

A Study on the Improvement of English Listening Comprehension Skills Based on Linear Regression Modeling in a Multimodal Learning Framework

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ABSTRACT

Based on the background of information technology, this paper proposes a multimodal blended learning model of English listening based on “WeChat+Classroom+TED-Ed”. It focuses on the experimental teaching of multimodal learning and English listening comprehension, and describes the object of the study, the design of the study and the process of the study. Based on the research idea, the experimental variables were designed, and the empirical analysis was carried out by using multiple linear regression model. The teaching effect of multimodal teaching is examined by comparing the differences in the total English listening scores of the two groups of students before and after the experiment. With the help of Pearson correlation analysis, the correlation between the experimental variables is explored. The value of R^2 was determined through the multiple regression model to determine the magnitude of the explanatory power of multimodal learning on English listening comprehension ability. The results showed that the scores of the control class improved by 1.19 points and the experimental class improved by 4.19 points in the experimental posttest, with a significance (two-tailed) p -value = $0.008 < 0.05$. The explanatory power of the combined three modalities of learning on English listening performance was 15.4%, and classroom learning had the highest level of significance in terms of its explanatory power on listening comprehension, and the test of regression coefficients reached the level of significance ($t=3.862$, $p=0.002 < 0.05$).

Keywords: multiple linear regression model, Pearson correlation analysis, multimodal learning, English listening comprehension ability

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Received 15 January 2024; Revised 10 March 2024; Accepted 30 November 2024; Published Online 15 April 2025.

DOI: [10.61091/jcmcc127a-387](https://doi.org/10.61091/jcmcc127a-387)

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1. Introduction

In today's globalization, English has become an indispensable language. And in the process of learning English, listening is one of the most important skills. It plays an important role in people's lives, especially English listening comprehension has become a basic way to get the latest information all over the world. In language communication, native speakers rely extensively on chunks of speech for communication, a common phenomenon that has caused the language and second language education community to reflect on traditional teaching [1]. Due to various reasons such as language teaching mode and learning environment, students generally think that learning English is just memorizing words without learning vocabulary in a deeper aspect, which leads to the fact that it has been difficult for them to improve their comprehensive language ability, and the traditional method of listening teaching often relies too much on pure listening materials, ignoring the diverse learning needs of students [2-3]. In order to improve the effect of secondary school English listening teaching, multimodal learning is applied, which is a learning method that combines multiple sensory stimuli. It does not only rely on listening materials, but also helps students understand and master English listening skills through vision, body movement, touch and other modalities [4]. Through the participation of multiple senses, it stimulates students' interest and improves their classroom participation, and then students can better understand and absorb the listening materials and improve their listening skills [5-6]. Multimodal learning not only focuses on students' listening skills, but also focuses on developing students' other abilities. Through the use of multi-sensory stimulation, students are able to develop their visual, body movement, tactile and other abilities while listening, which helps to improve students' comprehensive quality and develop their multiple intelligences [7]. Therefore, how to improve English listening comprehension in the context of multimodal learning becomes crucial.

In order to improve the level of students' English listening comprehension ability, many scholars have proposed their own methods. In terms of teaching methods, the literature [8] used the top-down teaching method to improve students' listening comprehension level by arranging tests after explaining English knowledge points one by one. However, the teaching method is easy to lead to students' boredom, which is not conducive to long-term teaching. In contrast, literature [9] utilizes Dictogloss interactive teaching method to teach English listening comprehension to students, and the method is highly approved by students, and it is really effective in improving students' listening comprehension ability. Literature [10] used two cycles of note-taking and fill-in-the-blank dictation to improve students' listening comprehension scores, and found that the first cycle of training was not effective, while the second cycle of training, the scores increased significantly. Literature [11] applies the cooperative listening training method in classroom teaching to improve students' interest and motivation in learning, so as to realize the improvement of English listening comprehension.

In terms of updating listening materials, literature [12] explored students' listening comprehension ability with podcasts of learning materials, and statistical analysis showed that the listening comprehension ability of students who received podcasts was improved. Literature [13] showed English movies to attract students' attention and interest, which made students visualize the utterances or words they heard, and students who watched the movies improved their English listening comprehension scores by an average of 22 points compared to those who did not watch the movies. Literature [14] integrated TED talks to make authentic video teaching materials, and used the materials for listening practice in English listening classrooms, and found that students' English listening comprehension levels were significantly improved.

