

# *Emotional Linkage among Teacher-Student in English Multimedia Smart Classroom Teaching in the Internet of Things Big Data Era*

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**Abstract:** At this stage, multimedia has been increasingly widely used in college English education with the advantages of rich content, convenient updating and various forms, providing rich and novel resources for college English teaching. However, compared with the traditional classroom, the multimedia smart classroom relatively reduces the linkage between teachers and students, making it difficult to form emotional linkage between teachers and students in the classroom teaching situation, which seriously affects the teaching effect. In view of this situation, this paper studied the English multimedia smart classroom in the era of Internet of Things big data and the emotional linkage between teachers and students in classroom teaching. This paper conducted experiments and analysed on the emotional linkage between teachers and students from five aspects: students' learning enthusiasm, learning efficiency, academic level, teachers and students' extra-classroom linkage, and teachers' satisfaction. The experimental results showed that under the condition of active emotional linkage between teachers and students, students' English learning enthusiasm has increased by 6.76%, students' English academic level has increased by 4.08%, and students' satisfaction with teachers has increased by 4.92%. Positive emotional linkage between teachers and students can effectively improve students' English learning enthusiasm and English learning performance, and can increase students' recognition of teachers.

## **1. Introduction**

With the development of educational information technology, modern English teaching activities are gradually changing from traditional blackboard mode to multimedia teaching mode, and multimedia technology is widely used in practical teaching. Teachers can use multimedia technology to provide students with rich teaching resources, so as to achieve the purpose of improving teaching effect. There are also problems with the multimedia teaching mode, which makes the teacher-student relationship seem indifferent and alienated in classroom teaching. Positive teacher-student linkage is conducive to cultivating a positive learning emotional attitude, which is of great significance for improving students' interest in learning and stimulating students'

creative potential.

Teacher-student emotional linkage is a key indicator to improve teaching efficiency, and many scholars have conducted research on it. Liu Y studied the role of teacher-student emotional linkage in the teaching effect of English flipped classroom, and concluded that teacher-student emotional linkage can improve students' autonomy [1]. Sanni has proved through experiments that positive emotional linkage mode can improve students' foreign language learning enthusiasm and learning effect [2]. Liu L studied the influence of teacher-student linkage on college students' participation in online learning, and concluded that a good teacher-student linkage model can increase college students' emotional investment and behavioral investment in online learning [3]. Li W X studied the interactive behavior in the English multimodal teaching classroom, and put forward some specific measures to strengthen emotional linkage [4]. Huston S conducted research on conventional teaching and smart teaching, and came to the conclusion that smart teaching based on emotional linkage can improve the efficiency of English teaching [5]. Wang C H conducted research on teacher-student emotional linkage in online learning [6]. Hu X discussed the problems and causes of teacher-student relationship in English smarter classroom teaching [7]. There are many studies on the emotional linkage between teachers and students, but there are few theories that study the emotional linkage between teachers and students based on the big data of the Internet of Things.

As an advanced technology, IoT big data has played an important role in the field of education. Zhang Y used big data technology to build a big data teaching platform applied to classroom teaching and classroom teaching evaluation [8]. Yong F analyzed the influencing factors of vocal music classroom teaching, and used the big data analysis platform to improve the effect of vocal music classroom teaching [9]. Jiao J H used the big data of the Internet of Things to analyze the theoretical curriculum of physical education, which provided a reference value for the theoretical research of physical education [10]. Wang S used the big data analysis of the Internet of Things to study the application of film and television teaching in teaching theory courses [11]. Ding J discussed the construction of smart campus based on cloud computing and the Internet of Things, and proposed a smart campus construction plan based on big data [12]. Mahmood S studied the application of IoT big data in English teaching and established a learning management system applied to English teaching [13]. Cheng L explored the role of IoT big data in education [14]. There are many applications of IoT big data in the field of education, but it has not been specifically applied to the research on the emotional linkage between teachers and students.

In order to solve the problem of teacher-student emotional linkage in English multimedia smart classroom, this paper studied the English multimedia smart classroom, the essential characteristics of teacher-student emotional linkage, and the theoretical basis for constructing emotional linkage. This paper proposed a positive emotion-oriented teacher-student linkage measure to improve the teaching effect and improve the comprehensive quality of students.

## **2. English Multimedia Smart Classroom in the Internet of Things Big Data Era**

As shown in Figure 1, the English multimedia smart classroom teaching activities in the era of IoT big data include three contents: before class, during class and after class.

