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Analysis of Classroom Interaction Efficacy of English Teachers in Higher Education and Modeling Research Based on Multiple Regression

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ABSTRACT
Teacher-student interaction, as the most important way of classroom interaction, its level directly affects the quality of classroom teaching. The study selected three English listening classes, three English reading and writing classes, and three English exercise classes, totaling nine English classes in a university for video recording. With the help of the Improved Flanders Interaction Analysis System (iFIAS), the study utilized classroom observation and multiple regression analysis to investigate the effectiveness of teacher-student interactions in the classroom and their influencing factors. It was found that the average value of students' classroom discourse ratio (40.3%) was smaller than the average value of teachers' classroom discourse ratio (48.1%), and that a reasonable structure of teacher-student language ratio was more conducive to the formation of benign interactions in the classroom and the enhancement of the overall classroom effectiveness. In addition, teaching ability, learning style, learning motivation and classroom environment all positively affect the effectiveness of English teachers' classroom interaction in colleges and universities. Therefore, it is necessary to start from these four aspects to adjust the language ratio structure, create a positive classroom atmosphere, and enhance the integration of information technology and the classroom.

Keywords: iFIAS system, classroom observation method, discourse ratio, multiple regression analysis, classroom interaction effectiveness

1. Introduction

Classroom interaction is the most common and efficient way of teaching English. It is the process of teacher-student and student-student interaction that occurs to facilitate students' comprehension of input, correction of output, and thus language acquisition [1-3].

Teaching efficacy refers to a teacher's beliefs and confidence in his/her ability to organize and implement a particular teaching action, as well as a teacher's subjective judgment of his/her ability to influence students' learning behaviors and academic performance, and includes both general teaching

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efficacy and personal teaching efficacy [4-7]. The former refers to teachers' perceptions of the value of education, their general views and judgments about the role of education in students' development, and their knowledge and evaluation of the relationship between teaching and learning. The latter refers to teachers' evaluation of whether they have the skills and techniques to teach students well and whether they are able to change students' learning abilities. And assessing the classroom interaction efficacy of English teachers is of great significance to teachers' understanding of their own teaching efficacy, mainly because they can optimize the classroom interaction mode according to the assessment results for better teaching. However, the factors affecting teachers' teaching effectiveness are multifaceted. To summarize, the external factors are: socio-cultural background, school characteristics, the relationship between teachers and students, interpersonal relationships among teachers, teaching age, and educational factors [8-10]. Internal factors are: experience of success or failure in teaching, indirect experience of teachers, verbal persuasion, physical and emotional state [11-13]. Among them, subjective factors are the key to influence teachers' teaching efficacy, such as teachers' values and self-concept. Teachers' teaching efficacy affects teachers' teaching behaviors, which also affects students' motivation and makes differences in teaching effectiveness [14-15]. Teachers with high self-efficacy are more committed and attentive to instructional activities in the classroom, and teaching efficacy is related to teachers' beliefs about student control, satisfaction with their profession, and superior administrators' evaluations of teacher competence. Teacher teaching efficacy also affects the ability to monitor instruction [16]. Teachers with low levels of efficacy tend to adopt punitive management strategies to monitor the classroom, whereas teachers with high levels of efficacy adopt democratic management strategies and encourage student self-discipline. Teachers' teaching efficacy is developmental, and their efficacy beliefs are malleable, cultivable, and can be trained, regulated, controlled, and improved through certain methods [17].

The degree of classroom teacher-student interaction is an important influence on students' academic performance. Therefore, assessing English teachers' classroom interaction efficacy helps teachers to better improve their own teaching, which in turn promotes students' interest and ability to learn English.

Based on the iFIAS analysis system, this study utilizes the classroom observation method and the ratio analysis method in the iFIAS analysis system to carry out classroom observation of nine regular classes of English listening and speaking, reading and writing, and exercise classes in a university. In order to collect the data and organize, count and analyze them, the current situation and characteristics of teacher-student verbal interaction in English classrooms in colleges and universities are explored based on the iFIAS analysis system. Then semi-structured interviews were conducted with teachers, students and school administrators who influence the verbal interaction between teachers and students in college English classrooms to find the factors affecting the interaction between teachers and students in secondary English classrooms, and regression analysis model was used to analyze in-depth the effects of classroom interaction efficacy affecting English teachers in colleges and universities.

2. Overview

Teacher efficacy is a concern not only for students and parents but also for school administrators. Literature [18] concludes that teacher efficacy is not correlated or even negatively correlated with teachers' intelligence test scores, and is slightly positively correlated with cognitive abilities including high school entrance exam scores and basic skills test scores. Whereas, literature [19] showed that teacher self-efficacy was positively correlated with teacher efficacy in the three areas of classroom knowledge transfer, teacher-student interaction, and motivation of students to learn, and that cooperation between teachers and school leaders also had a positive impact on teacher self-efficacy. In addition, classroom he optimal teaching is also a positive influence on teacher self-efficacy [20]. Most of the teachers as the dominant party in English classroom interaction, the quality of classroom

interaction is influenced by teachers' empathy [21], classroom politeness [22], and interactional fairness [23]. And the assessment and analysis of classroom interaction efficacy in teacher teaching effectiveness plays a crucial role in improving the quality of interactive teaching in English classrooms. Therefore, there is a need to understand the relationship between English teachers' classroom interaction efficacy and classroom quality, teachers' self- and personal teaching efficacy, and students' attitudes toward interaction in order to improve efficacy and promote students' English proficiency. For this purpose, multiple regression can analyze the interrelationship between a dependent variable and multiple independent variables [24]. Literature [25], for example, used multiple regression analysis to analyze the effectiveness of a course with more than ten variable factors such as teachers, students, and course management, and the results showed that teachers' knowledge level, teaching style, students' attitudes, and students' pre-preparation were related to the effectiveness of the course. And as mentioned before, teachers' classroom interactive teaching effectiveness is affected by many factors, but there is a difference between light and heavy, to understand the correlation between these influencing factors and interactive effectiveness, teachers can target interactive classroom teaching adjustments in order to improve teaching quality and students' English learning efficiency.

