Classroom Practice of Computer Intelligent English Translation Teaching Based on Embedded System

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ABSTRACT Computer intelligent teaching has become an important approach for improving English translation education through artificial intelligence and embedded computing technologies. This study investigates the classroom practice of computer intelligent English translation teaching based on an embedded system and develops an adaptive teaching framework integrating embedded hardware, multimodal perception, and a Self-Organizing Feature Map (SOFM) neural network. The embedded platform acquires real-time visual and behavioral information to evaluate student engagement and provides immediate instructional feedback through local processing with low latency. Experimental evaluation involving 300 students from three universities demonstrates that the proposed approach significantly enhances translation performance, increasing the mean translation accuracy from 50.3% to 83.8% after one semester of instruction, with an average improvement of 33.5 percentage points. The embedded system maintains an average feedback latency below 0.55 s while sustaining real-time multimodal data processing, confirming its practical deployment capability. By integrating embedded intelligent sensing, multimodal signal acquisition, and efficient information transmission into classroom teaching, the proposed framework provides an engineering-oriented solution for adaptive educational systems and offers potential references for electromagnetic sensing-assisted edge devices, wireless information interaction, and intelligent signal processing in next-generation digital learning environments.

INDEX TERMS embedded system, computer intelligent English translation teaching, multimodal sensing, electromagnetic sensing, intelligent signal processing

I. INTRODUCTION

ET is a functional work to improve students' English skills and effectively ensure their English learning. There are significant differences between computer intelligent English teaching and language translation practice. Translation is a complex thinking activity. To cultivate translation talents, students should be taught to think correctly. The ultimate goal is to cultivate students' ability to analyze and convey information, organize and construct information in other languages, and make it consistent with equivalent semantic information. It includes the reorganization of information in the mother tongue or foreign language to realize seamless transmission of information, improve students' translation skills, and help them understand and master translation rules.

The content of a computer intelligent ET course is one of the keys. Textbooks are the most important means to convey content. They should adhere to the learning-centered learning principle and a specific teaching basis. The research content of Bi Shengqin was an artificial intelligence technology based on neural network and ET system based on an intelligence knowledge base [1]. Xiao Dong Li discussed the motivation and premise of successfully integrating intelligent computer-assisted language learning tools into the current foreign language teaching practice [2]. Yuan Zhang built filter functions based on deep learning models, and used text for the retraining of error-correction models [3]. Wen Hongxia built a support vector-based intelligent ET system that accurately identifies the exact meaning of a word in translation [4]. Qiao Fang analyzed the characteristics of translation teaching and constructed a new mobile translation teaching mode [5]. Marouf Ahmad M believed that intelligent teaching systems were the products of emerging technologies that can provide direct training to students [6]. Liu Haiyuan introduced an intelligent tutoring system aimed at helping student translators learn to understand the difference between literal translation and free translation. From the discussion of researchers, he extracted the definitions that are convenient in calculation for them, and applied them to the corpus for translation preparation for the intelligent teaching system [7]. The above explanations for the teaching of computer intelligent ET are more specific, and do not

mention the classroom practice of ET teaching.

Today's English education not only exists as a subject, but also has a part of society and policy. In the teaching process, translation teaching still plays an irreplaceable role in other teaching methods. Especially in international communication, translation is a necessary link in English classes, which is of great practical significance. David Samuel S positioned teaching translation as an example of a cross language teaching method, aiming to make full use of the language resources of emerging bilinguals [8]. Schwab Susanne examined perceptions of inclusive teaching practices, and students using questionnaires about teaching practices [9]. Seltzer Kate elaborated on how the identity of teachers affects teachers' positions and practices, and pointed out that different teachers must treat their cross language teaching methods in a way that understands racial language ideology [10]. Beiler Ingrid Rodrick, based on the translation practice of English writing teaching in college freshmen, presented new insights and combined multiple data to provide multiple ways of translation [11]. By analyzing and comparing the collected data, Krulatz Anna found that the students' daily activities were closely related to their habits and learning attitudes [12]. Deng Lijun proposed a translation learning method that can improve the integration of teaching and evaluation [13]. Poulou Maria S found that teachers' self-report and observational evaluation showed obvious differences in their teaching methods [14]. These researches on ET teaching are relatively comprehensive, but they do not include embedded systems and computer intelligent ET teaching.