The pre-class content includes accepting pre-class tasks, self-preparation and making study plans. Students need to accept the teacher's pre-class tasks to understand the teaching requirements of the learning chapters, and then select appropriate learning resources from the big data learning platform according to their specific learning conditions. After completing the self-prepared exercises, people can develop a personalized learning plan according to their own learning ability and learning progress. Lessons include immersive situations, collaborative inquiry, in-class testing, and real-time critiques. English learning in the context of immersion teaching can increase students' sensory

experience. Students cooperate and answer questions in the collision and communication between groups. The big data learning platform automatically collects student test results, and actively completes test correction, statistics and analysis. After-school content includes assessments, personalized instruction and feedback. Students evaluate smarter classrooms, including their evaluations of teachers and themselves. Students turn to teachers for personalized guidance and assistance. Teachers organize and provide feedback on students' classroom performance and academic level data [15].

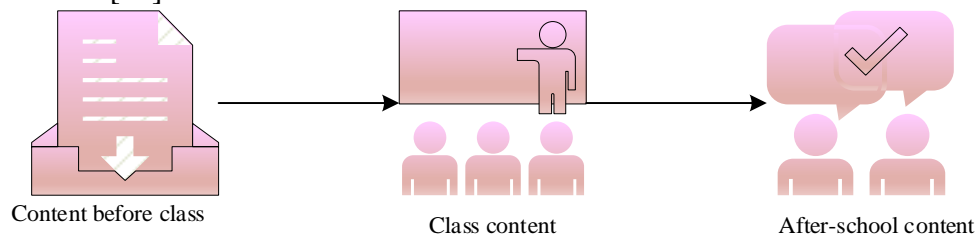


Figure 1: English Multimedia Smarter Classroom

### 3. Teacher-Student Emotional Linkage in Smarter Classroom Teaching

#### (1) Characteristics of emotional linkage between teachers and students

Teacher-student emotion mainly refers to the emotion related to teaching activities. As shown in Figure 2, the emotions of teachers and students have five remarkable characteristics: synchronicity, dominance, effectiveness, performance, and dynamics.

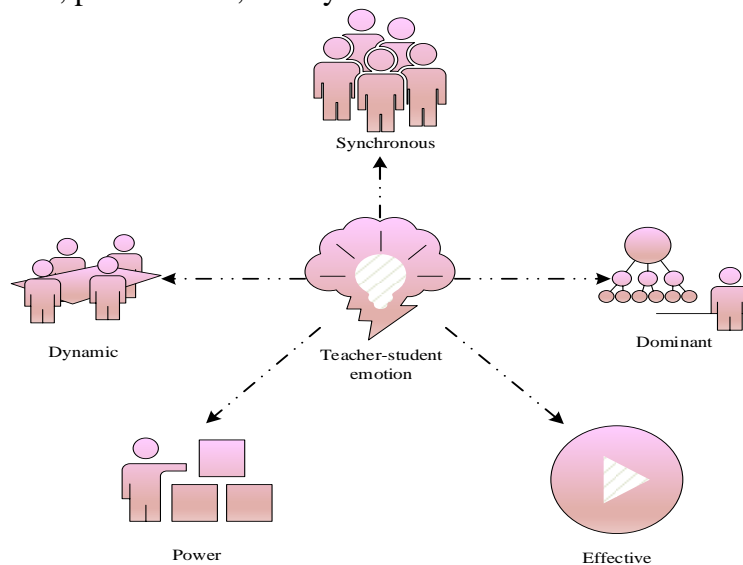


Figure 2: Characteristics of teacher-student emotional linkage

The synchronicity of teachers and students' emotions refers to the fact that teachers' emotions and students' emotions are often consistent. In the actual smart classroom situation, the emotional performance of students is similar to that of teachers. The dominance of teacher-student emotion is reflected in that teacher plays a leading role in emotional linkage, and teacher is the organizer and guide of emotional linkage in teacher-student smart classroom teaching. Effectiveness means that a positive and effective emotional linkage can improve the confrontational relationship in the classroom and establish a closer and friendly classroom relationship. Dynamic means that emotional linkage is affected by many factors such as students' personality and teacher's linkage level, and has dynamic characteristics [16].

## (2) Theoretical basis for constructing emotional linkage

By querying relevant literature, this paper summarizes the theoretical basis for constructing emotional linkage, as shown in Figure 3. The theoretical basis includes four contents: teaching nature, emotion theory and sociology, teaching optimization theory, and basic teaching requirements.

