Curriculum and Teaching Methodology (2023)
Clausius Scientific Press, Canada

DOI: 10.23977/curtm.2023.060906
ISSN 2616-2261 Vol. 6 Num. 9

Cultivation Strategy of Business English Cross-cultural Communication Ability Based on Fuzzy PID Algorithm

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Keywords: Fuzzy PID Algorithm, Business English, Cross-cultural Communication Skills, Training Strategy

Abstract: In today's era, with the acceleration of the globalization process, China, as one of the WTO members, has increasingly close contacts with other countries in the world. In international communication, intercultural communicative competence is a very important ability. This means that China needs a large number of professionals in the field of Business English with strong cross-cultural communication skills. The main training channel for Business English cross-cultural communication talents comes from the Business English cross-cultural communication teaching in various colleges and universities. This brings certain challenges to Business English teaching. In the common Business English classes of colleges, more attention is generally paid to the learning of grammar and vocabulary, while the awareness of the cultivation of cross-cultural communication skills needs to be improved. Therefore, Business English education should keep up with the development trend, and put forward and apply appropriate Business English cross-cultural communication skills training strategies to improve the education of cross-cultural communication skills of Business English. The purpose of this paper is to explore the strategy of cultivating Business English cross-cultural communicative competence based on fuzzy PID algorithm. Therefore, based on fuzzy PID algorithm, this article designs a new educational method of Business English cross-cultural communicative competence, and conducts the application experiment of this teaching method. The experimental results show that the situational teaching plan of Business English intercultural communicative competence based on fuzzy PID algorithm has a good effect on improving the intercultural communicative competence of Business English majors. It resulted in a total of 16 points improvement in the average score of Business English intercultural communication among the selected 40 students.

1. Introduction

Cross-cultural communication in Business English refers to the fact that Chinese and foreign interlocutors with cultural background differences all use the same language for oral communication in specific business and activity communication situations. In today's era of accelerated global economic integration and increasingly close exchanges between countries, intercultural communication skills are an indispensable and important ability for people of all

countries. For China, the increasing frequency of international exchanges with foreign countries, especially the increasing frequency of cross-border exchanges in economics, has created a greater demand for cross-cultural communication talents in Business English. This also makes Business English education in colleges face more challenges. Colleges are important bases for cultivating Business English cross-cultural communication talents. The traditional Business English education in colleges and universities generally focuses on the knowledge teaching and ability training of students' English grammar, syntax and vocabulary, while the training of students' Business English cross-cultural communication skills is still insufficient. Therefore, Business English education in colleges and universities urgently needs to make changes to fit to the trend and keep pace with the development of the times. That is to enhance students' awareness of Business English cross-cultural communication, and to cultivate students' Business English cross-cultural communication ability. However, the cultivation of cross-cultural communicative competence in Business English in China today needs to break through the bottleneck of cultivation strategies. With the innovation progress of science and technology, the research on the cultivation strategies of Business English cross-cultural communication ability also provides some help. For example, fuzzy PID algorithm is an intelligent algorithm that uses fuzzy set theory to realize the adjustment and control of specific controlled objects. This paper mainly based on the fuzzy PID algorithm to study the cultivation strategy of Business English cross-cultural communication ability.

The innovations of this paper are: (1) Based on fuzzy PID algorithm, it discusses the cross-cultural communication ability training strategy of Business English education in colleges and universities; (2) It designs a multimedia situational teaching method for Business English cross-cultural communication based on fuzzy PID algorithm. And the effectiveness of the teaching method is proved by experiments.

2. Related Work

In recent years, there have been many researches related to fuzzy PID algorithm in academia. Among them, Mahto T's research proposed a novel fuzzy logic control scheme based on fuzzy PID algorithm for frequency and power control of isolated hybrid power system and two-zone power system based on HPS [1]. Kuantama E's research is based on the fuzzy PID algorithm to analyze the data analysis of the dynamic attitude of the quadcopter on the circular trajectory. It mainly conducts data modeling analysis through traditional proportional-integral-derivative and fuzzy PID algorithms [2]. Liu F's research proposed a fuzzy PID control scheme for the azimuth and elevation loop tracking controllers based on the fuzzy PID algorithm. It is verified by simulation experiments that the control scheme can improve the tracking accuracy of real-time targets [3]. Kosari A's research proposed a controller scheme for the docking maneuver of two spacecraft based on the fuzzy PID algorithm. And the application results of this scheme show that it has efficient performance in the orientation stage of chasing spacecraft [4]. Through his research, Gu J designed a set of intelligent control system based on fuzzy PID algorithm and genetic algorithm for the control of various environmental protection requirements of winery boilers. The application results show that the system can achieve better environmental protection effect [5]. Natsheh E mainly studied the application of fuzzy PID algorithm in improving the efficiency of industrial process. He proposed an improved version of the PID fuzzy logic controller. It uses this controller during experiments to eliminate unnecessary user-defined parameters set for the algorithm to run [6].