3. Research design

3.1. Subjects of study

In this study, the third-year English classroom students and teachers of a university in Shanghai were selected as the research objects. The textbook used in the class is College English, Second Edition, published by Higher Education Press. In order to carefully analyze the interaction between teachers and students in English classrooms in colleges and universities, this study selected three lessons each of listening and speaking, reading and writing, and exercises, for a total of nine lessons as the object of the study, and the length of each lesson is about 45 minutes.

3.2. Research methodology

3.2.1. Classroom observation method. Classroom observation method is the most common research method for classroom research. Based on certain research purposes - that is, to investigate and discover the current situation of teacher-student verbal interaction in English classrooms in colleges and universities, to find out the differences between teacher-student verbal interaction in different types of courses, to analyze the shortcomings of teacher-student verbal interaction in English classrooms in colleges and universities at present, and to put forward suggestions and ways to improve the results found. In order to record specific and real classroom teaching teacher-student verbal interaction, this study will videotape a third-year English classroom in a college in Shanghai, and then classroom observation and coding of the classroom video. The objects and contents of observation were selected from nine English classes in a vocational high school in Hohhot City, and the video recording of English classroom teaching was conducted. After the recording was completed, the recorded video was observed according to the requirements of iFIAS, the coding form was filled in, the video data was obtained every three seconds as an index of observation, and the iFIAS coding system was used to generate the matrix analysis chart and the dynamic folding analysis chart, and to analyze the data in terms of ratio and Matrix analysis.

3.2.2. Multiple regression analysis:

1) Multiple linear regression model. The multiple linear regression model contains an independent variable and a dependent variable, which is also known as the explanatory variable, i.e., a univariate linear regression model is established in which the dependent variable is about the independent variable, which represents a linear explanation of the dependent variable by the independent variable [26]. When the number of independent variables is greater than or equal to two, the model established

is called a multiple linear regression model. The representation of the multiple linear regression model can be seen as a generalization of the univariate linear regression model, which is generally represented as:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_m x_m + \varepsilon \tag{1}$$

Where, y is the dependent variable, $x_1, x_2, \cdots, x_m$ is the independent variable, $\beta_0, \beta_1, \beta_2, \cdots, \beta_m$ is the regression coefficient and ε is the random error of the model. Obviously, from equation (1), the model is a univariate linear regression model when $\beta_2 = \beta_3 = \cdots = \beta_m = 0$.

In practice, assuming that there are n sets of observations, in which the number of independent variables is m, then the multiple linear regression model (1) can be expressed as:

$$\begin{cases} y_1 = \beta_0 + \beta_1 x_{11} + \beta_2 x_{12} + \cdots \beta_m x_{1m} + \varepsilon_1 \\ y_2 = \beta_0 + \beta_1 x_{21} + \beta_2 x_{22} + \cdots \beta_m x_{2m} + \varepsilon_2 \\ \cdots\cdots \\ y_n = \beta_0 + \beta_1 x_{n1} + \beta_2 x_{n2} + \cdots \beta_m x_{nm} + \varepsilon_n \end{cases} \tag{2}$$

Eq. (2) can be further written in the form of a matrix as follows:

$$y = X\beta + \varepsilon \tag{3}$$

Eq.

$$y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}, X = \begin{bmatrix} 1 & x_{11} & \cdots & x_{1m} \\ 1 & x_{21} & \cdots & x_{2m} \\ \vdots & \vdots & & \vdots \\ 1 & x & \cdots & x_{nm} \end{bmatrix}, \beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_m \end{bmatrix}, \varepsilon = \begin{bmatrix} \varepsilon_0 \\ \varepsilon_1 \\ \vdots \\ \varepsilon_n \end{bmatrix} \tag{4}$$

2) Parameter estimation of multiple linear regression models. A key issue in multiple linear regression models is to calculate the estimates of the regression coefficients obtained. Similar to the parameter estimation method of the same linear regression model, the parameter estimates of the commonly used multiple linear regression models are also least squares. In the multiple linear regression model, the model requires the assumption that there is no complete covariance between the independent variables, and in practice, although there is usually an approximate covariance problem between the independent variables, this does not violate the basic assumptions of the multiple linear regression model [27]. Therefore, the least squares method is still the best linear unbiased estimation method, and this subsection focuses on the basic principles of the least squares method.

