

Analyzing the Effect of Task-Based Pedagogy on Learning Effectiveness in English Classroom Based on Computational Linguistic Modeling

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Abstract: This paper proposes to use computational linguistic modeling to assess teaching effectiveness, with the help of technical methods such as Wasserstein distance and cosine similarity to assist in the diagnosis of teaching effectiveness. Taking the English teaching of two ordinary classes in a key high school as the research object, the impact of task-based teaching on English learning effect is analyzed. The questionnaire method was utilized to investigate the changes in students' evaluation of English learning before and after the experiment. The results show that the mean value of the total grade of the experimental class using task-based teaching is 119.4973, which is about 35 points higher than the mean value of the total grade of the control class, and the test of difference in grades shows that $\text{sig}=0.00<0.05$, the difference in the grades of the two classes is significant, which verifies that the task-based teaching method can effectively improve the English learning effect of the students.

Keywords: assessment of teaching effectiveness; cosine similarity; Wasserstein distance; task-based teaching; English teaching

1. Introduction

With the changes in the concept of English education, the task-based teaching method has gradually attracted the attention of educators. In traditional teaching methods, teachers often take the way of teaching grammar, vocabulary and other knowledge points, and students as passive receivers complete various exercises under the guidance of teachers [1-2]. This approach often leads to a lack of actual language output and communication scenarios in the learning process [3]. However, in the context of globalization, language is no longer just a tool for information exchange, but also a platform for communication of culture, emotions and values, which puts forward requirements for the cultivation of students' actual communicative competence in English classrooms [4-6]. In view of the above problems, task-based teaching method can be adopted to effectively enhance the combination of theoretical teaching and practical teaching and improve the overall quality of English teaching.

Task-based teaching refers to the setting of a variety of tasks, so that students can explore the connotation of knowledge under the guidance of the teacher to improve the ability to understand and apply knowledge [7]. Teachers need to optimize and adjust teaching strategies according to students' learning status and preferences, so that students can face learning with a more positive attitude [8-10]. Task-based teaching focuses on the design of task content, teachers can set tasks according to the content of the textbook and teaching progress, as well as the learning ability of students, guiding students to solve learning problems from simple to complex, so as to enable students to deeply understand the connotation of English knowledge, and master the practical application of English knowledge [11-15]. Task-based teaching helps to enliven the classroom atmosphere, allowing students to find task solutions in the interaction, and to gain thought revelation and task processing inspiration in the discussion, so that students can have fun in the exploration, thus enhancing their interest in learning



English knowledge [16-19]. Based on the task-based teaching method, teachers, students, schools and education departments were able to work together to ensure that the teaching method could achieve the best results in practice and truly promote students' English learning and development [20-22].

The task-based teaching method not only challenges the traditional "listening, reading and writing" teaching mode, but also proves its significant effect on improving students' practical application of English in practice, bringing new opportunities and challenges to English education. In terms of the cultivation of listening ability, Chou, M. H. pointed out that the task-based teaching framework is conducive to the cultivation of students' metacognitive awareness of English listening, and helps students construct language knowledge by embedding the teaching in the task, so as to improve the effect of listening teaching in the English classroom [23]. Ni, Z. and Jingxia, L. applied the task-based teaching of listening to the English classroom, and the teaching method is conducive to the enhancement of the listening level and affective state of students, and is helpful for the improvement of students' listening skills and emotional state. Listening level and emotional state, which has important theoretical significance and practical significance for English classroom teaching [24].

In terms of oral skills development, Guerrero, B. R. S. et al. proposed the use of task-based learning method to guide students' oral skills development in English, and from the data of students' tests after the implementation of the teaching method, it can be seen that the task-based English language teaching method effectively improves the students' oral skills [25]. Masuram, J. and Sripada, P. N. showed that the task-based teaching method stimulates students' oral expression in the language classroom by carrying out a series of student-centered language activities, which makes students tend to be fluent and accurate for their oral skills [26]. Azizifard, F. M. argued that the implementation of task-based language teaching effectively promotes the frequency of students' use of spoken English, but it does not help to improve students' pronunciation skills [27].

