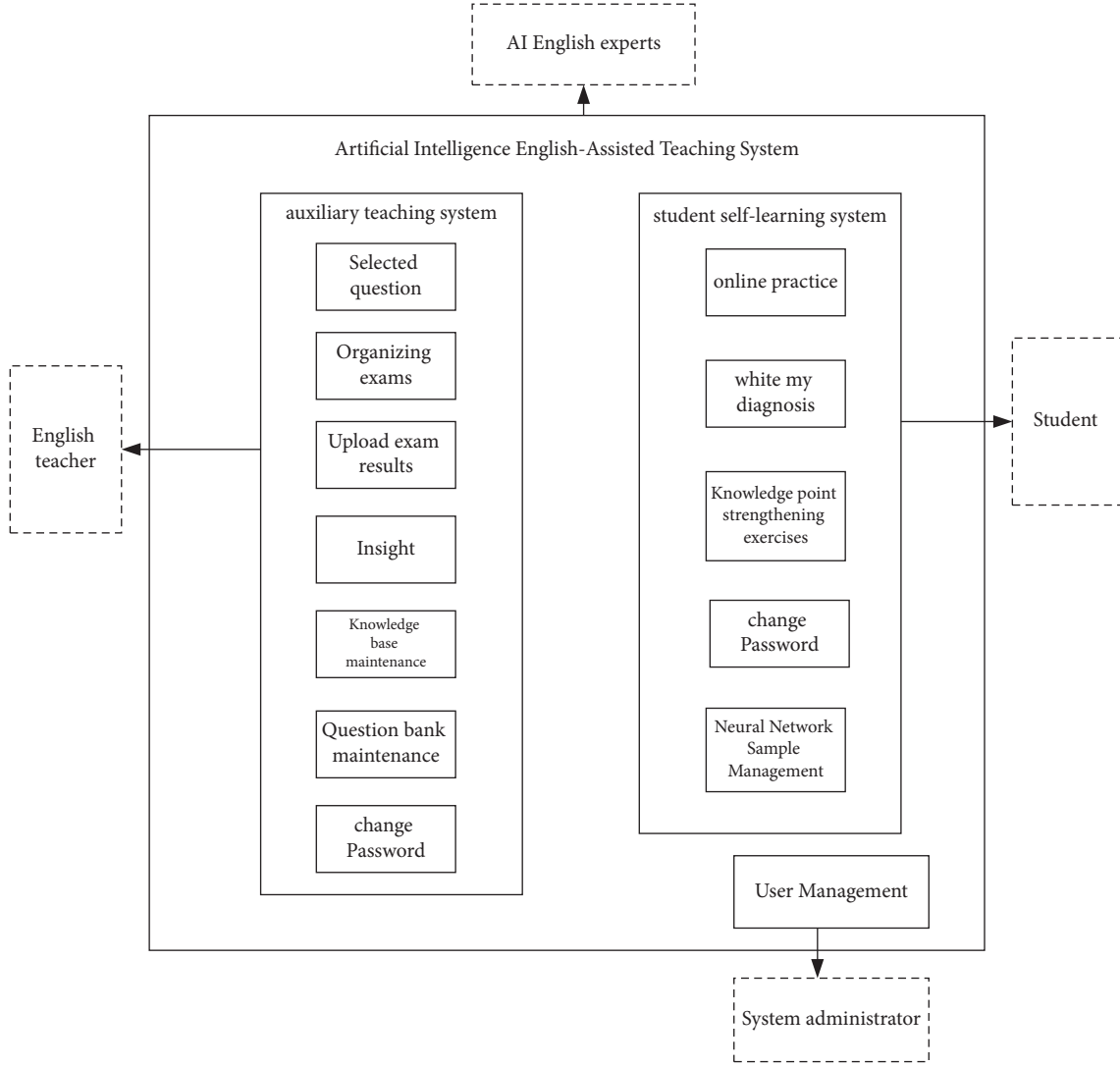


FIGURE 7: Overall system framework.