In terms of the application of intelligent tools, literature [15] tested students' listening comprehension ability with the English Listening Test application (App), and the test listening scores were significantly higher than those of students who did not use the App, which shows that the App can be used to improve students' listening comprehension ability. Literature [16] conducted an

experimental study on students' English listening comprehension by using Whatsapp's Listening Log section to identify the main points, identify details, identify the tone of voice, and expand vocabulary, and found that Whatsapp's Listening Log can significantly improve students' English listening comprehension. Literature [17] used YouTube videos for English listening instruction and tested and found that students who were taught with YouTube videos improved their listening comprehension scores by almost ten percent. Literature [18] compared the autonomous review mechanism of YouTube videos and found that the video labeling listening review mechanism is more helpful to improve students' listening comprehension, which is due to the difficulty of students to capture the parts they do not understand with the autonomous review mechanism. In addition, literature [19] utilized computer technology in the contextual teaching of English to improve communicative competence by facilitating the interactive process of students, which in turn improved students' listening comprehension. Literature [20] developed an app for enhancing English listening comprehension directly under the consideration of the process of recognizing and remembering information, which is suitable for students in mobile learning environments.

In this paper, a multimodal blended teaching framework of "WeChat+Classroom+TED-Ed" is constructed under the multimodal learning environment and learning tasks, which consists of three links: before, during and after class. The hypothesis that multimodal teaching can improve English listening comprehension was put forward, and the third-year computer science majors of a university were taken as the research subjects. The experimental group was designed to implement multimodal teaching, and a variable design and hypothesis testing model was proposed to investigate the effects of each independent variable on English listening comprehension using multiple linear regression model. The total listening scores of students in the experimental and control classes before and after the experiment were counted, and the significance was investigated based on the independent samples t-test. Compare the differences in the mean values of the scores to verify the effect of multimodal teaching on the improvement of English listening comprehension ability in the experimental class. Use Pearson correlation analysis to explore the correlation between the three components of multimodal learning and English listening comprehension ability. Use multiple regression modeling to determine the combined explanatory power of multimodal learning on English listening comprehension ability.

2. Research on Improving English Listening Comprehension Skills through Multimodal Learning

The rapid development of modern information technology provides important technical support and convenient technical means for the implementation of English teaching, which is welcomed and loved by students. In this context, this paper integrates information technology and English listening courses to construct the "WeChat + Classroom + TED-Ed" English listening multimodal blended learning model.

The specific structure of the "WeChat + Classroom + TED-Ed" English listening multimodal blended learning model is shown in Figure 1, which centers on the theme of teaching and consists of three segments: pre-class, in-class and post-class. Pre-lesson learning is carried out on WeChat platform, and the learning tasks involve vocabulary, parts of speech, thematic background and group oral discussion of the theme. Information input is carried out through learning materials and learning environments in different modalities, and then language output is carried out through oral and written modalities. The in-class session was conducted in a face-to-face format. In addition to the instructor's lecture on lecture listening note-taking skills and listening metacognitive strategies, the students also engaged in topic-related group presentations and discussions. The session was conducted in a multimodal environment with information input through the synergy of various modalities and language output through the speaking modality. Post-class learning was conducted on TED-Ed and WeChat, with TED-Ed's animated talk intensive listening tasks consolidating classroom learning, and WeChat's talk independent extensive listening and topic writing tasks expanding classroom teaching

and learning. The session also involves information input in a variety of different modalities and language output through the written language modality. In this model, the teacher acts as an organizer and mentor, guiding and supervising the students' collaborative and dialogical learning in task-based and cooperative learning, which leads to the construction of meaning oriented to the knowledge goals of the course.