For the set of multiple linear regression equations represented in equation (2), parameter $\beta_0, \beta_1, \beta_2, \cdots, \beta_m$ is estimated by least squares to find an estimate of parameter $\beta_0, \beta_1, \beta_2, \cdots, \beta_m$, $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \cdots, \hat{\beta}_m$, such that the sum of squares of the deviations of the model from observations

$$Q(\beta_1, \beta_2, \cdots, \beta_m) = \sum_{i=1}^{n} [y_i - (\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_m x_{im})]^2 \tag{5}$$

Obtain the minimum value, when the deviation sum of squares is minimum:

$$\begin{aligned} Q(\hat{\beta}_1, \hat{\beta}_2, \cdots, \hat{\beta}_m) &= \sum_{i=1}^{n} [y_i - (\hat{\beta}_0 + \hat{\beta}_1 x_{i1} + \hat{\beta}_2 x_{i2} + \cdots + \hat{\beta}_m x_{im})]^2 \\ &= \min_{\hat{\beta}_1, \hat{\beta}_2, \cdots, \hat{\beta}_m} \sum_{i=1}^{n} [y_i - (\hat{\beta}_0 + \hat{\beta}_1 x_{i1} + \hat{\beta}_2 x_{i2} + \cdots + \hat{\beta}_m x_{im})]^2 \end{aligned} \tag{6}$$

The $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \cdots, \hat{\beta}_m$ obtained in equation (6) is then called the least squares estimate of the regression coefficient $\beta_0, \beta_1, \beta_2, \cdots, \beta_m$. The estimate of the regression coefficient $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \cdots, \hat{\beta}_m$

needs to satisfy the following conditions:

$$\begin{cases} \dfrac{\partial Q}{\partial \beta_0}\Big|_{\beta_0-\hat{\beta}_0} = -2\sum_{i=1}^{n}\left[y_i - (\hat{\beta}_0 + \hat{\beta}_1 x_{i1} + \hat{\beta}_2 x_{i2} + \cdots + \hat{\beta}_m x_{im})\right] = 0 \\ \dfrac{\partial Q}{\partial \beta_0}\Big|_{\beta_1-\hat{\beta}_1} = -2\sum_{i=1}^{n}\left[y_i - (\hat{\beta}_0 + \hat{\beta}_1 x_{i1} + \hat{\beta}_2 x_{i2} + \cdots + \hat{\beta}_m x_{im})x_{i1}\right] = 0 \\ \cdots\cdots \\ \dfrac{\partial Q}{\partial \beta_m}\Big|_{\beta_m-\hat{\beta}_m} = -2\sum_{i=1}^{n}\left[y_i - (\hat{\beta}_0 + \hat{\beta}_1 x_{i1} + \hat{\beta}_2 x_{i2} + \cdots + \hat{\beta}_m x_{im})x_{im}\right] = 0 \end{cases} \tag{7}$$

For X in Eq. (7), if $(XX)^{-1}$ exists, then a least squares estimate of the regression coefficients can be obtained and the least squares estimate is:

$$\hat{\beta} = (XX)^{-1} Xy \tag{8}$$

At this point, the estimates of the regression coefficients are calculated and the resulting multiple linear regression model is:

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \cdots + \hat{\beta}_m x_m \tag{9}$$

3) Tests of regression model:

(1) Test of goodness of fit of multiple linear regression models. The goodness of fit of the multiple linear regression model is the same as that of the univariate linear regression model, which indicates the degree of explanation of the model to the sample data, and the higher the goodness of fit, the better the explanation of the model, and the goodness of fit is expressed by the magnitude of the value of the coefficient of determination R^2, which is the estimation of the model's goodness of fit to the sample data. The formula for calculating the coefficient of determination R^2 of the multiple linear regression model is the same as that of the coefficient of determination of the univariate linear regression model. In practice, however, the coefficient of determination R^2 increases when an independent variable is added to the model, so that it is assumed that the model can be fitted better by increasing the number of independent variables. However, in practice, the increase in the coefficient of determination R^2 due to the increase in the number of independent variables does not have a strong relationship with the goodness of fit. Therefore, it is necessary to adjust the coefficient of determination R^2 to obtain the adjusted goodness-of-fit formula:

$$R^2 = 1 - \frac{SSE}{n-k-1} \Big/ \frac{SST}{n-1} \tag{10}$$

where $n-k-1$ is the degrees of freedom of the residual sum of squares SSE; and $n-1$ is the degrees of freedom of the overall sum of squares SST.

Similar to the univariate linear regression model, in the multiple linear regression model, the closer the calculated value of the coefficient of determination R^2 is to 1, the better the fit and the higher the degree of explanation of the model.

(2) Significance test of multiple linear regression model. The significance test of multiple linear regression model usually adopts the F test, which expands the formula of the total deviation squared and SST as:

$$SST = \sum_{i=1}^{n}(y_i - \overline{y})^2 = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2 + \sum_{i=1}^{n}(\hat{y}_i - \overline{y})^2 \tag{11}$$

Constructing statistics:

$$F = \frac{\sum_{i=1}^{n} (\hat{y}_i - \overline{y})^2}{\sum_{i=1}^{n} (y_i - \hat{y}_i)^2 / (n-2)} \sim F(1, n-2) \tag{12}$$

Hypothesis testing was performed:
Original hypothesis

$$H_0 : \beta_0 = \beta_1 = \beta_2 = \cdots = \beta_m = 0 \tag{13}$$

Alternative hypothesis:

$$H_1 : \beta_0, \beta_1, \beta_2, \cdots, \beta_m \text{ It's zero when it's different} \tag{14}$$

If domain $\chi_0 = \{F > F_{1-\alpha}(1, n-2)\}$ is rejected, i.e. the original hypothesis H_0 is rejected, then the regression model passes the test of significance, indicating that the regression model is good. Conversely, if $\chi_0 = \{F < F_{1-\alpha}(1, n-2)\}$, then the original hypothesis H_0 is accepted, then the regression model is considered to have failed the test of significance, i.e. the model is not significant.