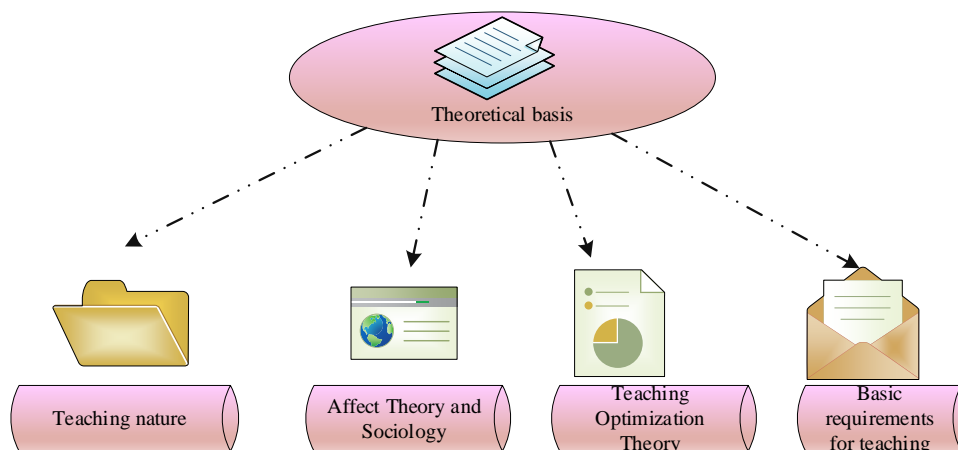


Figure 3: Theoretical basis for constructing emotional linkages

### 1) The nature of teaching

Based on the nature of teaching, the teaching process should be a process of combining emotion and knowledge. Learning includes not only cognitive aspects of knowledge and skills, but also emotional aspects [17]. Emotion and cognition have the characteristics of mutual influence. If students have a positive emotional attitude towards English learning, their English academic level would rise significantly. This shows that in classroom learning, emotional factors should be considered to promote the effect of teaching and learning. In actual teaching activities, some teachers only pay attention to teaching content and do not pay attention to emotional linkage, which makes the teaching atmosphere dull, cannot provide students with a good learning environment, and also affects the teaching effect. In the era of big data of the Internet of Things, teachers can not only pay attention to the role of educational technology in classroom teaching, but also pay attention to the role of teachers and students' emotions. In English multimedia smart classroom teaching, teaching managers cannot simply think that teaching activities are only a way for students to acquire knowledge.

### 2) Affect Theory and Sociology

In actual classroom teaching, due to the lack of necessary emotional linkage between teachers and students, the phenomenon of "teacher speaking on stage and students sleeping off stage" may occur. Emotion theory believes that teachers' emotional attention and expectations for students would stimulate students' learning motivation and improve students' enthusiasm [18]. Therefore, teachers should pay attention to emotional communication with students and realize that the teaching process is essentially a process of linkage between teachers and students.

### 3) Teaching Optimization Theory

From the perspective of the main body of emotional linkage, the one-way influence of teachers on students would eventually be transformed into multi-directional linkages between teachers, students and information. From the perspective of interactive information, compared with classroom teaching lacking emotional linkage, classroom teaching with emotional linkage can better promote the improvement of students' comprehensive qualities such as knowledge, emotion, and will [19].

### 4) Basic requirements for teaching

The modern teaching system puts forward the requirements of creative learning for students, and the realization of this requirement requires a good learning atmosphere. Positive teacher-student emotional linkage is an effective way to achieve a good classroom learning atmosphere. Therefore, in classroom teaching, teachers should actively guide students to participate in the emotional linkage between teachers and students, and cultivate students' creative learning ability [20].

#### 4. Measures for Constructing Teacher-student Linkage with Positive Emotion Orientation

No matter how advanced multimedia equipment is, it cannot replace the role of harmonious teacher-student relationship. In classroom teaching, the role of educational technology should be brought into play, and the importance of emotional linkage should be recognized. This paper proposes measures to construct emotional linkage. As shown in Figure 4, it mainly includes four contents.

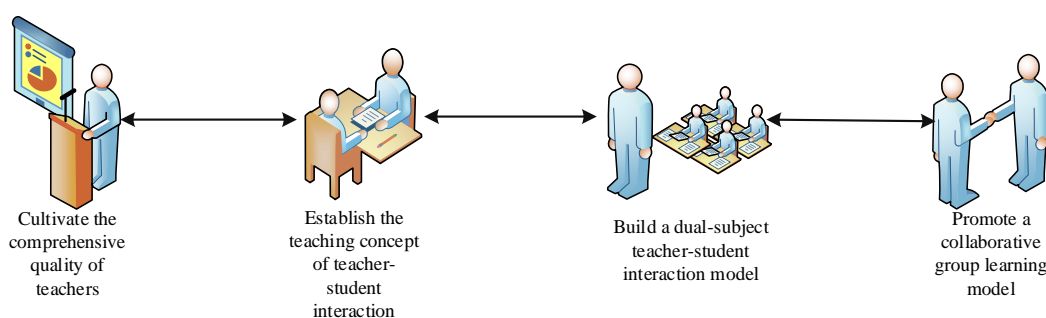


Figure 4: Measures for constructing positive emotion-oriented teacher-student linkages