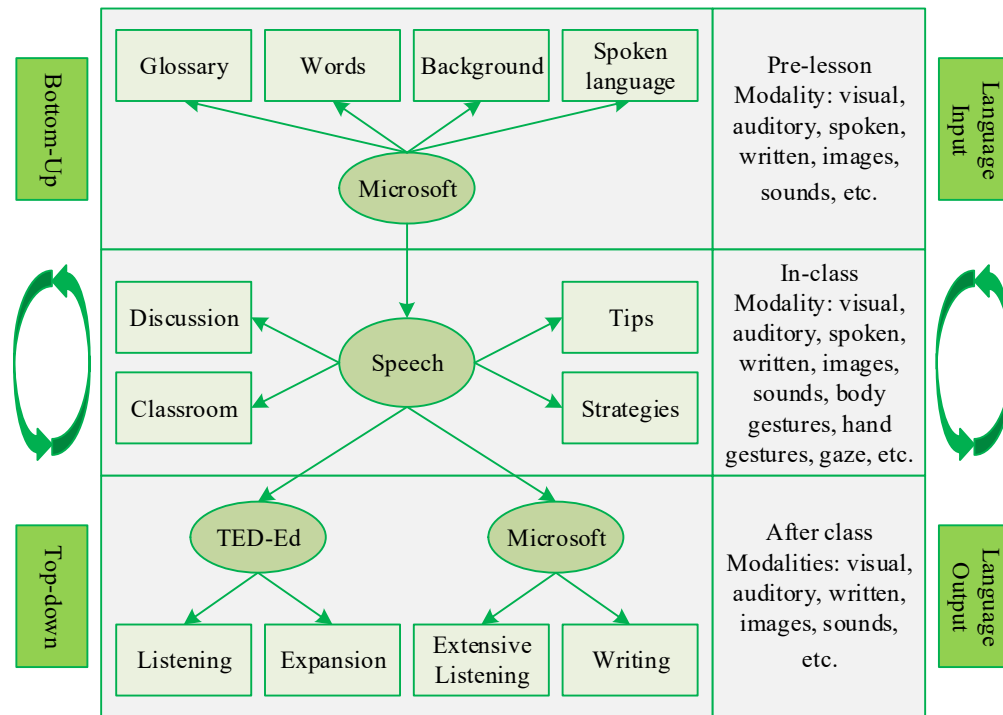


Fig. 1. Multimodal blended learning model

2.1. Research Questions and Objectives

This study is based on the constructed multimodal blended English listening learning model “WeChat+Classroom+TED-Ed”, and is a semester-long experimental teaching, aiming at investigating whether this model can improve students' English listening comprehension ability.

The study participants came from a third-year *A* class of computer science majors in a university in China (with upper-middle level scores on the entrance English proficiency test). A random sample of 90 students, 45 in the experimental group and 45 in the control group, was drawn from 203 students in three *A* classes taught by the same teacher, and the students had passed the National College Students' English Level 4 Examination before the experimental teaching began.

2.2. Research hypothesis and design

Experimental hypothesis: the listening comprehension ability of the experimental class is significantly higher than that of the control class after adopting the multimodal teaching mode.

Experimental design In the course of the study, the control and experimental groups used the same textbook and were taught by two teachers respectively. The control group was taught according to the multimedia conventional mode, and students were required to study the text before class, but there was no clear requirement for handing in homework. The classroom also had multimodal input multimedia courseware, but the teacher explained the text and the key points in the text, explained individual vocabulary, practiced, and interspersed with class discussions.

2.3. *Research implementation process*

The experimental group enhances the multimodal input intervention of language chunks throughout the teaching process, takes learners as the main body, and highlights the awareness of language chunks from the pre-course pre-study, classroom interaction, and post-course extension. Through the combination of explicit and implicit teaching, the multimodal intervention in the acquisition of language chunks by learners in the modern information technology and multimedia environment enhances their ability to extract language chunks and intentionally learn, use and deep-process them. Specific operations include:

1) pre-course activities, students preview the text under detailed instructions and requirements, before entering the classroom teaching session in the form of written assignments on the content of the text, the point of view of the two questions, excerpt five good words and two good sentences, excerpt the good words will be excerpted from the entire sentence and mark the good words (chunks of speech) in the sentence, and at the same time, submit the recording of the text read aloud in the form of an audio recording. The pre-writing process begins with students reading the CD-ROM that comes with the textbook to familiarize themselves with the vocabulary, then reading the text for the first time with their pens in hand, trying to focus on the content of the text, quickly marking up thoughts, questions, or understandings as they go along and interacting with the author, and learning about the author's ideas and perspectives through this constant interaction with the author, emphasizing the importance of concisely noting the connections made through the old knowledge and the new material as they read, and recording a moment of inspiration or association to pave the way for asking high-quality questions. Inspiration or association is emphasized as you read, paving the way for high quality questions. After comprehending the informational content of the text as the main focus and orally answering the after-school reading comprehension questions, two questions related to the content ideas of the text are posed in writing. Read the text out loud for the second time, guiding students to analyze, observe, perceive, and judge the input material by relying on the context and the context, and then identifying the chunks of language that need to be watched out for and extracted, and recording them. Attention is focused on the connection between linguistic meaning and form, looking for chunks of speech (good words and phrases) and extracting two sentences and five words and associating contexts in which they can be used, and then choosing one or two passages in the text for recording and submitting them to the class public mailbox or qq space. The teacher listens to the recordings and gives feedback, explains the prevailing problems in class, and focuses on guiding the students to pay attention to the semantic clusters of pauses by blocks of speech.