Language is a means of communication in human society, and translation skills are the comprehensive embodiment of students' foreign language skills and related knowledge. At present, computer English teaching is undergoing a new round of reform, using English for cross-cultural communication to meet the needs of educational economic development and international exchanges. Therefore, in the reform of English teaching, computer intelligent ET teaching has been effectively implemented, which fully reflects the needs of students for translation ability and meets the needs of modern society for compound talents.

II. ADVANTAGES OF ARTIFICIAL INTELLIGENCE AND COMPUTER INTELLIGENCE TEACHING MODE

A. MODERNITY OF TEACHING IDEA AND PROGRESSIVENESS OF TEACHING EQUIPMENT

The advantages of the computer intelligent teaching mode are first reflected in the teaching concept [15]. The multimedia teaching mode considers material technology, but does not consider the basic situation of students. However, computer intelligent teaching mode can strengthen the integration of education and information technology, and improve the equal status of teachers and students in the classroom. In addition, under the computer intelligent teaching mode, all learning environments, resources, and information in the learning process serve the teaching quality and optimize the teaching quality. In addition to computer intelligent learning and teaching, there are computer and information technology, which are the most modern principles in the education system, as shown in Figure 1. This equipment not only facilitates the development of teaching activities but also optimizes teaching efficiency and enhances the technological sophistication of teaching activities.

B. INTERACTION OF TEACHER-STUDENT RELATIONSHIP AND GUARANTEE OF TEACHING QUALITY

The remarkable feature of the computer intelligence teaching mode is different from the traditional model. It puts special emphasis on the communication and interaction between students and teachers in the learning process. Through the communication and interaction between teachers and students, teachers' leading position and learning position in the classroom have been well reflected, and they have unprecedented advantages in achieving teaching quality. All advanced teaching models are based on the principle of optimizing teaching quality [16]. The intelligent mode of computer intelligent teaching includes concept, equipment, teacher-student relationship, etc., to better realize and ensure the quality of education. The computer intelligence teaching mode well reflects the modern teaching concept, advanced teaching equipment, and teacher-student interaction, and plays a powerful role in guaranteeing teaching.

C. APPLICATION OF ARTIFICIAL INTELLIGENCE IN COLLEGE ET COURSE

Artificial intelligence (AI) is an intelligent simulator that uses big data technology, cloud computing, and deep learning as the main means to produce actual translation scenes. This is the only way for students to get a proper change in their ideas and become real participants in translation courses. When applying AI to college ET activities, it should strengthen the construction of facilities to avoid affecting the actual performance of the original AI. For example, in order to realize online translation and computer interaction functions, schools can analyze, optimize, and reconstruct the performance of the offline teaching system, as shown in Figure 2. The application of AI to English college translation is an important means of cultivating high-quality ET talents and expanding English teaching resources.

III. APPLICATION OF EMBEDDED SYSTEM AND COMPUTER IN ET TEACHING

This study utilizes an embedded system as the hardware foundation for deploying a computer vision multimodal learning module. A Raspberry Pi 4 Model B embedded platform is connected to a classroom camera and a depth sensor. This embedded system captures real-time video streams of students engaged in translation exercises. The system then extracts multimodal data from these streams. The extracted data includes facial expressions and upper body gestures. This hardware configuration allows the teaching system to