Although the above researches are related to the fuzzy PID algorithm and can provide some relevant information of the fuzzy PID algorithm for the research of this paper, the process of these researches is relatively complicated, and the practicability of the research is not strong enough.

3. Methods of Cultivating Cross-cultural Communication Competence in Business English

3.1. Business English

Business English is English specially used in business activities. The content of Business English involves not only English learning, but also the study of knowledge related to business activities. Business English teaching in colleges and universities is based on improving students' English level and then teaching them business knowledge, teaching them how to communicate and cooperate fluently with foreigners in future foreign-related business activities [7]. Nowadays, China's foreign economic exchanges and cooperation are becoming more and more frequent, and there are more and more foreign-related business activities. This is very much in need of Business English talents. Therefore, Business English education in colleges plays an vital role in realizing the barrier-free communication and exchange of China's foreign business activities, and also in promoting China's economic improvement [8-9].

Business English has the following characteristics:

Purpose: In the study and application of Business English, the purpose of the study and application of Business English and related business knowledge is higher than the study of English language itself.

Sociality: Business English is socialized, and the study and application of Business English will help people to establish a good social business relationship.

The logic of communication: The expression of Business English should strive to be logical, and at the same time, it should be as clear and concise as possible [10-11].

3.2. Intercultural Communication in Business English

Cross-cultural communication in Business English refers to the foreign economic and cultural communications and exchanges that China will involve in foreign business and trade exchanges. Nowadays, China's political, economic and cultural influence in the world is increasing, and its business ties and exchanges with other countries are getting closer and closer. That is, in foreign business and trade activities, Chinese people need to communicate with people from different parts of the world and people who use languages other than Chinese. This also means that in Business English, people will consciously or unconsciously carry out cross-cultural communication. To sum up, in the context of today's era, cross-cultural communication in Business English plays an important role in promoting China's cross-border exchanges and cooperation with other countries and promoting China's foreign economic development [12]

3.3. Fuzzy PID Algorithm

The basic idea of fuzzy PID algorithm is to use fuzzy set theory to quantify and transform it into a mathematically implementable controller to control a specific controlled object [13]. Fuzzy PID control includes several important components such as parameter fuzzification, fuzzy rule reasoning, parameter defuzzification, and PID controller. The composition principle of the fuzzy PID algorithm is shown in Figure 1:

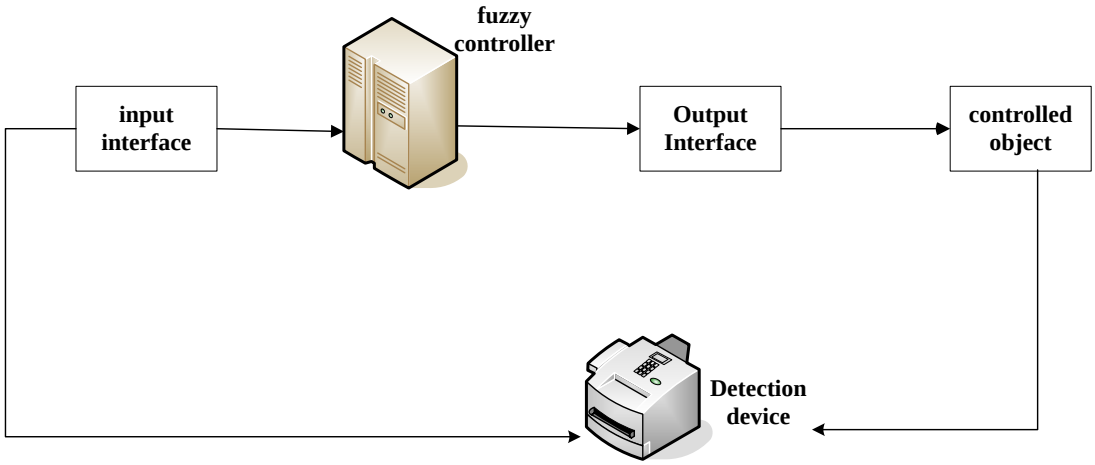


Figure 1: Composition principle of fuzzy PID algorithm

(1) PID module design

When writing the Verilog code of the fuzzy PID controller, the digital PID control algorithm can be divided into the positional PID algorithm and the incremental PID algorithm [14-15]. The calculation formula of the duty cycle in the position-type PID is as follows:

$$d(t) = k_p e(t) + k_i \sum_t^e dt + k_p \tag{1}$$

In the formula, d(t) represents the output duty cycle signal of the controller. e(t) is the input error signal of the controller. That is, the reference voltage minus the output power. k_p is the proportional gain coefficient of the controller. k_i is the integral gain coefficient of the controller [16-17]. The above formula can also be expressed in the following form:

$$d(t) = k_p[e(t)dt + T_i \frac{de(t)}{dt} \tag{2}$$

Combining the above formula, the discrete time T is used to replace the continuous time t, the full addition operation is used to replace the integral operation, and the incremental operation per unit time is used to replace the differential operation, it can get:

$$\frac{de(t)}{dt} = \sum_{T=o}^{n} e(T)n - 1 \tag{3}$$

Then the calculation formula of the duty cycle after discretization is as follows:

$$d(n) = k_p e(n) + k_i \sum_{T=1}^{n} eT \tag{4}$$

In the above formula, n is the sampling number, and e(n) is the error voltage sampled for the nth time. e(n-1) is the error voltage sampled at the n-1th time. It can be seen from the above formula that in order to obtain the duty cycle signal of the nth cycle, the error summation of the first n-1 samplings must be performed first. Therefore, this position-based PID algorithm has a relatively large disadvantage. The current sampling output duty cycle signal d(n) is related to all previous error states, and accumulating and summing all previous error states e(t) results in an increase in the amount of computation. In addition, errors in the calculation process will also cause the final result to deviate greatly through accumulation [18]. It incorporates the period T into the coefficients to obtain a new sum of k and k_p, as follows:

$$d(n) = k_p e(n) + k_I \sum_{t=1}^{i=n} e(t) + K_D[e(n-1) - e(n-2)] \tag{5}$$

Then the duty ratio at the previous moment is as follows:

$$d(n-1) = k_p e(n-1) + k_i \sum_{t=1}^{T=n=1} e(t) \quad (6)$$

The duty cycle conversion is as follows:

$$\Delta d = k_p[e(n-1) + K_i e(n) + k_D[e(n) - 2e(n-1)] \quad (7)$$

That is:

$$\Delta d = (k_p + k_i + k_D)e(n) - (k_p + 2K_D)e(n-1) \quad (8)$$

Then the incremental PID can be obtained, as shown in the following formula:

$$\Delta d = e(n) - e(n-1) + e(n-2) \quad (9)$$

The output of the incremental PID control algorithm is the increment Δd of the duty cycle control signal, which is the increment of the current duty cycle signal and the previous moment's duty cycle signal, not the actual amount of the current duty cycle signal. Therefore, the controller must have the accumulation operation of the increment of the duty cycle signal in order to obtain the current duty cycle signal output of the controller [19]. Because k_p, k_I, k_D may appear as decimals, the decimal operation is introduced in the PID code design, and the RTL-level circuit module of the PID module is shown in Figure 2.