Others are

$$\alpha_t(\theta) = (\alpha_{t-1}(\theta) + \alpha_{t-1}(\theta-1) + \alpha_{t-1}(\theta-2) \cdot y_\theta^t). \quad (14)$$

Similarly, when two adjacent characters in the corresponding label are identical, the sum of the probability of passing through all suffix sub paths of node  $\theta$  at time  $t$  can be expressed as

$$\beta_t(\theta) = (\beta_{t+1}(\theta) + \beta_{t+1}(\theta-1) \cdot y_\theta^t). \quad (15)$$

Others are

$$\beta_t(\theta) = (\beta_{t+1}(\theta) + \beta_{t+1}(\theta-1) + \beta_{t+1}(\theta+2) \cdot y_\theta^t). \quad (16)$$

Then, the total probability for all nodes is

$$\sum_{\phi \in B^{-1}} p(\phi|x) = \frac{\alpha_t(\theta) \cdot \beta_t(\theta)}{y_{l_\theta}^t}. \quad (17)$$

It can be obtained that, at any time, the probability sum of all paths can be obtained by traversing all nodes:

$$p(l|x) = \sum_{\theta=1}^{l'} \frac{\alpha_t(\theta) \cdot \beta_t(\theta)}{y_{l_\theta}^t}. \quad (18)$$

Thus, the end-to-end autonomous training of the model can be realized.

**4.2. System Design.** The overall structure and function of the system designed in this study are shown in Figure 7. It is mainly designed in four aspects: teacher assisted teaching, students' autonomous learning, system administrator, and AI intelligent expert diagnosis.

The data processing of the system is also carried out in four aspects: teacher assisted teaching, students' autonomous learning, system administrator, and AI intelligent expert diagnosis, as shown in Figure 8.

**4.3. Simulation Experiment.** This study randomly selects two classes in a school whose English courses are taught by the



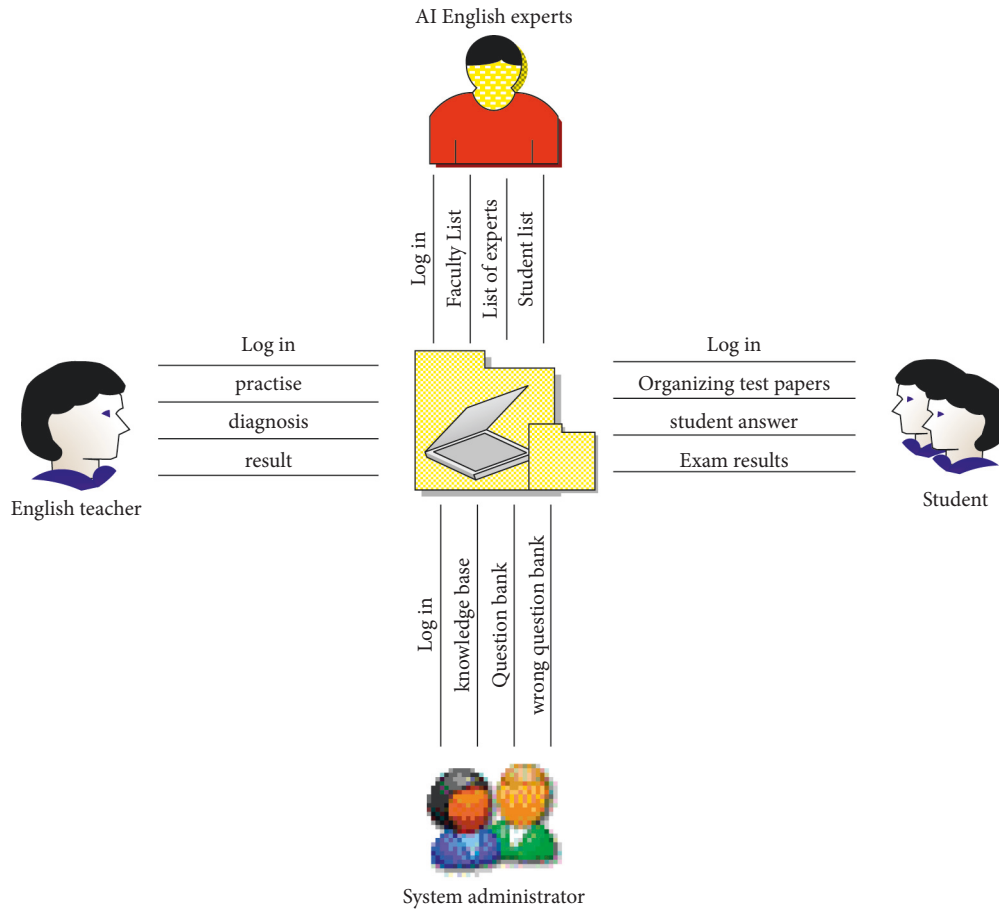


FIGURE 8: Data structure management.