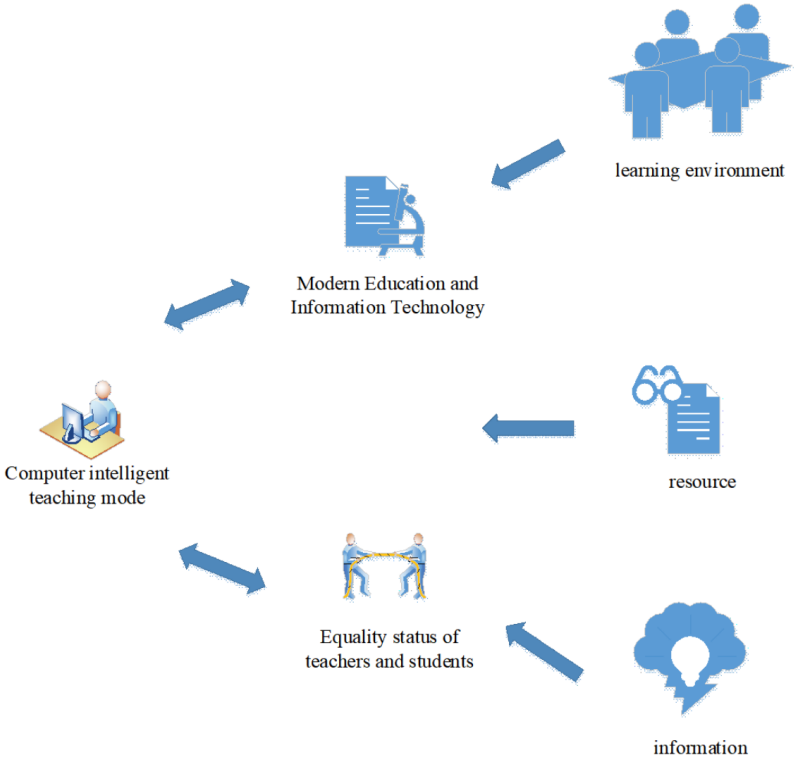

FIGURE 1. The Modernity of teaching concepts and the advancement of teaching equipment

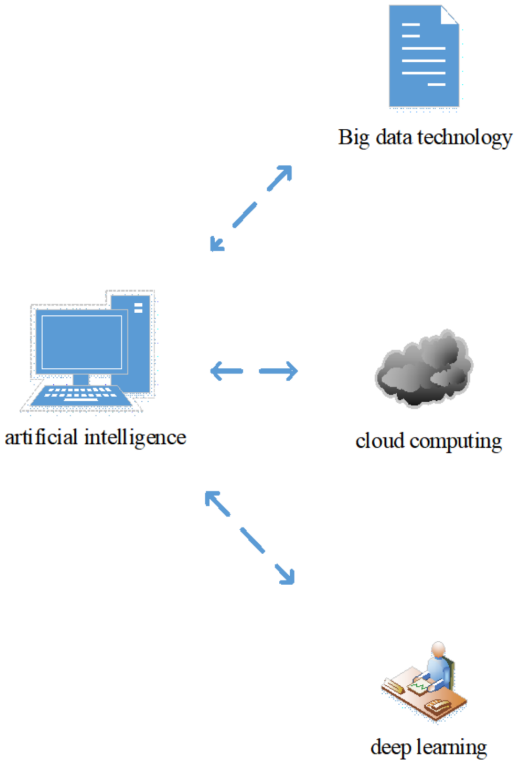

FIGURE 2. Application direction of artificial intelligence in college ET class

operate without relying on cloud computing resources. The embedded system processes all data locally to ensure student privacy and reduce latency. The processed data serves as input for the Self Organizing Feature Map neural network

discussed. The neural network evaluates student engagement levels. Based on this evaluation, the system provides real-time feedback to the instructor through a simple interface. The interface displays a color coded indicator. A green indicator suggests students are engaged. A yellow indicator suggests decreasing attention levels. A red indicator alerts the instructor to low engagement requiring immediate intervention. This setup directly links the embedded system hardware to the adaptive teaching method.

A. APPLICATION OF EMBEDDED SYSTEM IN ET TEACHING

Embedded ET teaching based on intelligent ET under a computer network is the best example of the practical application of ET [17]. It can be used to design teaching systems to assist teachers in teaching with it. Embedded system requires students to carry out program design, computer composition principle, and computer operating system.