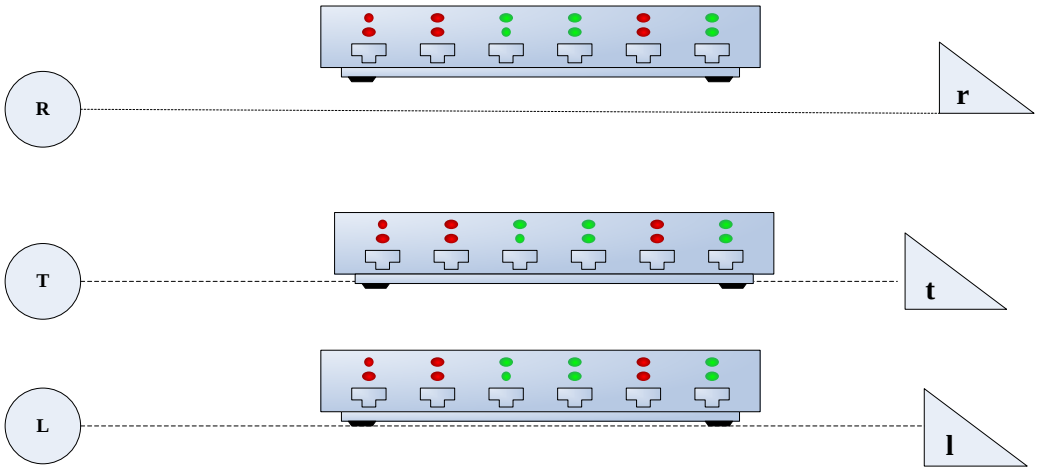


Figure 2: RTL-level circuit block of the PID block

(2) The establishment of fuzzy rules

The function of fuzzy rules is to establish the relationship between input and output. There are two main forms of fuzzy rules. One of the forms is: if the input is X, the output is y. Here X is the blurring quantity, and the output y is the actual output quantity, which does not need to be de-fuzzified. This shows that this form of fuzzy rules is based on a summary of the results obtained from multiple actual measurements. And the second fuzzy rule form is: if the input is X, the output is Y. Both input and output are fuzzy quantities, and of course input and output can be multiple variables. The fuzzy rule used here is: if E and F, then G. Its implication relationship is:

$$R(E, F, G) = E(e) \cap F(f) \cap G(g) \quad (10)$$

And if there are n fuzzy rules, the total fuzzy relationship is:

$$R = E_1 \cup E_2 \cup E_3 \quad (11)$$

That is:

$$R_n = \cup_{i=1}^{n} R_i \tag{12}$$

Finally, according to the approximate inference synthesis rule, the fuzzy output of the output is obtained as:

$$C \cup R = C \cup_{j=1}^{n} R_j \tag{13}$$

Clarification, on the other hand, is mainly used for output. There are many ways to clarify. It can be assumed that the membership function of a fuzzy set A on a universe is A(u), where u belongs to U. Then, assuming that the abscissa of the area's center of gravity is a, the following formula can be used to calculate:

$$a = \frac{\int A(u) u d_u}{\int A(u) d} \tag{14}$$

If the domain of discourse is discrete, the above formula can be expressed as:

$$a = \frac{\sum_{i=1}^{n} A(u_i)}{\sum_{j=1}^{n} A(u_j)} \tag{15}$$

In this way, the sharpening of the blur amount is achieved. A fuzzy PID structure used in this paper is shown in Figure 3:

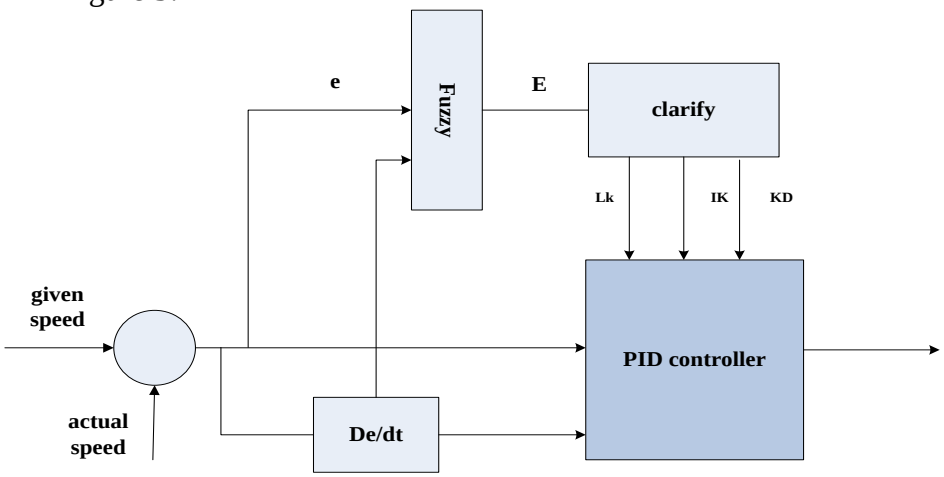


Figure 3: Fuzzy PID structure

According to the response curve of the general system in the previous section, two input variables are used, namely the rotational speed deviation o and the deviation change oc. The output variables are the changes $\Delta Lk, \Delta Ik$ and ΔKD of the PID coefficients. If $Lk_{0,} IK_{0,} KD_0$ is the initial value, the three coefficients of PID can be calculated according to the following formula:

$$\begin{cases} LK = LK_o + \Delta LK \\ IK = Ik_0 + \Delta IK \\ KD = KD_0 + \Delta KD \end{cases} \tag{16}$$

Among them, the fuzzy control rules of ΔLk are shown in Table 1:

Table 1: Fuzzy Control Rules of ΔLK

ΔLK	KB	KM	KS	PL
KB	AB	AB	PL	KM
KM	AB	PL	AB	KS
KS	KM	AB	PL	KM
PL	KS	KB	PL	KS

The fuzzy control rules of ΔIk are shown in Table 2:

Table 2: Fuzzy Control Rules of ΔIK

ΔIK	AB	LM	LS	PM
AB	PB	PB	LM	LM
LM	PB	LS	PB	LS
LS	LM	PB	LM	LM
PM	LS	PB	LN	LS

Then select the fuzzy universe and fuzzy subset according to the range of input and output. It makes its input quantum domain all [-n,n]. The output domain is [-m, m], and the fuzzy subsets are {AB, PM, PN, LS, PM, PB}. Then map the actual input and output to the universe of discourse [20].

The whole process of fuzzy PID algorithm can be shown in Figure 4:

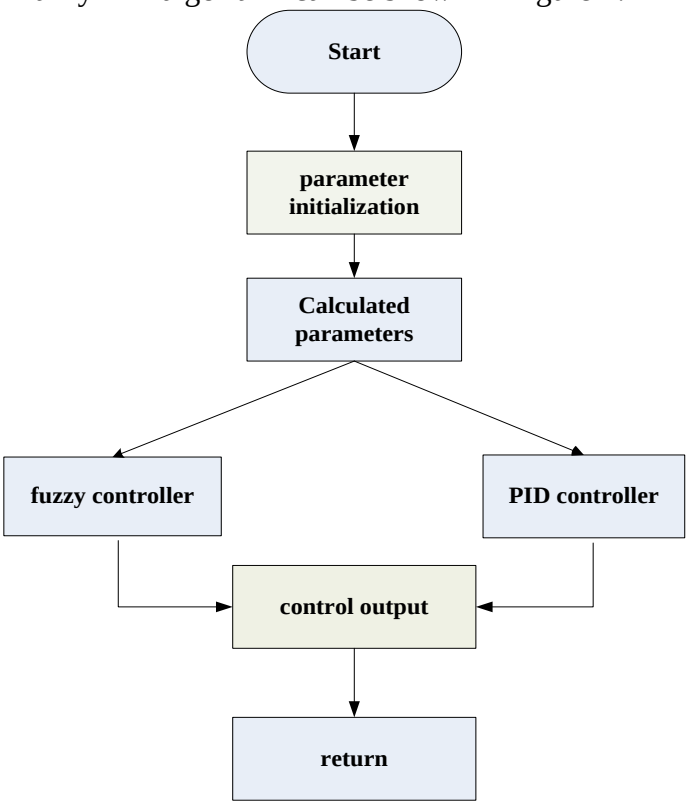


Figure 4: Fuzzy PID algorithm flow

4. Experiment on the Development of Business English Cross-cultural Communication Ability

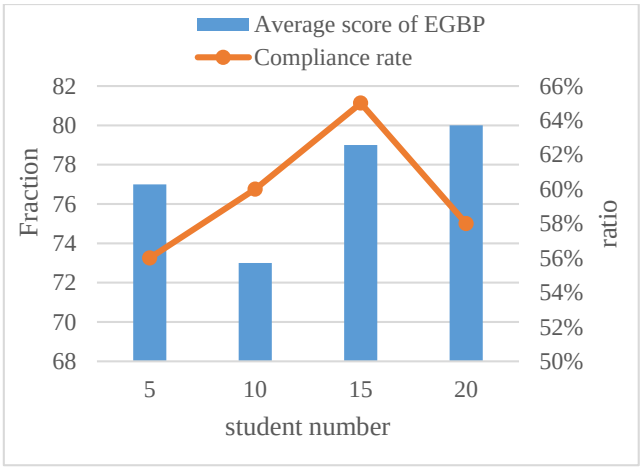
4.1. Experimental Design

In order to formulate appropriate strategies for cultivating students' cross-cultural communicative competence through Business English education in universities, it is an important prerequisite to have an understanding of the level of Business English inter-cultural communication of business English majors. Therefore, this experiment mainly consists of two main parts. The first part is to test the business English intercultural communication competence level of Business English majors. The Business English Intercultural Communication Competency Test consists of two parts: the EGBP test and the ESBP test. The full score for both tests is 100. The second part is to design a