2) Classroom Activities. Like pre-course activities, classroom activities also emphasize getting learners to move, but classroom activities are by no means lively, not students open their mouths to say that represents interaction, but rather the learning process of moving the brain, the heart, the mouth and the pen. The design of the task in principle to experience and communication-based, to avoid the "performance" of the language interaction task, to avoid "acting" to the teacher to see and cope with the activities of no real communicative significance, from the comprehension-type activities to the development of controlled output-type activities, and finally, learners The last step is for the learners to carry out real interactive communicative activities. Focus on designing activities that incorporate the minds and experiences of college students, aiming at challenging learning and creative use of language, and enhancing the authenticity of the topic. From participating in perceptual observation, experience, imagination, cognition, etc., to rational discursive, comparative analysis, generalization, judgment, reasoning, argumentation to problem-solving style thinking, designing topics that arouse students' interest, resonance, and enthusiasm for participation, so that students can learn the language in real scenarios, in the process of completing communicative tasks, and get deep cultural, pragmatic, and social information through experience and communication.

2.4. Research methodology

2.4.1. Variable design and statistics. Based on the research idea of this study, the researcher designed two sets of variables: independent variables and dependent variables. Among them, three independent variables: learning before class, learning during class, and learning after class; the dependent variable is English listening comprehension ability.

The subjects' English listening was tested through the test method, and the test scores were used as an indicator of the level of English listening comprehension ability. Vocabulary discourse scores were equated to the subjects' pre-course learning effect, analytical reasoning scores were equated to the subjects' classroom learning effect, and main idea summarization scores were equated to the subjects' post-course learning effect, and a multiple linear regression model was used to explore the effects of the respective variables on English listening comprehension ability.

2.4.2. Multiple linear regression models. A multiple linear regression relationship exists when the random variable y is linearly related to 2 or more variables. The linear regression model is:

$$y = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \cdots + \alpha_m x_m + \beta \quad (1)$$

where: $\alpha_0, \alpha_1, \alpha_2, \dots, \alpha_m$ is the regression coefficient and β is the random error. The sample has n sets of test data $(x_{i1}, x_{i2}, \dots, x_{im}; y_i) (i = 1, 2, \dots, m)$, then the above linear regression model is:

$$\begin{cases} y_1 = \alpha_0 + \alpha_1 x_{11} + \alpha_2 x_{12} + \cdots + \alpha_m x_{1m} + \beta_1 \\ y_2 = \alpha_0 + \alpha_1 x_{21} + \alpha_2 x_{22} + \cdots + \alpha_m x_{2m} + \beta_2 \\ \vdots \\ y_n = \alpha_0 + \alpha_1 x_{n1} + \alpha_2 x_{n2} + \cdots + \alpha_m x_{nm} + \beta_n \end{cases} \quad (2)$$

Its matrix form is:

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} = \begin{bmatrix} 1 & x_{11} & x_{12} & \cdots & x_{1m} \\ 1 & x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \begin{bmatrix} \alpha_0 \\ \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_m \end{bmatrix} + \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_n \end{bmatrix} \quad (3)$$

The simplified form of the matrix of Eq. (3) is:

$$Y = X\alpha + \beta \quad (4)$$

The deflated model Q of the multiple linear regression equation is:

$$SSE = \sum_{i=1}^n (x_i - \hat{x}_i)^2 \quad (5)$$

$$SST = \sum_{i=1}^n (x_i - \bar{x})^2 = SSE + SSR \quad (6)$$

where: SST is the sum of squares of the deviations of the differences between the observed and mean values of the dependent variable; SSE is the sum of squares of the residuals due to experimental errors, etc.; x_i is the true observed value; $\bar{x}$ is the mean of the true observed value; and $\hat{x}_i$ is the fitted value.

3. Findings and analysis

The two sets of listening test questions in this study, the pre-test and the post-test, are all questions from a city's unified test. Among them, the post-test questions are not duplicated with the classroom training questions to ensure the consistency of the pre and post-test question types, score distribution and difficulty coefficients. Both sets of test questions are multiple choice questions, totaling 20 questions, each question is 1.5 points, full marks 30 points. The test questions mainly examine students' three abilities: vocabulary discourse ability, analytical reasoning ability and main idea summarization ability, and their corresponding question types are: vocabulary discourse questions, analytical reasoning questions and main idea summarization questions, with a full score of 8, 14 and 8 points respectively.