B. EMBODY THE MODERNITY AND PROGRESSIVENESS OF ET TEACHING

Computer intelligence teaching mode not only reflects the integration of education, computer technology, and modern information technology, but also reflects the innovation of modern teaching concepts [18]. With the development of the international economic environment, ET has become a modern educational subject with continuous innovation. The modern technology and concept consciousness of computer intelligent teaching mode make the English education more modern. Computer intelligent teaching mode is a new teaching mode based on computer technology and modern information technology. Its development has always been inseparable from computer and intelligent information technology, representing the level of modern advanced technology. At the same time, the advanced computer technology and intelligent information technology have enhanced the intelligent education mode and the technological innovation of computer-based instruction. At present, English courses based on computer intelligence are not extensive. Therefore, the full implementation of the computer intelligent teaching mode can not only improve the methods of translation teaching, but also reflect the progressiveness characteristics of translation teaching.

C. REFLECTING THE INTERACTIVITY OF ET TEACHING AND THE GUARANTEE OF TEACHING QUALITY

Computer intelligence teaching affirms the basic position of students, provides students with equal opportunities to communicate with classroom teachers, and provides students with opportunities for friendly interaction. The introduction of computer intelligence teaching effectively reflects the reciprocal nature of ET instruction. In the process of English language translation teaching, the application of computer intelligence teaching effectively guarantees the effectiveness, efficiency, and quality of ET instruction.

IV. PRACTICAL APPLICATION OF COMPUTER INTELLIGENCE TEACHING MODE ON ET TEACHING

A. OPTIMIZING TEACHING CONCEPT AND IMPROVING TECHNICAL EQUIPMENT

Teaching philosophy is the guiding ideology that determines teaching activities, teaching methods, and teaching quality [19]. The introduction of the computer intelligence teaching model into ET teaching must be based on modern scientific ideas. The biggest difference between the traditional and computer aided teaching mode lies in the degree of integration of material technology. The traditional teaching mode emphasizes the teacher's independent role, while the computer intelligence mode emphasizes the teaching elements, modern information technology, and other comprehensive elements play a very important role. Therefore, in ET teaching, in order to stimulate the development of the computer intelligent teaching mode, it is necessary to introduce advanced computer intelligent technology. At the same time, teachers and students should actively participate in the learning and mastering of modern information technology. Only in this way can it make full use of modern information technology and new teaching methods that embody the quality principle of teaching and training, as shown in Figure 3.

B. STRENGTHENING TEACHER-STUDENT INTERACTION AND IMPROVING TEACHING QUALITY

The computer intelligence teaching mode has changed the teacher-student relationship under the traditional teaching mode. The current teacher-student relationship is a teacher-student cooperation model where teachers guide the learning process and students actively engage as primary participants. Teachers and students share equal opportunities to contribute to the learning process in computer intelligence teaching. Therefore, under this teaching mode, it needs to strengthen teacher-student interaction, deepen teacher-student friendship, activate teaching activities, and improve the teaching effect. In any case, the quality of education is the ultimate indicator of evaluation. In other words, teaching quality is the most important standard for testing a teaching mode. As ET teachers, they should follow the teaching philosophy as much as possible, strengthen the feedback of teachers and students through textbooks, make full use of textbooks, and introduce and develop computer intelligent teaching models. Teaching quality assurance is the greatest advantage of the computer intelligent teaching model and also the highest goal of ET teaching. The application of computer intelligence in English teaching should be combined with English teaching practice, give full play to the advantages of computer intelligence teaching, and construct a new ET teaching model, which also brings a new realm to ET teaching.