3.2.3. Ratio analysis. In ratio analysis, Flanders proposes to use it to further explain the meaning embedded in instructional behaviors, and he refers to these indicators as variables. Variables can be used to measure information about the effectiveness of teaching, student learning, and the teacher's teaching methods, thus providing a basis for developing more effective teaching strategies. The formula for calculating ratios is as follows:
1) Teacher discourse ratio:

$$\left[\sum_{i=1}^{7} Row(i)\right] \times 100 \div Total \tag{15}$$

2) Ratio of student discourse:

$$\left[\sum_{i=8}^{10} Row(i)\right] \times 100 \div Total \tag{16}$$

3) Ratio of indirect to direct teacher influence:

$$\left[\sum_{i=1}^{3} Row(i)\right] \times 100 \div \sum_{i=6}^{7} Row(i) \tag{17}$$

$$\left[\sum_{i=1}^{4} Row(i)\right] \times 100 \div \sum_{i=5}^{7} Row(i) \tag{18}$$

4) Quiet or chaotic ratio:

$$\left[\sum_{i=11}^{14} Row(i)\right] \times 100 \div Total \tag{19}$$

5) Teacher discourse - student driven ratio:

$$\left[\sum_{i=1}^{3} Row(i)\right] \times 100 \div \left[\sum_{i=1}^{3} Row(i) + \sum_{i=6}^{7} Row(i)\right] \tag{20}$$

6) Teacher questioning rate:

$$Row(4)\times 100\div\left[\sum_{i=4}^{5}Row(i)\right] \tag{21}$$

7) Student discourse - student-initiated rate:

$$[Row(9)]\times 100\div\sum_{i=8}^{9}Row(i) \tag{22}$$

8) Content cross-district ratio:

$$\left[\sum_{i=4}^{5}Row(i)+\sum_{j=4}^{5}Col(j)-\sum_{i=4}^{5}\sum_{j=4}^{5}Cell(i,j)\right]\times 100\div Total \tag{23}$$

9) Ratio of steady state zones:

$$\left[\sum_{i=j=1}^{14}Cell(i,j)\right]\times 100\div Total \tag{24}$$

10) Student Stability Zone Ratio:

$$\left[\sum_{i=j=8}^{10}Cell(i,j)\right]\times 100\div\sum_{i=8}^{10}Row(i) \tag{25}$$

3.3. Research tools

3.3.1. Improved Flanders interaction analysis system. The research tool selected for this paper is the Improved Flanders Interaction Analysis System, which is referred to as iFIAS [28]. The Flanders Interaction Analysis System lacks the analysis of information technology, and the handling of teacher's questioning, students' active speaking, and the phenomenon of silence is not perfect enough.After synthesizing a wide range of data and information, the Improved Flanders Interaction Analysis System is proposed, and this analysis system is still composed of three parts: first, a set of This analysis system still consists of three parts: first, a coding system for recording classroom interaction behaviors; second, a set of coding guidelines for recording observations; and third, a matrix form for presenting and analyzing the data. iFIAS inherits both the advantages of FIAS and the categories about analyzing information technology interactions, which is very suitable for researching classroom teaching and learning, and also develops an auxiliary analytical tool for iFIAS to reduce the workload of the coders, so the author chose iFIAS as a research tool in this paper. iFIAS consists of 16 coding categories, which are presented as shown in Table 1.

Table 1. Improved Flanders interactive analysis system

Teacher language	Indirect influence	1	Teachers accept emotions		
		2	Teacher performance or encouragement		
		3	Teachers adopt students' opinions		
		4	Teacher question	4.1	Open question
				4.2	Question closing problem
	Direct influence	5	Teacher teaching		
		6	Teacher instruction		
		7	Teachers criticize or maintain teacher authority		
Student language		8	Student passive response		
		9	Student active speech	9.1	Student response
				9.2	Students ask questions
		10	Students and peer discussions		
Silence		11	It's not helping the confusion of the teaching		
		12	The silence of teaching		
Technology		13	Teacher control technology		
		14	Student manipulation		

3.3.2. Supporting analytical tools. In order to obtain the coding data faster, this paper uses iFIAS Coding Assistant developed by the Digital Learning Laboratory of Capital Normal University to record, and analyzes the data with Analysis Tool, an iFIAS analysis program developed by it.

FIAS Coding Assistant Assistant is very easy to use, its page design is very simple and beautiful, the 14 codes are organized according to the four sections of teacher language, student language, silence and technology, which is orderly and convenient for the coder to find the determined code quickly when coding, and it adopts the click coding, without manually inputting the numbers, so the coder can record the determined code in a shorter period of time. The coder can record the determined code in a shorter period of time.

Using the iFIAS analysis program Analysis Tool, matrix analysis tables, ratio calculations, and curve analysis charts can be produced quickly, greatly reducing the time it takes for coders to calculate and count. At the same time, the Digital Learning Laboratory at Capital Normal University developed the iFIAS Analysis Tool with instructions for use, so that coders who do not know how to use it can refer to the accompanying instructions and quickly master the use of this analysis program.

4. Findings and analysis

The basic information of the research subjects in this paper is shown in Tables 2 and 3:

Table 2. Teacher's basic situation registration form

	Gender	Age	Educational background	Teaching age	Class type	Student population
W	Female	34	Undergraduate	11	Grammar	45
Y	Female	31	Undergraduate	5	Grammar	51
Z	Male	28	Undergraduate	2	Hear of	50
M	Female	33	Undergraduate	11	Read	49
F	Female	38	Undergraduate	8	Read	44
Q	Female	40	Undergraduate	12	Hear of	50

Table 3. Student's basic information registration form

Class	Number	Gender

Junior year	145	Male
	144	Female

4.1. Characteristics of teachers' verbal interaction in the English classroom

1) Teachers' direct control of students and classrooms has more positive than negative impacts on students. Through the ratio analysis method in the FIAS analysis system to get the results as shown in Table 4, as can be seen from the table, from the average value can be seen, the total frequency of indirect influence in the classroom teacher-student verbal interaction is less than the direct influence, and in the table, the average value of I/D is 0.276, which is less than 1, which indicates that the teacher tends to control the students and the classroom directly.