3.1. Analysis of the effect of teaching controlled experiments

In order to test whether the listening comprehension ability of the students in the two classes is comparable, this paper carries out statistics on the total pre-test listening scores of the students in the experimental class and the control class, and the results are shown in Figure 2. As can be seen from Figure 2, before the teaching experiment, the mean value of students' pre-test listening scores in the experimental class and the control class were 17.62 and 18.60 respectively, and the difference between the mean values of the listening scores of the two classes was 0.98, which is a small difference.

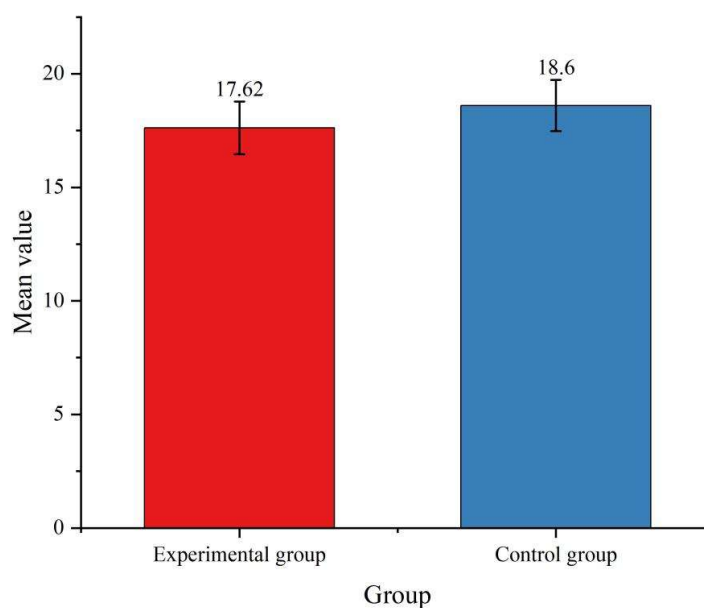


Fig. 2. Descriptive statistics of total pre-test listening scores

Independent samples t-test was performed on the pre-test scores and the visualization results are shown in Figure 3. The pretest scores of both the experimental and control groups conformed to normal distribution, and the independent samples t-test significance (two-tailed) $p\text{-value} = 0.967 > 0.05$ indicated that there was no significant difference in the listening scores of the two classes. Therefore, the two classes are reliable as experimental and control classes.

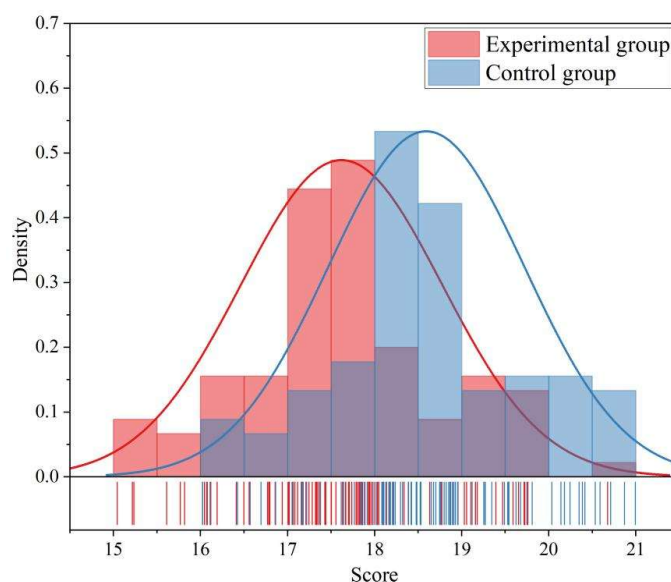


Fig. 3. Independent sample T test for total pre-test listening scores

After the experiment, this paper counts the total post-test listening scores of the students in the two classes, and the results are shown in Fig. 4. As can be seen in Figure 4, after the experiment, the mean values of the listening scores of the experimental class and the control class were 21.81 points and 19.79 points, respectively. The listening scores of both classes improved, the control class improved by 1.19 points and the experimental class improved by 4.19 points, and the experimental class improved more, which to some extent indicates that multimodal learning helps to improve the listening scores.