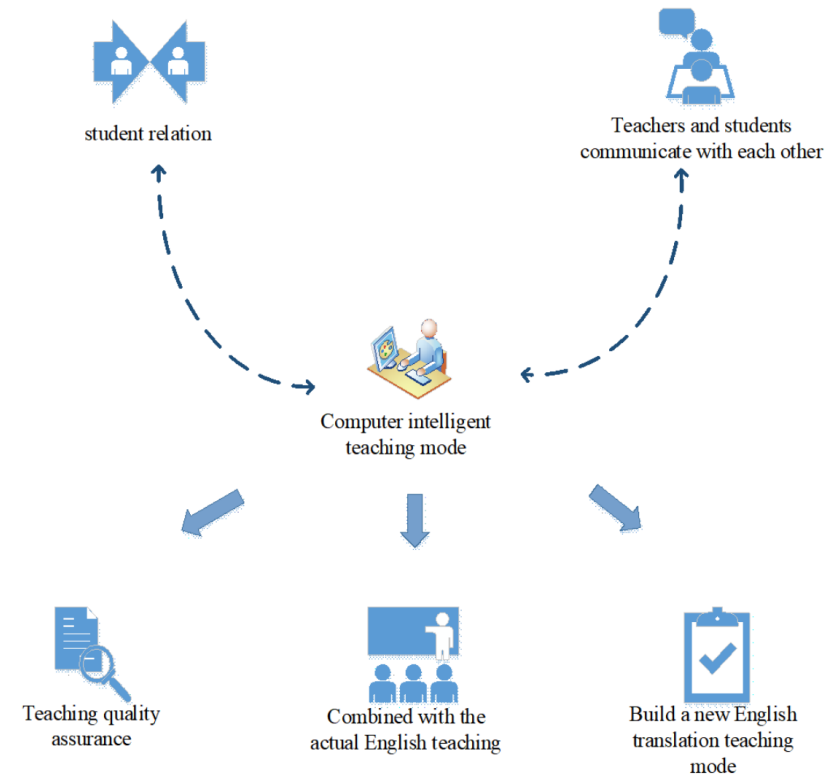

FIGURE 3. Optimize teaching concepts and improve technical equipment

V. APPLICATION OF SOFM NEURAL NETWORK TEACHING MODEL ALGORITHM IN COMPUTER INTELLIGENT ET TEACHING

Compared with traditional classification algorithms, SOFM (Self Organizing Mapping) uses a controlled classification process to transform the classification center into a surface, as shown below.

The input n dimension training sample vector is:

$$X = (x_1, x_2, \ldots, x_n)^T \tag{1}$$

The weight vector is:

$$W_j = (w_{j1}, w_{j2}, \ldots, w_{jn})^T \tag{2}$$

The iteration number is k, and the sample vector is normalized according to formula (1), where $x = \sum_{i=1}^{n}(x_i)^2$ represents the norm of the sample vector; In equation (2), $y_i(0) = \sum_{j=1}^{n}[y_{ij}(0)]^2$ represents the Euclidean norm of the weight vector.

$$x' = \frac{x}{\|x\|} \tag{3}$$

$$y'(k) = \frac{y_i(0)}{\|y_i(0)\|} \tag{4}$$

The sample vector x' is obtained from the input sample, and neuron A can be obtained.

$$\|x' - y'_A\| = \min \|x' - y'_i\|, \quad i = 1, 2, 3, \ldots, n \tag{5}$$

The connection weight value of the neighboring neurons of the winning neuron $A(k)$ is updated according to formula (5). In formula (5), δ_k is the update learning rate:

$$A(k) = \min[A(0)(1 - k/n)] \tag{6}$$

$$y'(k+1) = y'(k) + \delta_k[x' - y'_i(k)] \tag{7}$$

The updated weight shall be normalized again according to Formula (6).

$$y'(k-1) = \frac{y'_{i-}(k+1)}{\|y'_{i-}(k+1)\|} \tag{8}$$

VI. COMBINED WITH SOFM NEURAL NETWORK ALGORITHM AND EXPERIMENTAL ANALYSIS

In order to investigate the classroom development of traditional ET teaching in more detail, the traditional ET teaching methods were investigated. ET teaching is to achieve the goal that students can read or translate English language content. Therefore, ET teaching must be combined with curriculum resources, teaching methods, teacher-student interaction, situational teaching, etc. to ensure that students' requirements for the content of translation courses can be met. In order to investigate the current classroom development of ET teaching, an experiment was conducted to investigate the students' evaluation of traditional ET teaching in three universities. A total of 300 students were investigated. The three universities were selected based on

their regional distribution and educational level. University A is a comprehensive university located in an eastern coastal city. University B is a provincial key university located in a central region. University C is a municipal university located in a western area. All three universities offer four-year English major programs with ET courses as compulsory components. The 300 participating students were all second-year English majors who had completed at least one ET course prior to the survey. Among the 300 students, 182 were female, and 118 were male. The age range of the participants was from 19 to 21 years old. Table 1 presents the demographic distribution of the participants across the three universities.