As shown in the table, the mean value of P/N is 1.486, which is greater than 1, i.e., it indicates that the positive influence of teacher's words on students in classroom verbal interaction is greater than the negative influence. Although the total frequency of teachers' positive influence speech in the table is small, the part of teachers' directive speech and teachers' language criticizing students or asserting teachers' authority verbally are relatively less than positive speech, which indicates that teachers gradually pay attention to students' self-esteem and show a tendency to reduce the control of the classroom and the students during the process of guiding the students and teaching knowledge in the classroom verbal interaction.

Table 4. The teacher interactive style comparison table

Teacher	Indirect influence and direct influence ratio			Positive influence and negative impact ratio		
	Indirect influence	Direct influence	I/D	Positive influence	Negative influence	P/N
	1-4 times	5-7 times		1-3 times	6-7 times	
W	112	368	0.154	52	19	2.359
Y	94	231	0.257	49	43	1.052
Z	88	186	0.322	32	44	0.674
M	121	354	0.191	36	33	1.005
F	121	387	0.162	29	6	3.224
Q	143	197	0.569	78	117	0.602
Mean value	113.2	287.2	0.276	46	43.7	1.486

2) Teachers' classroom questioning rate is low, and the rate of asking open questions is greater than that of closed questions. In this study, the teachers' classroom questioning situation was obtained according to the ratio analysis method and matrix chart statistics in the FIAS analysis system as shown in Table 5.

As can be seen from the table, the average value of the rate of asking open questions in English teachers' classroom verbal interactions is 4.2%, and the average value of the frequency of asking closed questions is 4.7%, both of which are low, indicating that the teachers ask fewer questions to the students in the classroom teacher-student verbal interactions, and that if a lesson lasts for 45 minutes, then the teachers' time to ask the students open questions and closed questions is about 1.8 and 2 minutes. . In addition, the average value of the frequency of continuous questioning by teachers is 10, and the average rate of this is 1.2%, which means that in a 45-minute English lesson, about 0.6 minutes are spent on continuous questioning. It shows that teachers lack of questions aimed at inspiring and guiding in classroom teaching, the probability of asking ineffective questions is higher, and teachers do not know enough about students' learning, fail to grasp students' mastery of the knowledge points or learning methods of this lesson through students' responses to questions in time, and do not test students' listening, reading, writing and viewing abilities comprehensively.

Table 5. The teacher's classroom question table

Teacher	The question frequency and ratio of the question of the teacher	The teacher questions the frequency of the closed problem and the ratio	Continuous question frequency and ratio of teachers
W	27(2.8%)	37(3.9%)	0(0%)
Y	18(1.9%)	30(3.15%)	4(0.3%)
Z	57(8%)	46(5.7%)	19(3.1%)
M	34(3.8%)	54(7%)	14(1.5%)
F	49(5.5%)	46(5%)	18(1.8%)
Q	32(3.2%)	34(3.4%)	7(0.6%)
Mean value	36.1(4.2%)	41.2(4.7%)	10(1.2%)

4.2. Characteristics of students' verbal interactions in the English classroom

1) Students' classroom discourse ratio is low and classroom speech is mainly passive. In this study, according to the iFIAS analysis system, the data in the matrix diagram were counted by the ratio analysis method and the matrix diagram analysis method in the system, and the classroom discourse ratio between teachers and students in the teacher-student verbal interaction in junior high school English classroom was calculated according to the ratio analysis method as shown in Figure 1. The data in the figure show that: the ratio of teacher discourse in teacher W's classroom is 54.4%, with a cumulative length of about 24 minutes, while the ratio of students' classroom discourse is 29.3%, with a cumulative length of about 13 minutes; the ratio of teacher discourse in teacher Y's classroom is 37.3%, with a cumulative length of about 16 minutes, while the ratio of students' classroom discourse is 57.2%, with a cumulative length of about 25 minutes. On the average, the teacher discourse rate in teacher's classroom was 48.1% with a cumulative duration of about 21 minutes, and the student discourse rate in teacher's classroom was 40.3% with a cumulative duration of about 18 minutes.

Teachers Y, Z, and Q's classroom teacher-student verbal interactions had a higher rate of student discourse than teacher discourse, suggesting that students may be the main players in the classroom, and that the teacher, as a guide in classroom verbal interactions, organizer of classroom activities, and provider of classroom learning resources, guides the students to carry out classroom interactions. However, classroom observations showed that the sources of students' higher classroom discourse ratios were not the same in the classrooms of Teachers Y, Z and Q.