##### (1) Cultivate the comprehensive quality of teachers

The development of emotional linkage work is more dependent on teachers' personal ability and quality, and higher comprehensive quality can lay a good foundation for the effect of emotional linkage between teachers and students. Therefore, teachers need to strengthen their own theoretical level and practical ability. For students, teachers with high moral character and strong teaching ability are trustworthy, which is conducive to promoting the emotional linkage between teachers and students. Students would increase their emotional investment in learning in classroom teaching, and their learning initiative and learning efficiency would be significantly improved.

##### (2) Establish a teaching concept based on teacher-student linkage

Compared with conventional classroom teaching, multimedia smart classroom teaching has obvious advantages, but if teachers cannot use multimedia resources correctly, they would not be able to achieve good teaching effects. Therefore, on the one hand, teachers should get rid of excessive dependence on multimedia courseware to prevent the occurrence of reduced teacher-student linkage and student learning initiative. On the other hand, people should express their inner concern for students and show their loving attitude towards students. Appropriate methods can be used to guide students to participate in the teaching process, guide students to actively participate in classroom discussions, and encourage students to actively answer questions.

##### (3) Build a dual-discipline teacher-student linkage model

In the multimedia smart classroom teaching, teachers cannot only interact with teachers and students in the form of question and answer. Of course, the question and answer form is also meaningful, but question and answer also has limitations, and it cannot increase the atmosphere of linkage and mutual assistance between students. In contrast, the form of group learning can better meet the requirements of teacher-student linkage. In the process of multimedia smart classroom teaching, teaching administrators should make it clear that the purpose of establishing

teacher-student linkage is to improve the comprehensive quality of students, and should promote the establishment of classroom emotional linkage.

(4) Promote the cooperative group learning model

Cooperative learning in small groups is an important means of achieving effective linkage. Promoting the cooperative group learning mode is conducive to improving students' autonomous learning ability, and students have the ability to collect and organize materials by themselves when they are studying. This behavior can increase their research and analytical skills. The cooperative group learning mode can increase students' self-confidence in learning. When students encounter difficulties and anxiety, peers can find them in time and provide psychological counseling, which can help students build self-confidence. The cooperative group learning mode can also enhance students' team awareness and cultivate students' collaborative learning ability. In the cooperative group learning mode, students can choose tasks that suit their abilities, which can increase their initiative and enthusiasm for learning. In the process of group cooperative learning, students are prone to have a competitive mentality, which would improve the motivation of English learning. In addition, students need to undertake learning tasks in the cooperative group learning mode, which would also enhance their English learning motivation. In a word, in the process of cooperative and autonomous learning, the knowledge learned by the learners would be more stable, and the linkage between teachers and students would be more meaningful.

## 5. EEG Features and Feature Extraction

This paper studies the feature extraction of EEG signals to effectively analyze the emotions of students, so as to improve the level of emotional linkage between teachers and students.

(1) Entropy features in the time domain features of EEG signals

Set the original signal to be  $\chi$  and its length to be  $J$ , then:

$$\chi_p = \{\chi_1, \chi_2, \dots, \chi_j\} \quad (1)$$

Let  $i$  be the embedding dimension, the reconstruction vector is defined as:

$$\chi(p) = [\chi_p, \chi_{p+1}, \dots, \chi_{p+i+1}] \quad (2)$$

Define  $e_{pq}$  as the maximum value of the absolute value of the interpolation of the corresponding elements of  $\chi_p$  and  $\chi_q$ , then there are:

$$e_{pq} = e[\chi(p), \chi(q)] = \max[|\chi(p+c) - \chi(q+c)|] \quad (3)$$

Count the number of  $e_{pq}$  less than the similar tolerance, and calculate the ratio of this number to  $j-i-1$ , namely:

$$\beta_p^i(u) = \frac{1}{J-i} \{e_{pq} < u\} \quad (4)$$

Among them,  $p \in [1, J-i+1], p \neq q$ .