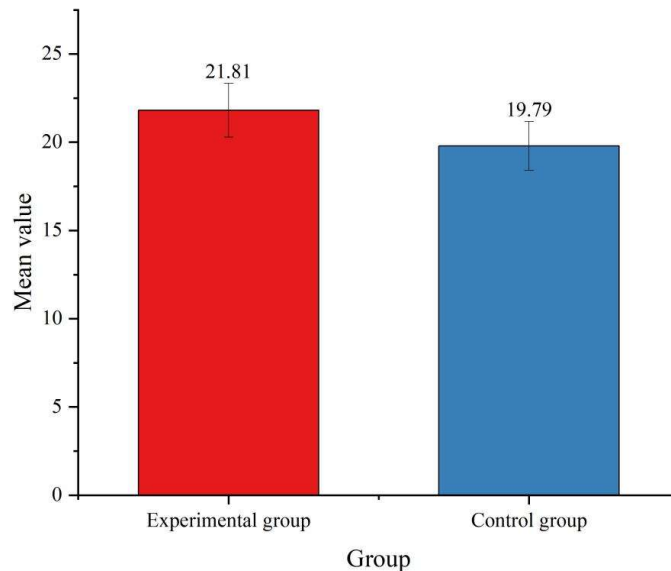


Fig. 4. Descriptive statistics of total post-test listening scores

An independent samples t-test was conducted on the posttest scores and the visualization results are shown in Figure 5. As can be seen in Figure 5, the posttest scores of both the experimental and control groups conform to a normal distribution with a significance (two-tailed) p -value = $0.008 < 0.05$, indicating that there is a significant difference in the listening scores of the two classes after multimodal learning. It can be inferred that multimodal teaching in the experimental class can improve students' English listening comprehension to a certain extent compared with the control class.

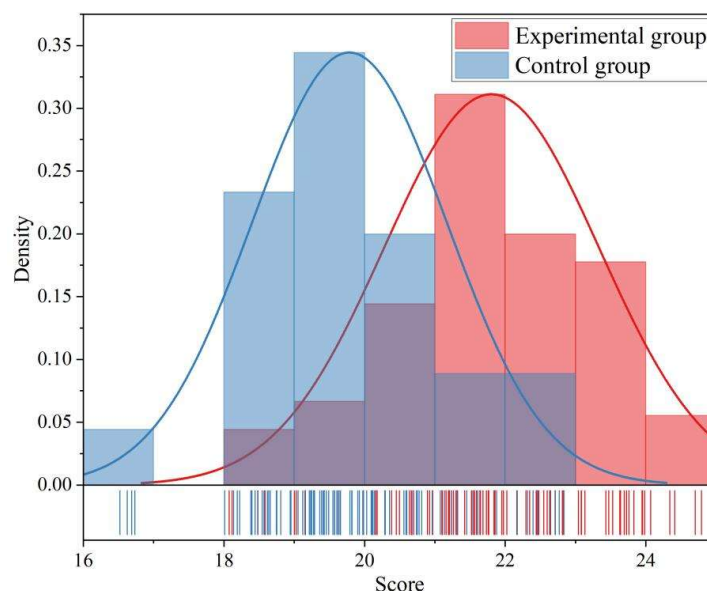


Fig. 5. Independent sample T test for total post-test listening scores

3.2. The Effect of Multimodal Learning on English Listening Comprehension Ability

3.2.1. Correlation analysis. This part of the study takes the experimental group as the research object, and statistically analyzes the correlations between the pre-course learning component, the in-course learning component, the post-course learning component and English listening comprehension ability. This study needs to analyze the correlation between the two before conducting multiple regression analysis, mainly using Pearson correlation analysis to explore whether there is a correlation between the three parts of multimodal learning and English listening comprehension ability and to what extent. The premise of correlation analysis is that there is a linear relationship between two variables. Therefore, this paper first presents the trend of change between each of the multimodal learning components and listening comprehension ability sequentially in the form of a scatter plot.

The relationship between pre-course learning and English listening comprehension ability is shown in Figure 6. From Figure 6, it can be observed that the scatter points in the graph are basically distributed around the middle diagonal line, and the scatter points between the vocabulary discourse variable and the listening comprehension ability variable are roughly in an upward trend from the lower left corner to the upper right corner, indicating that there is basically a linear relationship between the two variables, which may be a positive correlation. Therefore, this study was able to test the correlation between the two using Pearson's correlation analysis.