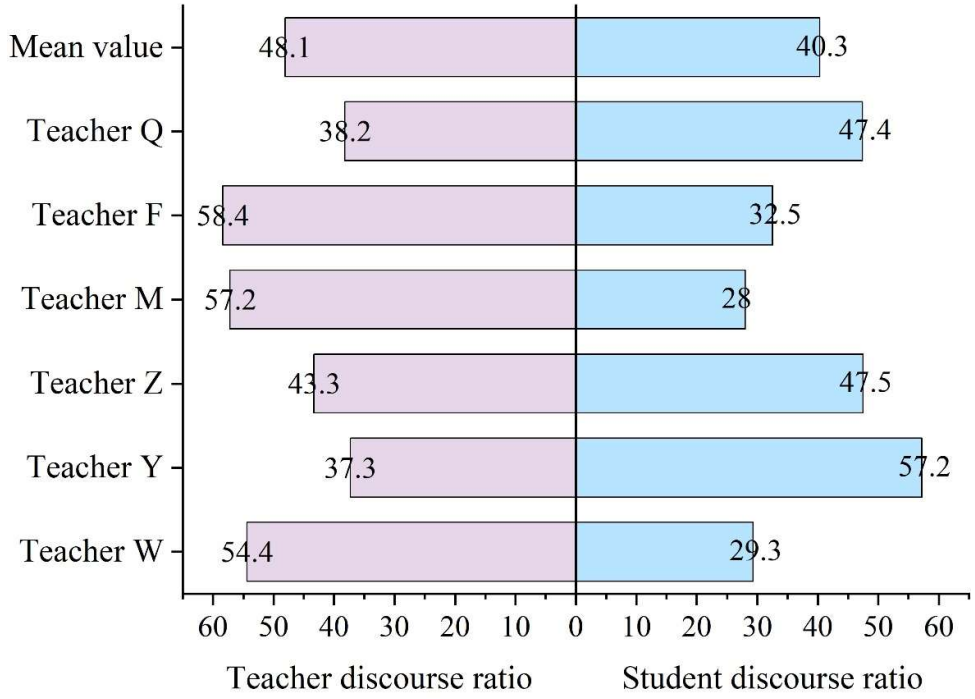

Fig. 1. Classroom teacher and teacher discourse ratio diagram

2) Students' active speaking ratio is low and initiative is weak. According to the ratio analysis method in the iFIAS analysis system, made students' classroom interaction initiative is shown in Table 6. The table shows that the average value of students' passive discourse ratio in classroom teacher-student verbal interaction is 19.4%, the average value of active discourse ratio is 16.4%, and the ratio of students' active questioning discourse is 0, and the ratio of active discourse is smaller than the ratio of passive discourse, which indicates that most of the amount of students' discourse in the ratio of students' discourse in the classroom teacher-student verbal interaction is derived from the students' passive response ratio and compared with the normative model of 34%, the amount of students' discourse in classroom The average value of active discourse ratio of students in the classroom is 16.4%, which is much lower than the norm, indicating that students' initiative in classroom verbal interaction is weak, the main discourse is dominated by the teacher, and they lack the ability to actively respond to the questions and question the content of the classroom teaching, and they are more dependent on the teacher.

Table 6. Student classroom interaction initiative table

Class	W	Y	Z	M	F	Q	Mean value(%)
Student passive response ratio(%)	17.1	12.5	19.6	7.6	20.1	39.4	19.4
Student active speaking ratio(%)	8.8	25.7	22.3	19.5	12.6	9.2	16.4
Student active question speech ratio(%)	0	0	0	0	0	0	0

4.3. Dynamic curve analysis of interaction ratios

The dynamic curve graph drawn by the iFIAS analysis assistant can completely describe the classroom behavior; then the stability and variability of the classroom interaction can be judged by the number and duration of the peaks and troughs on the curve graph. Taking the sample College English classroom video as an example, the dynamic curve graph is shown in Figure 2.

As can be seen from the graph, the classroom as a whole is dominated by the teacher's lecture, and the peaks appearing in the teacher's behavior are significantly higher than the students' behavior. In the 30th-40th minutes of the classroom, the teacher's behavior peaks, indicating that the teacher's

verbal behavior dominates the classroom during this time. The overall fluctuation of the curve representing student behavior is more stable, indicating that students are in a more stable state during class. The green curve representing silence in the classroom has multiple peaks, indicating that students spend more time thinking about problems or writing Chinese characters during this time. The yellow curve representing technology behavior in the classroom is consistent throughout the classroom, with two peaks occurring at the beginning and end of the classroom, indicating that the teacher and students have been using media technology in the classroom.