Table 1 shows that each university contributed 100 students to the survey. The gender ratio across the three universities was approximately 60 percent female and 40 percent male. The majority of students were 20 years old. This demographic information supports the representativeness of the sample population. This paper adopts the form of questionnaire to investigate students' satisfaction with the current traditional ET teaching classroom curriculum resources, teaching methods, teacher-student interaction, and situational teaching. The three universities are set as A, B and C, as shown in Table 2.

It can be seen from Table 2 that 300 students in the three universities surveyed are not satisfied with the curriculum resources, teaching methods, teacher-student interaction and situational teaching of traditional ET teaching. Among them, School A is 31% satisfied with curriculum resources, 45% with teaching methods, 31% with teacher-student interaction and 39% with situational teaching. School B is 36% satisfied with curriculum resources, 33% satisfied with teaching methods, 42% satisfied with teacher-student interaction, and 29% satisfied with situational teaching. School C is 33% satisfied with curriculum resources, 29% with teaching methods, 37% with teacher-student interaction, and 36% with situational teaching. From the survey, it can see that the current ET teaching curriculum still has shortcomings and needs to be further improved. In order to investigate the problems of students' translation in traditional ET teaching courses, this paper selects three colleges and universities to investigate the problems of students' translation in the way of questionnaire. The survey contents are mainly summarized as follows: slow translation speed, poor translation accuracy, and inaccurate sentence translation. From these three points, it investigates the problems of students' translation in traditional ET teaching courses. The school is set as A, B, and C, and the number of people surveyed is 300. The survey is shown in Figure 4.

It can be seen from Figure 4 that 68% of students in School A have slow translation speed; 71% have poor translation accuracy; and 77% have inaccurate sentence translation. In ET, 76% of students in School B are slow in translation; 81% are poor in translation accuracy; and 69% are inaccurate in sentence translation. In ET, 59% of students in School C are slow in translation; 53% are poor in translation accuracy; and 49% are inaccurate in sentence translation. The current ET teaching curriculum has not played a very good role in students' translation ability, so it should strengthen the training of students' translation ability to improve their ET ability.

In order to test the computer intelligent ET teaching constructed by the SOFM neural network algorithm, this paper investigated 300 students in the above three universities, and reassessed the students' satisfaction with the curriculum resources, teaching methods, teacher-student interaction and situational teaching in the new computer intelligent ET teaching. During the same experimental period, the study also collected operational data from the Raspberry Pi 4 Model B embedded system deployed in each classroom. The system recorded the latency between capturing student behavior and updating the instructor feedback interface. The system also logged the central processing unit usage during peak classroom activity. Table 3 presents the average performance metrics of the embedded system across the three universities over ten class sessions.

The data in Table 3 shows that the embedded system maintained a feedback latency below 0.55 seconds across all three universities. A latency below one second is sufficient for an instructor to receive and react to classroom feedback. The peak central processing unit usage remained under 83 percent, indicating that the system did not become overloaded during normal teaching activities. The data processing rate remained close to 30 frames per second. This rate is sufficient for capturing student gestures and facial expressions without noticeable lag. The operational data confirms that the embedded system is a practical and stable component of the proposed teaching method.

The evaluation results are specifically shown as the students' satisfaction with the teaching of the new computer intelligent ET, and the specific effect is shown in Figure 5.

As shown in Figure 5, the students of the three colleges and universities are relatively satisfied with the teaching

TABLE 1. Demographic distribution of participant students across three universities

University	Total Students	Female	Male	Age 19	Age 20	Age 21
A	100	62	38	28	54	18
B	100	58	42	25	60	15
C	100	62	38	30	52	18

TABLE 2. Functional evaluation of the Learning resource query system by a university student

	A	B	C
Curriculum resources	31%	36%	33%
Teaching methods	45%	33%	29%
Teacher-student interaction	31%	42%	37%
Situational teaching	39%	29%	36%

TABLE 3. Operational performance metrics of the embedded system across three universities

Performance Metric	University A	University B	University C
Average Feedback Latency	0.47 seconds	0.52 seconds	0.49 seconds
Peak CPU Usage	0.78	0.82	0.79
Data Processing Rate	29.8 frames per second	28.5 frames per second	