The sample entropy is defined as:

$$SE(i, u, J) = \ln \beta_p^i(u) - \ln \beta_p^{i+1}(u) \quad (5)$$

Differential entropy is generally defined as:

$$L(\alpha) = -\sum_{a \in \alpha} h(a) \log h(a) \quad (6)$$

Among them,  $a$  is a random variable obeying a Gaussian distribution, and its probability density function is:

$$f(a) = \frac{1}{\sqrt{2\pi\rho^2}} \varepsilon^{-\frac{(a-\nu)^2}{2\rho^2}} \quad (7)$$

Therefore, differential entropy can be defined as:

$$l(\alpha) = -\int_{\alpha} f(a) \log f(a) e a \quad (8)$$

(2) Frequency domain characteristics of EEG signals

The average power of the EEG signal is:

$$H = \lim_{S \rightarrow \infty} \frac{1}{S} \int_{-S/2}^{S/2} f(s)^2 e s = \frac{1}{2\pi} \int_{-\infty}^{\infty} \lim_{S \rightarrow \infty} \frac{|F_s(\mu)|^2}{s} e \mu f(s)^2 e s \quad (9)$$

The power spectral density function of  $f(s)$  is:

$$H(\mu) = \lim_{S \rightarrow \infty} \frac{|F_s(\mu)|^2}{2\pi s} \quad (10)$$

The energy definition formula of EEG signal is:

$$m = \int_{-\infty}^{\infty} T(s)^2 e s \quad (11)$$

Fourier transform is performed on  $t(s)$ , and the definition formula of energy is:

$$m = \int_{-\infty}^{\infty} T(s)^2 e s = \int_{-\infty}^{\infty} |T(\mu)|^2 e \mu \quad (12)$$

$|T(\mu)|^2$  is the energy spectral density.

(3) Time-domain characteristics of EEG signals

The discrete wavelet transform is applied to feature extraction, which is defined as:

$$dwt(q, c) = \int_{-\infty}^{\infty} a(s) \frac{1}{\sqrt{2^q}} v\left(\frac{s-2^q c}{2^q}\right) e s \quad (13)$$

For the known EEG signal  $\gamma(s)$ , its wavelet decomposition coefficient is:

$$\gamma(s) = \int_{-\infty}^{\infty} \alpha(c) \gamma_c(s) + \sum_{q=0}^{\infty} \sum_{c=-\infty}^{\infty} E(q, c) \gamma_{q,c}(s) \quad (14)$$

The overall wavelet entropy of the EEG signal is:

$$F(\alpha) = -\sum_q \rho_q \gamma_c \log \rho_{q,c} \quad (15)$$

Among them,  $\rho_{q,c}$  is the normalized wavelet energy, and the formula of the wavelet energy is:

$$\rho_{q,c} = \frac{F_q}{F_s} \quad (16)$$

EEG feature extraction based on graph theory:

The calculation formula of the EEG signal correlation matrix is:

$$K(p, q) = \frac{1}{H} \sum_{s=0}^{H-1} \gamma_s^{p^s} \gamma_s^q \quad (17)$$

Linearly transform the EEG signal matrix to obtain the estimator of the relationship between each group of EEG signals:

$$T = (\log(\lambda_1 + \lambda_2) - \Pi) / (\log(\lambda_1 + \lambda_2) - \Pi_{\min}) \quad (18)$$

The formula for dividing the brain functional area modules by the clustering coefficient is:

$$D = \frac{1}{J} \frac{\sum_{p,q} \chi_{pq} \chi_{pc} \chi_{qc}}{c_c (c_c - 1)} \quad (19)$$

The generalized module function can optimize the partitioning scheme of EEG, which is defined as:

$$J = \frac{1}{2S} \sum_{p,q \leq J} \left[ v_{pq} - \frac{s_p s_q}{2s} \right] g(k_p, k_q) \quad (20)$$

## 6. Experimental Results of Emotional Linkage between Teachers and Students

Form two classes using multimedia smart classroom for teaching activities, each class has 25 students, and these 25 students have similar English learning results. Among them, one class actively engages in the emotional linkage between teachers and students in the English multimedia teaching activities, and this class is called E class. Another class maintains regular English multimedia teaching activities and does not carry out emotional linkage between teachers and students. This class is called Class C. The experiment conducted a 6-week experimental study on Class E and Class C from five aspects: students' learning enthusiasm, learning efficiency, academic level, teacher-student linkage outside the classroom, and teacher satisfaction. In this paper, the experimental results are observed and analyzed after the experiment is over.

### (1) Students' enthusiasm for learning English

Students' learning enthusiasm is one of the important factors affecting their academic level. This paper analyzes and makes statistics on the learning enthusiasm of E and C classes. The index of learning enthusiasm ranges from 1 to 100. The results are shown in Figure 5.