TABLE 3: Comparison between the two classes.

Class	A	B
Total number of student	45	45
Initial English evaluation score	81.3	82.6
Teaching system	AI auxiliary system	Traditional multimedia auxiliary system

same teacher, and the number of English courses per week is equal. The situation of these two classes is shown in Table 3. The A class of two classes was used in the AI EAIS, and B class used the usual normal teaching method to compare the average scores of the monthly English examinations of the two classes of students. The results are shown in Figure 9.

Although the average score of students' monthly tests fluctuated after the AI-assisted English teaching system was introduced in class A, it tended to rise overall, as shown in Figure 9. Furthermore, the initial score of 81.5 was upgraded to 90.11 points and 6.89 points higher than the 83.22 score of class B, despite the fact that it was 1.1 points lower than the class B score of 82.6. This demonstrates that the auxiliary system proposed in this study has some impact on student English proficiency.

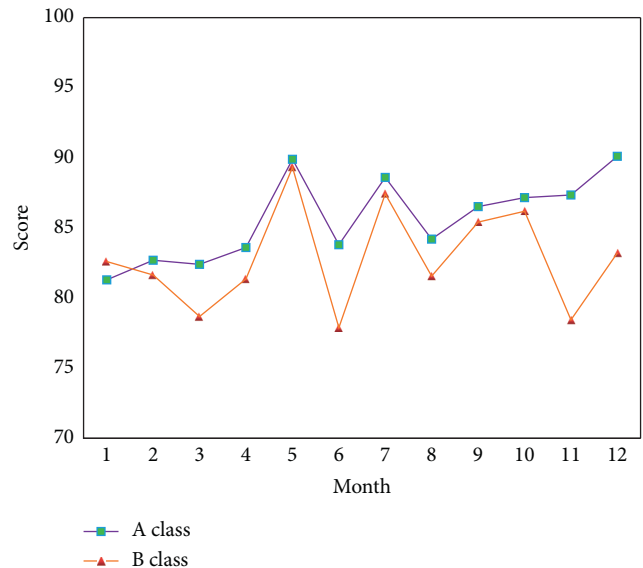


FIGURE 9: Comparison of average scores in class English monthly test.

### 5. Conclusion

Firstly, this study quickly presents the research background and relevance of the full text, discusses the concept of the full

text's major research material, and explains the experimental design and outcomes of this study in the summary section. The study then goes on to introduce the important contents of computer-assisted instruction, as well as the significance and innovation of this research content, in the introduction. Finally, in order to comprehend the research status and current challenges of this research material, this study conducts an example analysis of relevant work. This study first introduces the evolution of AI teaching and the use of AI English teaching in theoretical research. This study then discusses the current state of the English teaching system, as well as the design approach for the English teaching system, which includes the autonomous learning system for students and the database design method. Using the English auxiliary system established in this study and the regular English learning system, this study compares the English scores of two classes in a school. The findings suggest that the auxiliary system proposed in this study has a positive impact on students' English proficiency.

Despite the fact that the AI English-assisted teaching system proposed in this study has yielded some outcomes. However, it still has some flaws that need to be addressed, including the following. (1) This study should improve understanding of artificial intelligence technology, continue to research the implementation and application of advanced artificial intelligence technology at home and abroad, and continually improve the system's realization ability. (2) This study should further communicate with the English teaching group at a deeper level. It deepens the understanding and understanding of English teaching reform, optimizes existing modules, adds new modules, and enhances and expands the functions of this system. At the same time, the ease of operation of the system still needs further efforts and improvement. (3) In a large amount of information environment, students' autonomous learning system should be more inclined to learn "autonomy" and "intelligence" when the system serves students. It provides each student with a personalized learning environment and truly realizes a personalized intelligent autonomous learning system. With the progress of memory science, the mathematical model of memory forgetting should be further optimized to be more in line with the law of human memory forgetting. (4) This study conducts network reliability test and intelligent test for this system, which needs to be further solved in future work practice.

### Data Availability

The data used to support the findings of this study are available from the author upon request.

### Conflicts of Interest

The author does not have any possible conflicts of interest.

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