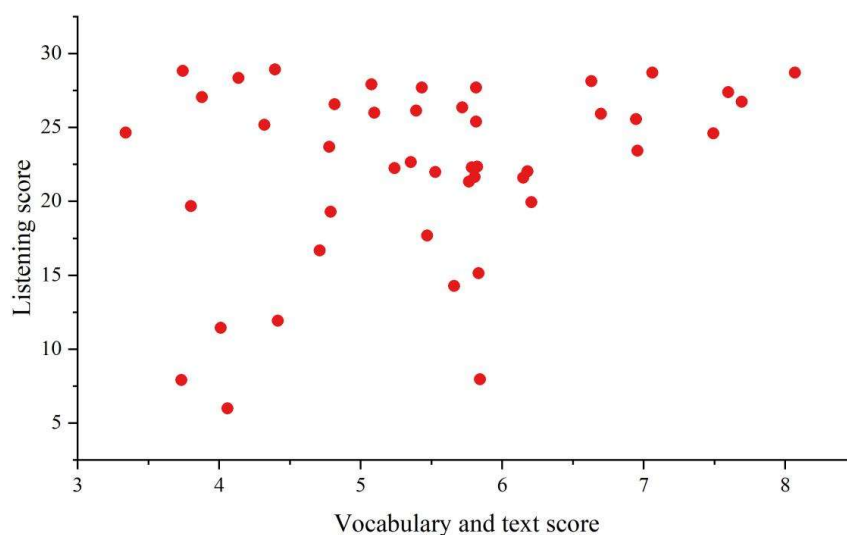


Fig. 6. The relationship between pre-class learning and listening comprehension

The relationship between classroom learning and English listening comprehension ability is shown in Figure 7. As can be observed from Figure 7, the scatter in the graph is roughly distributed around the middle diagonal line, and the scatter between the analytical reasoning variable and the listening comprehension ability variable shows a roughly upward trend from the bottom left to the top right, indicating that there is basically a linear relationship between the two variables, which may be a positive correlation. Therefore, this study was able to further test the correlation between the two using Pearson's correlation analysis.

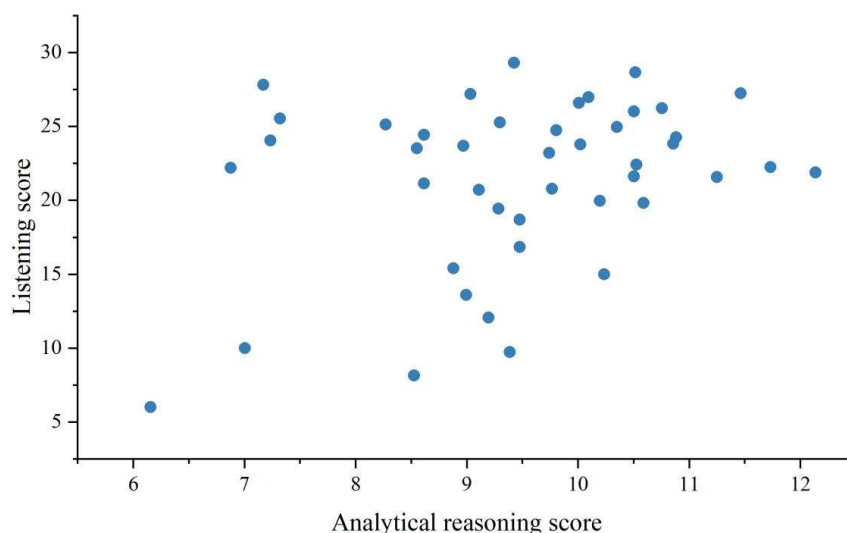


Fig. 7. The relationship between classroom learning and listening comprehension

The relationship between after-school learning and English listening comprehension ability is shown in Figure 8. As can be observed from Figure 8, the scatter points in the graph are basically distributed around the middle diagonal line, and the scatter points between the main idea summarization variable and the listening comprehension ability variable show a roughly upward trend from the lower left corner to the upper right corner, which indicates that there is basically a linear relationship between the two variables, probably a positive correlation. Therefore, the correlation between the two can be tested in this study using Pearson's correlation analysis.

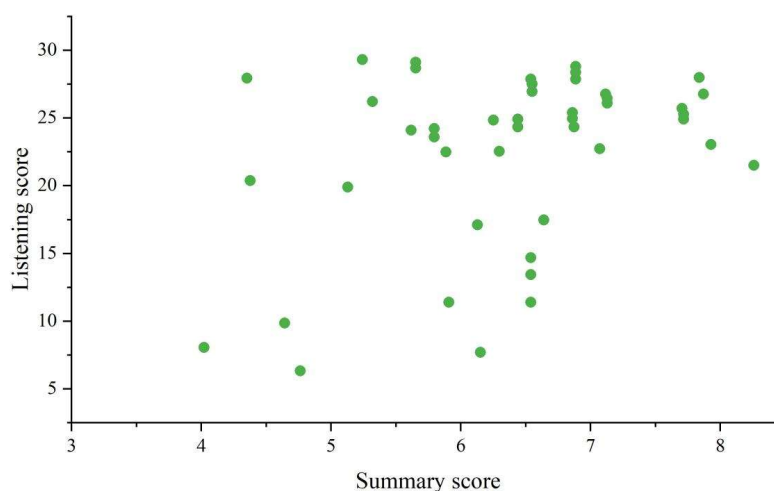


Fig. 8. The relationship between after-school learning and listening comprehension