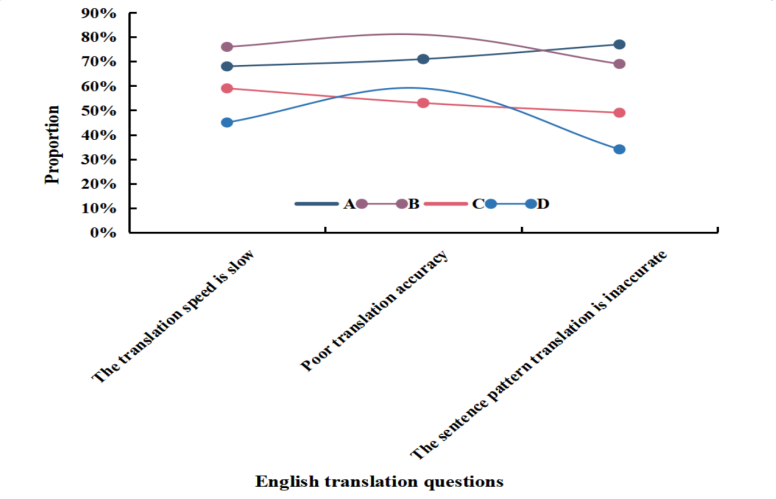

FIGURE 4 . Problems existing in traditional ET Teaching courses

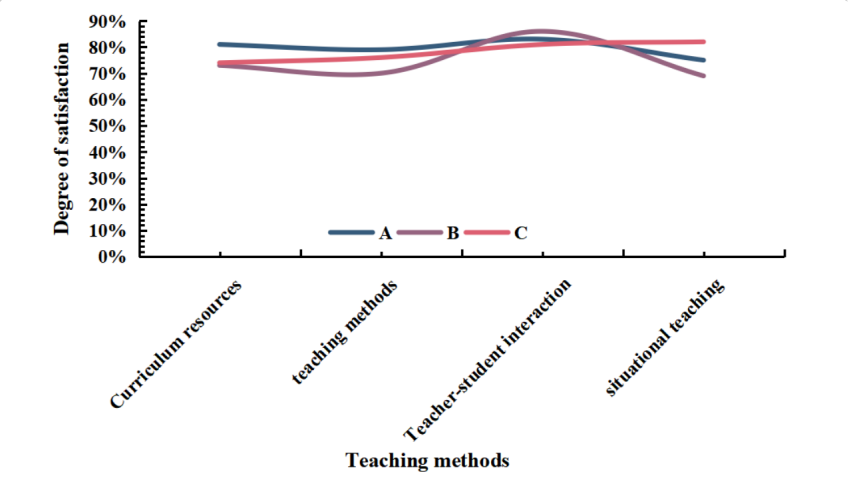

FIGURE 5 . Students' satisfaction with the new computer intelligent ET teaching

of the new computer intelligent ET, accounting for the majority. Among them, School A is 81% satisfied with the curriculum resources and 79% satisfied with the teaching methods. The satisfaction of teacher-student interaction was 83%, and the satisfaction of situational teaching was 75%. School B is 73% satisfied with curriculum resources, 70% with teaching methods, 86% with teacher-student interaction, and 69% with situational teaching. School C is 74% satisfied with curriculum resources, 76% satisfied with teaching methods, 81% satisfied with teacher-student interaction, and 82% satisfied with situational teaching. According to the survey, the new computer intelligence ET teaching has played an effective role in improving various factors in ET teaching, and the addition of computer intelligence has driven students' enthusiasm for learning more. In order to test whether the new computer intelligent ET teaching can improve the students' ET ability, the students in the three colleges mentioned above are investigated to