It can be seen from Figure 5 that the weekly learning enthusiasm index of class E students is greater than that of class C students. The learning enthusiasm index of class E students in the first week was 87.29, and the learning enthusiasm index of class C students in the first week was 84.63. The learning enthusiasm index of class E students in the first week is 2.66 higher than that of class C students in the first week. It can be seen that positive teacher-student emotional linkage can have an impact on students' learning enthusiasm. This impact was reflected in the first week of teaching. The learning enthusiasm index of class E students in the sixth week is 93.35, and the learning enthusiasm index of class C students in the sixth week is 85.69, the gap between the two is obvious. The average learning enthusiasm index of class E students is 90.66, and the average learning enthusiasm index of class C students is 84.92. The average learning enthusiasm index of class E students is 5.74 higher than that of class C students, and the improvement ratio is 6.76%. It shows that effective teacher-student emotional linkage can improve students' learning enthusiasm.



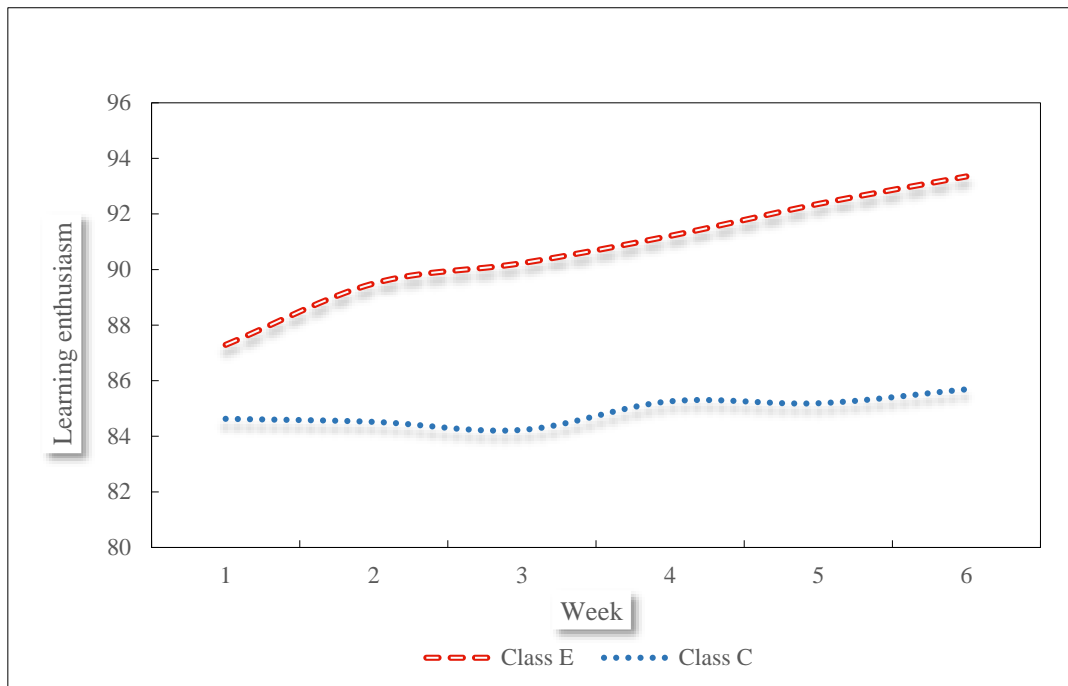


Figure 5: Students' English learning enthusiasm

(2) Students' English learning efficiency

Learning efficiency is a key factor affecting academic performance. This paper records the learning efficiency index of students in class E and class C. The index of learning efficiency ranges from 1 to 100. The results are shown in Figure 6.