Correlation analysis through Pearson's correlation analysis was conducted to obtain a positive linear relationship between pre-course learning, classroom learning and post-course learning in multimodal learning and their English listening comprehension ability.

3.2.2. Multiple linear regression analysis. In order to determine the combined explanatory power of multimodal learning on English listening comprehension ability, then the multiple regression model was used for analysis. The multiple regression model determines the magnitude of explanatory power by determining the value of R^2 and thus the results of the correlation analysis of the three independent variables on English listening comprehension ability are shown in Table 1.

Table 1. Multiple regression analysis

Model abstract b							
Model	R		R ²	Adjusted R ²	The error of the standard estimate	Durbin-Watson	
1	0.325a		0.154	0.132	5.297	1.734	
ANOVA a							
Model	Sum of squares		Degree of freedom	Mean square	F	Significance	
Regression	903.53		5	302.43	12.435	0.000	
Residual error	5873.25		218	32.19			
Total	6864.42		223				
Coefficient a							
Model	Unstandardized coefficient		Standardization coefficient	t	Significance	Collinearity statistics	
	B	Standard error	Beta			Tolerance	VIF
(constant)	5.274	3.187		1.973	0.167		
Pre-class learning	1.874	.983	0.118	1.983	0.058	0.719	1.673
Classroom learning	4.082	1.486	0.301	3.862	0.002	0.619	1.704
After-school learning	0.297	0.853	0.019	0.372	0.715	0.917	1.137

According to the data related to the analysis of the above table, it can be seen that the regression equation of synthesizing the three modes of learning and listening performance is significant

($F=12.435$, $p=0.000<0.001$), and according to the magnitude of the value of the coefficient of determination of the coefficient R^2 of the multivariate linear regression model, it comes out that the effect (predictive power) of the three modes of learning, namely, pre-course learning, classroom learning, and post-course learning, on English listening performance is 15.4%, which indicates that the effect (predictive power) of synthesizing the explanatory power of the three modal learning on English listening performance is 15.4%. The test of regression coefficient of pre-classroom learning reaches the significant level ($t=1.983$, $p=0.058<0.05$); the test of regression coefficient of classroom learning reaches the significant level ($t=3.862$, $p=0.002<0.05$); and the test of regression coefficient of after-classroom learning does not reach the significant level ($t=0.372$, $p=0.715>0.05$), which indicates that the integrated three modal learning can explain English listening performance. Classroom learning has a higher significance level of explanatory power for listening achievement compared to pre-classroom learning.

4. Conclusion

This paper proposes a multimodal teaching approach to English listening, and explores its effect and influence on students' English listening comprehension ability through a semester's comparison of teaching practices.

The mean values of students' pre-test listening scores in the experimental class and the control class were 17.62 and 18.60 respectively, with independent samples t-test significance (two-tailed) $p\text{-value}=0.967>0.05$. The post-test scores of the control class improved by 1.19 points, and those of the experimental class by 4.19 points, with significance (two-tailed) $p\text{-value}=0.008<0.05$. The results show that after the multimodal learning after, the experimental class improved more and there was a significant difference in listening scores between the two classes.

The results of Pearson's analysis show that there is a positive linear relationship between pre-course learning, classroom learning and post-course learning in multimodal learning and their English listening comprehension ability. The value of the coefficient of determination R^2 of the multiple linear regression model showed that the explanatory power of combining the three modalities of learning on English listening performance was 15.4%. The test of regression coefficient of pre-classroom learning reaches the significant level ($t=1.983$, $p=0.058<0.05$); the test of regression coefficient of classroom learning reaches the significant level ($t=3.862$, $p=0.002<0.05$); and the test of regression coefficient of after-classroom learning does not reach the significant level ($t=0.372$, $p=0.715>0.05$), which means that combining three modes of learning can explain English listening performance. Classroom learning has a higher significance level of explanatory power for listening achievement compared to pre-course learning.

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