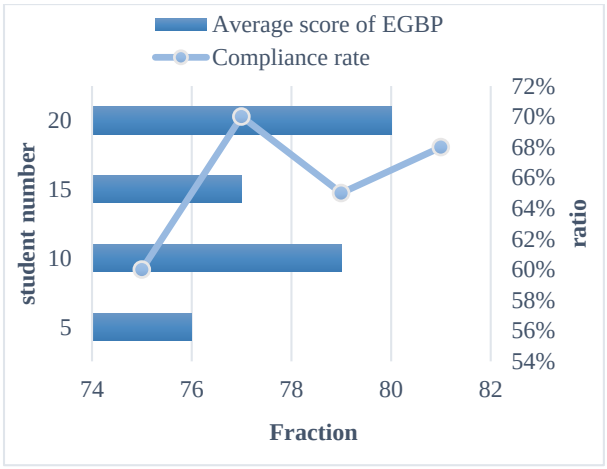
multimedia situational teaching method of Business English cross-cultural communication based on fuzzy PID algorithm, and test whether the level of students' Business English cross-cultural communication ability has been improved based on this teaching method. According to the test results, the effectiveness of the teaching method based on the fuzzy PID algorithm is judged. Finally, according to the experimental results, it summarizes the beneficial teaching strategies for improving the cross-cultural communication ability of Business English majors.

4.2. Intercultural Communication Competence Test for Business English Majors

First of all, the experimental subjects selected in this paper are students from two Business English major classes in a university in Shanxi Province, hereinafter referred to as Class 1 and Class 2. There are 20 students in each class, with a total of 40 students in both classes. First, EGBP test and ESBP test are carried out on the students of these two classes, and the actual situation of the students' Business English intercultural communication ability level can be grasped through the test results. The EGBP and ESBP test results for students in these two classes are shown in Figures 5 and 6:

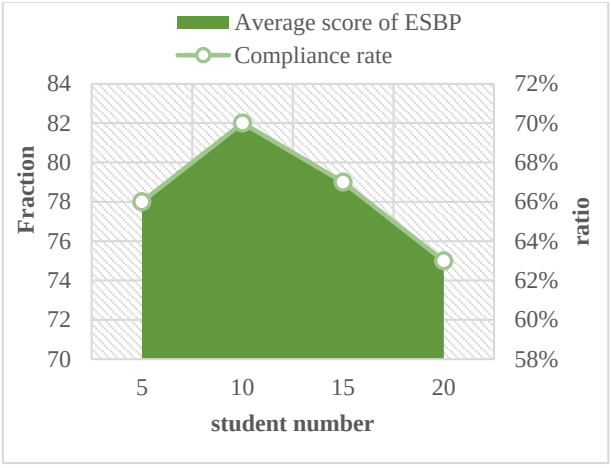


A. EGBP score of class 1

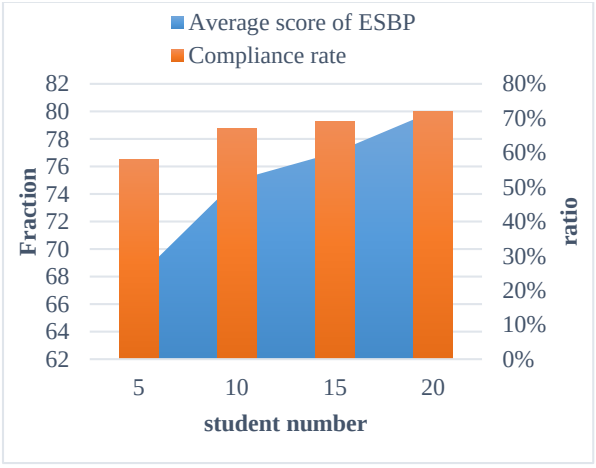


B. EGBP score of class 2

Figure 5: EGBP achievement test results for students in classes 1 and 2



C. ESBP score of class 1



D. ESBP score of class 2

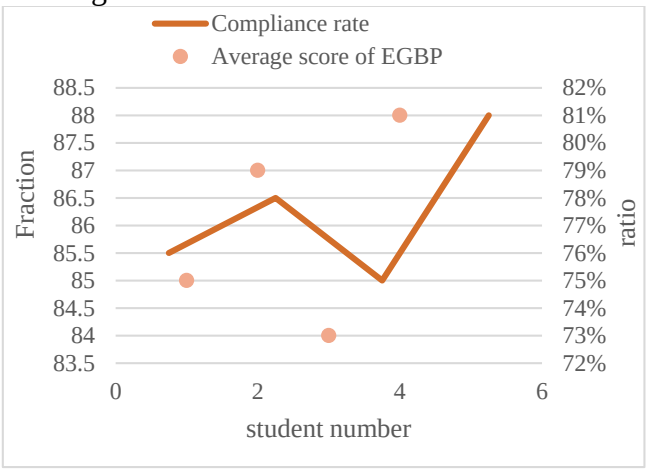
Figure 6: ESBP achievement test results for students in classes 1 and 2