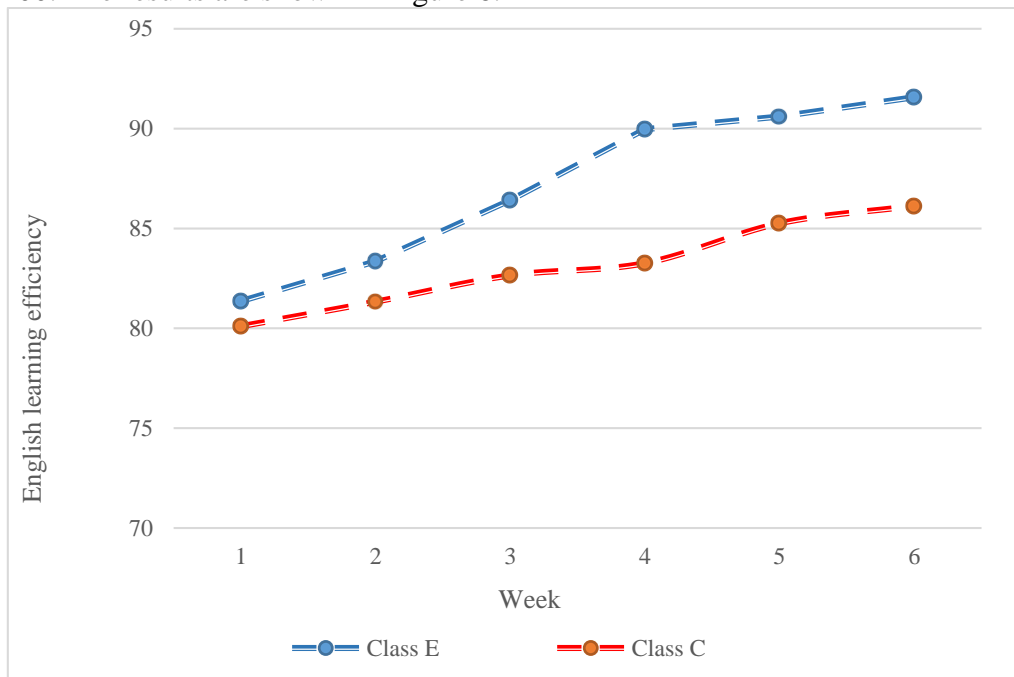


Figure 6: Students' English learning efficiency

It can be seen from Figure 6 that the English learning efficiency index of class E students in the first week is 81.36, and the English learning efficiency index of students in class C in the first week is 80.1. It shows that the emotional linkage between teachers and students plays an obvious role in

improving students' learning efficiency, which is reflected in the first week. The English learning efficiency index of the students in the E class in the sixth week is 91.57, and the English learning efficiency index of the students in the C class in the sixth week is 86.13. The English learning efficiency index of class E students in the sixth week is 5.44 higher than that of class C students in the sixth week. The average weekly English learning efficiency index of E class students is 87.21. The average English learning efficiency index of class C students is 83.12, the difference between the two is 4.09.

(3) Students' English academic level

The English academic level of students can reflect the effectiveness of the emotional linkage between teachers and students. The academic performance of students in class E and class C is shown in Figure 7.

As can be seen from Figure 7, from an overall point of view, the English learning performance of students in class E has improved significantly. From the specific results, the English academic performance of class E students was 87.5 in the first week and 92.31 in the sixth week. The English learning performance of the students in the E class in the sixth week has improved significantly compared with the English learning performance in the first week. The English academic performance of the students of Class C was 85.32 in the first week and 88.26 in the sixth week, and there was not much difference between the two. The average English learning score of E class students is 90.24, and the average English learning score of C class students is 86.7. The average English learning performance of class E students is 3.54 higher than that of class C students, and the improvement ratio is 4.08%.

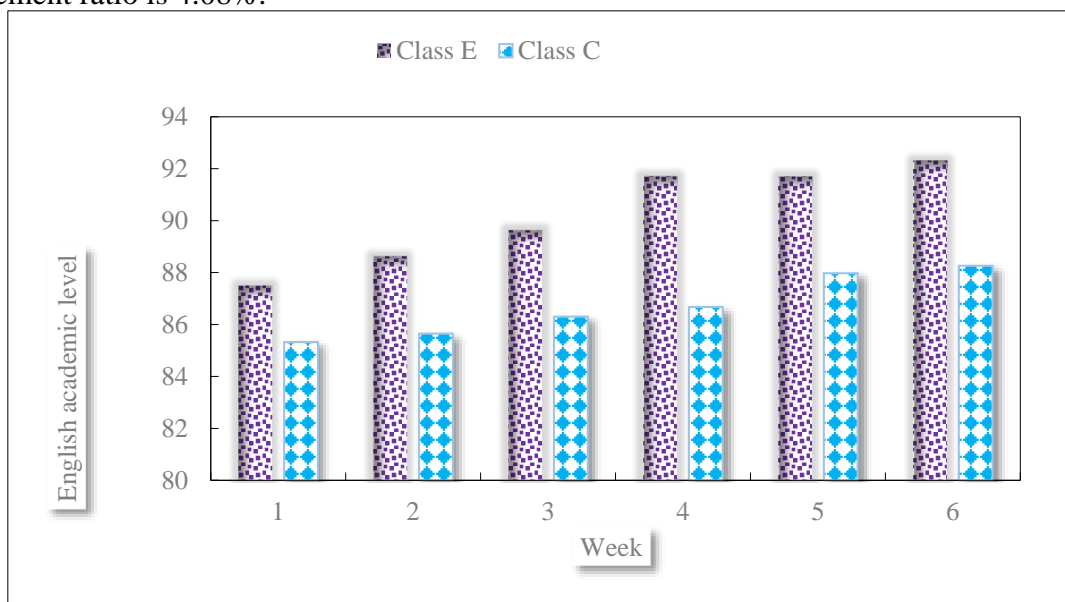


Figure 7: Students' English academic level

(4) Interaction between teachers and students outside the classroom

The experiment investigated the extra-classroom linkage of students in class E and class C, and analyzed the impact of students' emotional linkage on students' mental health. The results are shown in Figure 8.