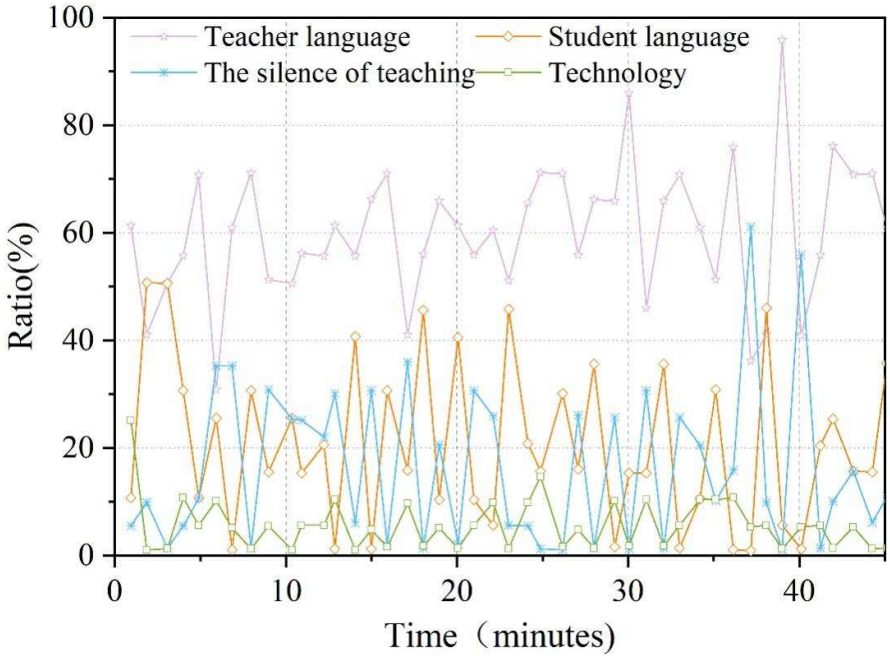

Fig. 2. Dynamic graph

4.4. Analysis of factors influencing the effectiveness of the interaction

4.4.1. Questionnaire implementation and reliability and validity tests. The designed questionnaire on factors influencing teacher-student interactions in college English classrooms includes 30 questions divided into six dimensions, specifically: teaching ability (6 questions), learning styles (4 questions), motivation to learn (5 questions), classroom environment (5 questions), content of interactions (5 questions), and effective teacher-student interactions (5 questions), which are listed in Appendix 2. Each item is in the form of a five-level Likert scale, and the value of "strongly disagreeing" is assigned to 1, "not conforming" is assigned to 2, "fair" is assigned to 3, "somewhat agrees" is assigned to 4, and "very consistent" is assigned to 5.

The questionnaires were distributed in the English classroom classes after the completion of the pilot test and directly collected on the spot, 150 copies were distributed and 150 copies were collected, removing the invalid questionnaires, 110 copies were left, the recovery rate was 100%, and the validity rate was 73%. The questionnaire data were entered into SPSS19.0 to test the reliability and validity of the data.

1) Reliability test. By using Cronbach's alpha coefficient test for each dimension and the overall questionnaire respectively to verify whether the reliability of the junior high school information technology teacher-student interaction influencing factors questionnaire meets the standard, the results of the Cronbach's alpha test for each dimension are shown in Table 7, according to the Cronbach's alpha coefficient test of Wu Minglong, who was mentioned in the reliability test for the questionnaire of the current status of the teacher-student interaction, the reliability of each dimension of the influencing factors questionnaire is above 0.7, indicating that each dimension is reliable. The

Cronbach's Alpha values of the dimensions of the questionnaire of influencing factors are all above 0.7, indicating that the titles of the dimensions are reliable, while the overall reliability of the questionnaire is shown in Table 8, with an overall Cronbach's Alpha of 0.874, indicating that the overall reliability of the questionnaire is good, synthesizing the results of the test of the reliability of the dimensions and the overall reliability of the questionnaire test results prove that the junior high school information technology teacher-student interaction is a good one. Influencing Factors Questionnaire has good reliability and can be studied.

Table 7. Cronbach alpha results of each dimension

Dimension	Cronbach's Alpha
Teaching ability	0.812
Learning style	0.834
Learning motivation	0.859
Interactive content	0.858
Classroom environment	0.882
Effective interaction between teachers and students	0.794

Table 8. Reliability statistic

Cronbach's Alpha	Cronbachs alpha based on standardization	Term number
.874	.911	30

2) Validity test. The validity test of the questionnaire on the influence factors of teacher-student interaction in junior middle school information technology mainly adopts the method of structural validity test on the KMO value and Bartlett's test, and the results are shown in Table 9, the KMO value of the questionnaire is 0.832, and the p-value is 0.00 smaller than 0.05, which indicates that the questionnaire's structural validity is good, and at the same time, the KMO value of the dimensions and the p-value are shown in Table 10, and the KMO values are all 0.7 or more, indicating that the questionnaire is suitable for investigating the factors affecting teacher-student interaction.

The combined results of the reliability and validity analysis of the questionnaire indicate that the questionnaire on factors influencing teacher-student interactions in junior middle school information technology classrooms is feasible and can be used for subsequent correlation and regression analyses.

Table 9. KMO and Bartlett tests

The cayser-meyer-olkin metric of the sampling is sufficient		.832
Bartlett's spherical test	Approximate card	3842.472
	df	534
	Sig.	.000

Table 10. The KMO values and sig values of each dimension

Dimension	KMO value	Sig.
Teaching ability	0.821	0.000
Learning style	0.793	0.003
Learning motivation	0.723	0.000
Interactive content	0.812	0.001
Classroom environment	0.832	0.000
Effective interaction between teachers and students	0.754	0.001

4.4.2. Correlation analysis between factors influencing teacher-student interaction. On the basis of analyzing that there are correlations between teaching ability, learning styles, motivation, interactive content and classroom environment with effective teacher-student interaction, which can be used as influences on effective teacher-student interaction, the correlations between the independent variables were next tested and analyzed. After the analysis/correlation/bivariate in SPSS, the converted "Teaching Ability", "Learning Style", "Learning Motivation", "Interactive Content" and "Classroom Environment" were selected into the variable box, and "OK" was selected after selecting "Pearson", and the statistical results are shown in Table 11. Generally, when the correlation coefficient between the independent variables is greater than 0.8, there is a serious multicollinearity between the independent variables, which cannot be used for the regression analysis of the influencing factors. The maximum value of the correlation coefficient between the respective variables was found to be 0.525, which are all less than 0.8, so there is no serious multicollinearity between the five independent variables, and regression analysis can be carried out on the dependent and independent variables.