Combining Figure 5 and Figure 6, it can be concluded that the average score of the EGBP score of Class 1 is about 74 points, and the average score of the ESBP score is about 80 points. The average score of EGBP in Class 2 is around 78, and the average score of ESBP is around 77. From this, it can be seen that the level of Business English intercultural communication ability of the students in Class 1 and Class 2 of the Business English major of the school is generally above the average level. Among them, the overall level of students in class 2 is slightly higher than that in class 1.

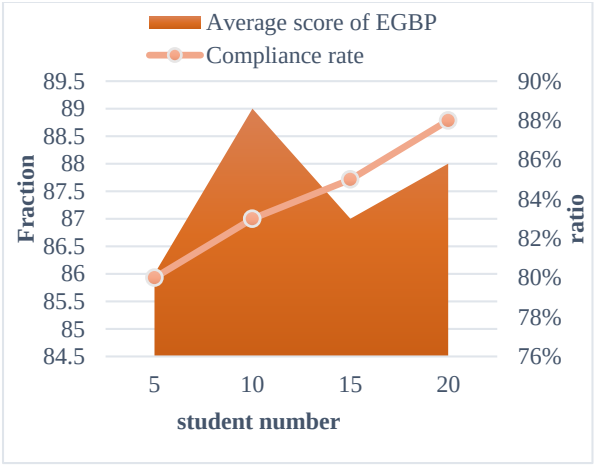
4.3. Situational Teaching of Business English Cross-cultural Communication Based on Fuzzy PID Algorithm

Through the above tests, the students in the two classes have mastered the actual level of Business English intercultural communication ability. In order to find out the main influencing factors that affect the students' Business English intercultural communicative competence in these two classes, this experiment also conducted random interviews with the students in these two classes. The main content of the interview is what factors the students think affect their Business English intercultural communication level. After the interview, it was found that most of the students believed that the main influencing factor was the teaching method. After in-depth understanding, it is found that the existing Business English cross-cultural communication teaching methods are relatively boring and cannot enhance students' interest in Business English cross-cultural communication. Therefore, in order to enhance the Business English students' interest in cross-cultural communication, this experiment designed a multimedia situational teaching method of Business English cross-cultural communication based on the fuzzy PID algorithm. This teaching method is obtained after appropriate adjustment and control of the input related teaching requirements through fuzzy PID algorithm. Compared with the traditional teaching method, the multimedia nature of this teaching method is more prominent.

In order to judge whether the teaching method is effective, the last step of this experiment will be carried out. It uses this teaching method to conduct Business English intercultural communication teaching for students in Class 1 and Class 2, and conducts EGBP test and ESBP test for students in these two classes again after 3 months of teaching. According to the test results, it can be intuitively judged whether the teaching method based on the fuzzy PID algorithm is effective. After the teaching, the EGBP and ESBP test results of all students in Class 1 and Class 2 are shown in Figure 7 and Figure 8:

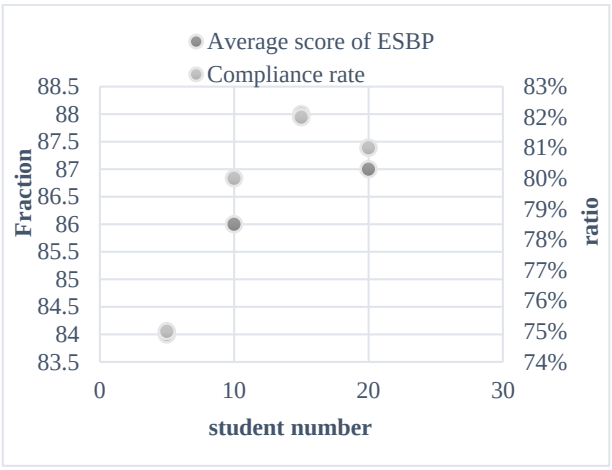


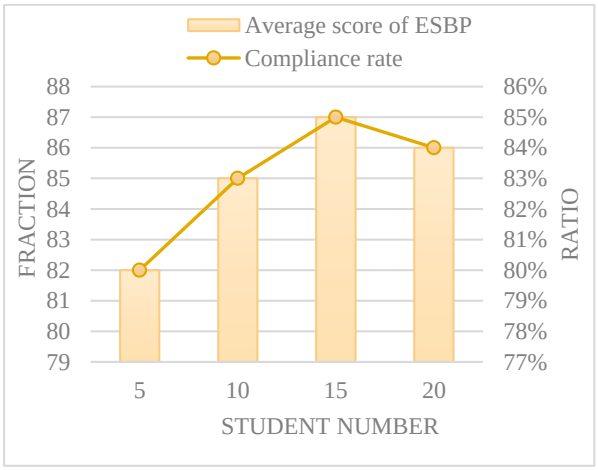
1. EGBP test scores in class 1 after teaching



2. EGBP test scores in class 2 after teaching

Figure 7: EGBP test results for classes 1 and 2 after teaching





1. ESBP score of class 1 after teaching 2. ESBP score of class 2 after teaching

Figure 8: ESBP test results for classes 1 and 2 after teaching

Combining Figures 7 and 8, it can be concluded that after using the multimedia situational teaching method based on the fuzzy PID algorithm for 3 months of teaching, the average score of the EGBP score of Class 1 has increased from the original 74 points to about 85 points. The average ESBP score has increased from the original 80 points to about 86 points. The average score of the EGBP score of Class 2 has increased from 78 points to about 84 points. The average ESBP score has increased from 77 points to 85 points. Therefore, it can be calculated that based on this teaching method, the average score of Business English cross-cultural communication of 40 students in Class 1 and Class 2 has increased by 16 points. It can be seen that the level of Business English intercultural communication ability of the students in Class 1 and Class 2 of the school's Business English major has been improved from the original middle-upper level to the excellent level. The whole experiment is over. It can be judged that the multimedia situational teaching plan of Business English cross-cultural communication based on fuzzy PID algorithm has a significant effect on improving the cross-cultural communication ability of Business English majors.

5. Discussion

With the increasing frequency of China's foreign economic and trade exchanges, the significance of Business English cross-cultural communication is more obvious. China has always been in great need of Bbusiness English cross-cultural communication talents, which is of course inseparable from the cultivation of cross-cultural communication skills of their Business English majors by colleges. However, for the cultivation of Business English cross-regional cultural communication ability, colleges and universities must put forward reasonable strategies and methods and implement them, so as to cultivate more Business English cross-cultural communication talents for China.

This paper mainly studies the Business English cross-cultural communicative competence strategy based on fuzzy PID algorithm. In order to achieve the research purpose, this paper designs a new multimedia educating scheme of Business English cross-cultural communication depended on fuzzy PID algorithm, and conducts the application experiment of the scheme. Experiments have shown that the teaching plan has obvious effect on improving the Business English intercultural communication ability of Business English majors in colleges and universities. It improves the selected students' Business English intercultural communication ability to a certain extent.

The experimental results can provide some references for the cultivation strategies of Business English cross-cultural communicative competence. It shows from the side that the cultivation of Business English intercultural communication ability should start with improving learners' interest

in intercultural communication. Then it is necessary to formulate effective teaching strategies to better improve learners' Business English intercultural communication skills.

6. Conclusions

Intercultural communication competence in Business English is a very important competence in the context of today's accelerated global economic integration. The cultivation of this ability needs to be based on correct and appropriate cultivation strategies. This paper researches about the guideline strategies of Business English cross-cultural communication ability and draws the conclusion that the multimedia situational teaching method of Business English cross-cultural communication based on fuzzy PID algorithm has played a certain role in improving Business English cross-cultural communication ability. The research conclusions of this paper fully illustrate that the primary entry point for the development of Business English cross-cultural communicative ability should be: focus on enhancing learners' interest in cross-cultural communication. On the basis of this entry point, with appropriate teaching strategies, a better training effect can be achieved. However, due to the limited research level and conditions, the research in this paper is not perfect, and there are also some shortcomings. It is hoped that it can be improved in future research, so as to contribute more to the development of strategies for fostering cross-cultural communicative ability in Business English.

Acknowledgements

Instructional Reform on Innovative and Experimental English Course for International Communication (J2021393); Construction of Assessment Framework for Innovative and Experimental Foreign Language Courses (PJ-21070); the Practical Exploration of Curriculum Design and Construction of Innovative and Experimental English Course (SXSKL2021SX0063).

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