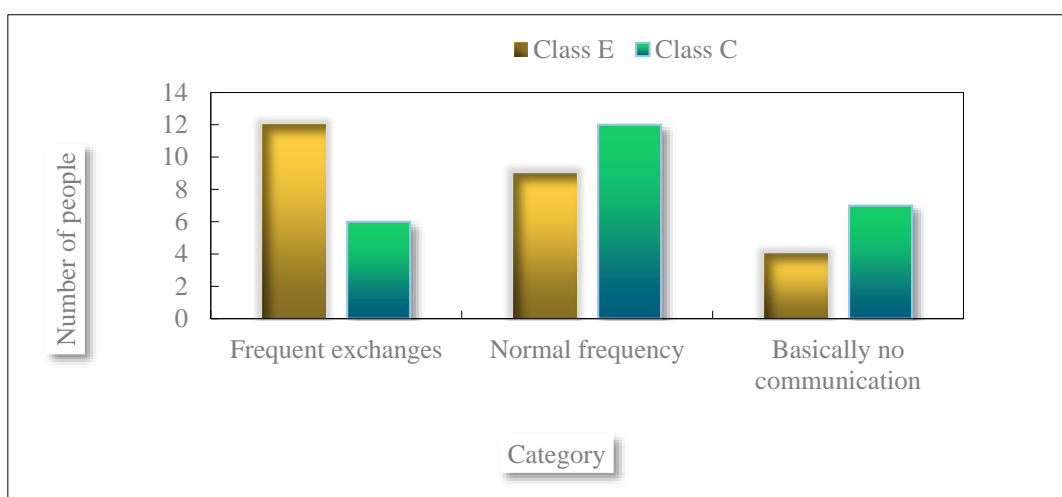


Figure 8: Interaction between teachers and students outside the classroom

As can be seen from Figure 8, in terms of linkage outside the classroom, there are 12 students in class E who frequently interact with teachers outside the classroom. There are 9 students whose frequency of linkage outside the classroom is at an average level, and 4 students basically do not interact with teachers outside the classroom. There are 6 students in Class C who frequently interact with teachers outside the classroom, 12 students whose frequency of linkage outside the classroom is at an average level, and 7 students basically do not interact with teachers outside the classroom. This situation shows that the positive emotion-oriented teacher-student linkage in the classroom situation is beneficial to the linkage between teachers and students outside the classroom.

#### (5) Students' satisfaction with teachers

Experiments were conducted to investigate the satisfaction of students in class E and class C with teachers, and the results were recorded and sorted to obtain data on students' satisfaction with teachers, as shown in Table 1.

Table 1: Student satisfaction with teachers

	Class E	Class C
1	83.53	78.77
2	84.16	80.43
3	85.3	81.65
4	87.42	83.59
5	89.15	85.75
6	92.83	87.76

It can be seen from Table 1 that from the first week to the sixth week, the satisfaction of students in class E is always higher than that of students in class C, indicating that positive teacher-student emotional linkage increases students' recognition of teachers. The satisfaction of the students of class E in the first week is 83.53, the satisfaction of students of class C is 78.77 in the first week, the satisfaction of the students of class E in the first week is 4.76 higher than that of the students of class C in the first week. The satisfaction rate of students in class E was 92.83 in the sixth week, and the satisfaction rate of students in class C was 87.76 in the sixth week. In the sixth week, the satisfaction of class E students was 5.07 higher than that of class C students. The average satisfaction of students in class E is 87.07, and the average satisfaction of students in class C is 82.99. The average satisfaction of students in class E increased by 4.08 compared to the average satisfaction of students in class C, and the ratio of improvement was 4.92%. It shows that positive emotional linkage between teachers and students can increase students' recognition of teachers, and

students can recognize teachers more, which is conducive to the improvement of teaching effect.

## 7. Conclusion

Faced with this situation, this paper proposed some measures to strengthen emotional connection, and through experiments, it has been proved that positive teacher-student emotional linkage can improve students' learning efficiency, students' academic level, and students' recognition of teachers. In the case of active emotional linkage in the classroom, the linkage between teachers and students outside the classroom also increased significantly.

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