Table 11. Correlation analysis between influencing factors

		Classroom environment	Teaching ability	Learning style	Learning motivation	Interactive content
Classroom environment	Correlation	1	.457**	.267**	.437**	.388**
	Sig.(Double side)		.000	.000	.000	.000
	N	110	110	110	110	110
Teaching ability	Correlation	.481**	1	.365**	.317**	.443**
	Sig.(Double side)	.000		.000	.000	.000
	Correlation	110	110	110	110	110
Learning style	Correlation	.255**	.367**	1	.528**	.422**
	Sig.(Double side)	.000	.000		.000	.000
	Correlation	110	110	110	110	110
Learning motivation	Correlation	.437**	.318**	.525**	1	.347**
	Sig.(Double side)	.000	.000	.000		.000
	Correlation	110	110	110	110	110
Interactive content	Correlation	.393**	.438**	.417**	.341**	1
	Sig.(Double side)	.000	.000	.000	.000	
	Correlation	110	110	110	110	110

Note: **Significantly correlated at the .01 level (two-sided)

4.4.3. Regression Analysis of Teacher-Student Interaction and Influencing Factors. The correlation between the respective variables was tested and it was found that there was no multicollinearity between the respective variables, thus multiple regression analysis was further applied to test the linear relationship between the respective variables, i.e., the influencing factors and the dependent variable, effective teacher-student interaction. The multiple regression equation utilized in the regression analysis is:

$$Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots \beta_k X_k + \varepsilon \tag{26}$$

In the regression equation, Y is the dependent variable, β_1, β_2 ..... β_k is the regression coefficient, i.e., the B-value obtained after regression analysis, X_1, X_2 ..... X_k is the independent variable, and ε is the random variable of error. In the study of factors influencing teacher-student interaction in English classroom, the dependent variable is effective teacher-student interaction, and the independent variables are the influencing factors of teacher-student interaction, mainly teaching ability, learning style, motivation to learn, content of interaction and classroom environment. The test results of the multiple regression analysis of the influencing factors and teacher-student interaction are shown in Table 12.

Through the test results, it was found that after the multiple regression analysis of the independent variables of the five influencing factors, namely teaching ability, learning style, learning motivation, interactive content and classroom environment, in the final regression analysis results, the interactive content as an influencing factor was excluded, and only four factors, namely, teaching ability, learning style, learning motivation and classroom environment, were left, which indicated that the remaining four factors were closely related to effective teacher-student interaction Influencing factors. The table generated by the regression found that the first factor entered into the regression is learning motivation, which indicates that the students' own motivation to stimulate and maintain learning has a significant effect on the effectiveness of student-teacher interaction in the classroom, that is to say, learning motivation has a predictive effect on effective teacher-student interaction.

By analyzing the regression results, the B value in the standardized coefficients was used as the regression coefficient of the equation. By using the standardized B value to predict the correlation between the independent variable and the dependent variable, the units of the independent variable and the dependent variable can be unified and the results can be more accurate. Finally, the standardized regression equation of the factors affecting teacher-student interaction in junior high school information technology classroom can be concluded as:

$$\text{Y}=0.457\times\text{academic motivation}+0.214\times\text{teaching ability}+0.127\times\text{Learning style}+$$
$$0.034\times\text{classroom environment}$$

Table 12. Multivariate regression analysis

Model		Nonnormalized coefficient		Standard coefficient	t	Sig.	Common linear statistics	
		B	Standard error	Beta distribution			Tolerance	VIF
1	Constants	9.272	.901		9.134	.000		
	Learning motivation	.496	.039	.642	10.785	.000	1.000	1.000
2	Constants	7.612	.905		8.324	.000		
	Learning motivation	.356	.043	.473	8.001	.000	.712	1.355

	Teaching ability	.277	.054	.297	5.011	.000	.712	1.355
3	Constants	6.774	.956		7.048	.000		
	Learning motivation	.347	.045	.455	7.546	.000	.697	1.314
	Teaching ability	.243	.053	.258	4.211	.000	.667	1.364
	Learning style	.092	.035	.135	2.376	.011	.833	1.154
4	Constants	5.756	.923		6.783	.000		
	Learning motivation	.316	.043	.457	7.041	.000	.696	1.527
	Teaching ability	.214	.052	.214	3.755	.000	.654	1.517
	Learning style	.083	.034	.127	2.108	.012	.829	1.246
	Classroom environment	.025	.026	.034	1.848	.022	.758	1.132

5. Conclusion

In this study, the English classroom of third-year students and teachers in a university in Shanghai was selected as the research object, and the quantitative methods of classroom observation, ratio analysis and matrix diagram analysis in the iFIAS analysis system were used to collect, count and analyze the data, and the following conclusions were drawn:

1) In the classroom teacher-student verbal interaction, the ratio of students' classroom discourse is smaller than that of the teacher, indicating that the teacher still occupies a dominant position, and students' classroom discourse is mainly dominated by the teacher. In addition, in the classroom verbal interaction, the ratio of students' active discourse in classroom discourse is low, mostly passive discourse under the teacher's instruction, and the probability of students' active questioning is zero, so the initiative in classroom verbal interaction is weak.

2) Taking the sample video of college English classroom video as an example, presenting the results of data processing of teacher-student classroom interaction behavior, the dynamic curve diagram drawn by iFIAS analysis assistant can show that the teacher's speech behavior dominates in the classroom, and the students' state stability is higher during the class.

3) A questionnaire on the influencing factors of teacher-student interaction in the English classroom was designed, and the questionnaire data were analyzed by correlation analysis and regression analysis of the influencing factors of teacher-student interaction using SPSS to determine the four influencing factors of teacher-student interaction as teaching ability, learning styles, motivation to learn and classroom environment.

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