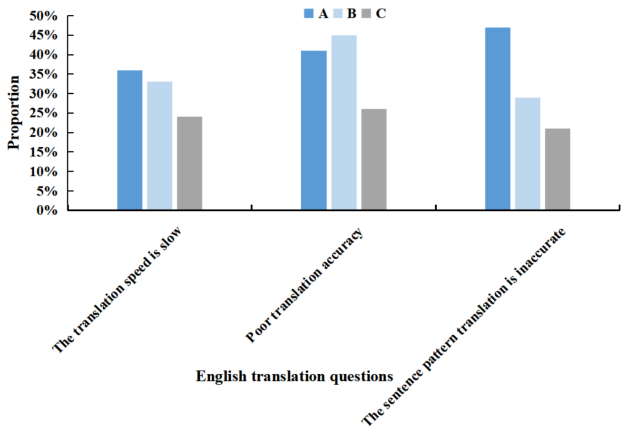

FIGURE 6. Can the new computer intelligent ET teaching improve students' ET ability

check whether the problems, such as slow translation speed, poor translation accuracy, and inaccurate sentence pattern translation in students' ET have decreased, as shown in Figure 6 .

It can be seen from the Figure 6 that the new computer intelligent ET teaching has played a great role in improving students' ET ability. The proportion of students in School A who are slow in translating English has decreased by 32%; the proportion of poor translation accuracy has decreased by 30%; and the proportion of inaccurate sentence translation has decreased by 30%. In ET, the proportion of students in School B who translated slowly decreased by 43%; the proportion of poor translation accuracy decreased by 36%; and the proportion of inaccurate sentence translation decreased by 40%. The proportion of students in School C who translated slowly in English decreased by 35%; the proportion of poor translation accuracy decreased by 27%; and the proportion of inaccurate sentence translation decreased by 28%. With the change of teaching mode, students' interest in ET has become stronger and stronger, and students' autonomous learning ability has been gradually strengthened.

To measure the improvement in translation accuracy, all 300 students completed a standardized translation test before and after one semester of instruction using the new teaching method. The test consisted of twenty English sentences of moderate complexity. Each sentence contained three key elements that required accurate translation: a technical noun, a verb tense, and a prepositional phrase. Translation accuracy for a sentence was defined as the correct translation of all three key elements. A student's overall accuracy score was the percentage of the twenty sentences in which all three key elements were correctly translated. Table 4 presents the mean accuracy scores for each university before and after the intervention.

TABLE 4. Mean translation accuracy scores before and after one semester of computer intelligent teaching

University	Number of Students	Mean Accuracy Score Before Intervention (%)	Mean Accuracy Score After Intervention (%)	Improvement Percentage (%)
A	100	52.3	85.7	33.4
B	100	48.6	82.4	33.8
C	100	50.1	83.2	33.1
Average	300	50.3	83.8	33.5

Table 4 shows an average improvement of 33.5 percentage points in translation accuracy across 300 students from three universities. This consistent improvement demonstrates a positive association between the implementation of the computer intelligent teaching method and higher student test scores. The improvement originates from the SOFM neural network algorithm described. The algorithm processes multimodal data from the embedded system. This processing generates real-time feedback on student engagement. Instructors receive color coded alerts when attention levels decline. Instructors then adjust classroom activities immediately. This closed loop feedback mechanism provides immediate instructional adjustments. The mechanism is absent in traditional teaching environments where instructors cannot access real time engagement data. The observed accuracy gains therefore reflect the introduction of this real time adaptive feedback system. The data does not isolate the teaching method from all other variables due to the absence of a control group. The consistency of the improvement across three diverse universities nevertheless supports the role of the proposed method in raising translation accuracy.

VII. CONCLUSION

With the development of the Internet, ET teaching inevitably adopts new tools and technologies. ET is not to cultivate academic talents, but to cultivate technical personnel. Under the Internet environment, students can obtain high-quality textbooks and better understand the teaching content through computer intelligence, and teachers play a leading and supporting role in it. How to further optimize the learning effect and maximize the role of computers in the field of learning also needs time to solve. As internationalization progresses, international exchanges and cooperation have become increasingly close, bringing unprecedented opportunities to the development of the translation market including ET teaching. A good translator should not only have good translation skills, but also have new translation skills, and more effectively complete the translation task.

ETHICS AND INFORMED CONSENT

This study has been approved by the Ethics Committee of Xinyang University.

AUTHOR CONTRIBUTIONS

Work concept or design-Rui Li

CONFLICTS OF INTEREST

All author declares that they have no conflicts of interest.

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