In terms of reading ability development, Zhou, Y. elaborated on the positive impact of task-based teaching methods on English reading classrooms, in which students showed strong interest in classroom activities and tasks, and fully developed a sense of cooperation in the process of participation, built up self-confidence in English learning, and then improved their English reading ability [28]. NamazianDost, I. et al. empirically investigated the impact of task-based Language Teaching Method on English teaching effectiveness and found that it significantly enhances learners' motivation and develops students' grammatical competence by carrying out example and practice teaching [29]. Noroozi, M. and Taheri, S. compared the effects of PPP method with task-based teaching method in improving students' English grammar and strengthening their motivation, showing that TBLT teaching method has a more significant positive effect on the positive impact on learning outcomes is more significant [30].

In terms of writing ability development, Ahmed, R. Z. and Bidin, S. J. B. discussed the effectiveness of the task-based language teaching method for improving students' English writing ability, which is student-centered and makes full use of classroom teaching resources to promote students' fluent and confident use of English [31]. Husain, B. et al. focused on exploring the effectiveness of the task-based language teaching method on Husain, B. et al. focused on exploring the extent to which the task-based language teaching method enhances students' specific English writing skills, and found that it has a more significant effect on the improvement of narrative text writing skills [32]. The above studies analyze the influence of task-based teaching method and English learning effect mostly based on students' feedback and teachers' observation, with certain subjective experience. However, through the establishment of computer linguistic model, the linguistic problems can be formalized by mathematical methods, which can directly understand the complexity of English language analysis, and show the objective and scientific characteristics in exploring the practical utility of task-based teaching method.

This paper first clarifies the research object and utilizes a comparative experiment to investigate the effect of task-based teaching method on learning effects in English classroom. The cosine similarity is utilized to compare the similarity between students' effect output and teaching objectives, and the concept of optimal transmission is introduced to measure the distance between the distribution of students' effects and the distribution of expected objectives. Design and implement the teaching steps of task-based teaching in the experimental class and conventional teaching in the control class. Utilizing the questionnaire method to investigate the changes in students' learning attitudes and satisfaction with teachers' teaching styles before and after the experiment. Compare the results of the experimental class and the control class by conducting an English test after the experiment to investigate the teaching effect of the task-based teaching method.

2. Subjects and methodology of the study

2.1. Subjects of study

This paper takes the English teaching of two liberal arts regular classes in a key high school in City B as the object of study. From the Registrar's Office, we can know the class placement situation: the liberal arts are divided into classes according to the average grade rankings of the previous large-scale examinations in the first year of high school (including midterm exams, final exams, and monthly exams), and the students in the two liberal arts general classes come from the bottom 118 ranked students in the school year (220 liberal arts students in total), of which 58 are in class (6), and 60 are in class (7). There are only 13 students whose enrollment scores can reach the admission score line of the year.

Based on the above academic situation, this paper determines the number of students in the experimental and control classes through two steps.

Step 1: Preliminary selection of experimental subjects.

According to the following: according to the results of previous large-scale examinations of English in the first year of high school (including monthly exams, midterm and final grades), students with scores lower than 90 points (out of 150 points).

Step 2: Determine the experimental subjects.

After a period of classroom observation and analysis of the pre-test scores, this paper finds that: 49 out of 58 students in the (6) class in the pre-test scored less than 90 points (out of 150 points). Among them, there are three students who, through the usual unit test and classroom performance, have stable and front-ranking academic performance, a positive attitude to learning, and study hard and take the initiative, so this paper thinks that the failing grade is caused by chance. These three students were not included in the experimental research subjects. As for the nine people whose grades are above 90 points, there are two students with unstable learning status, poor learning foundation and poor habits. This paper believes that their passing grade this time belongs to accident, so these two students are classified into the subjects under study. (The total number of students selected for the experimental study in class (6) is 48. (The process of determining the number of research subjects in class (7) is the same as class (6).

Based on the above process, the author determined class (6) as the experimental class with a total of 58 students and 48 students participating in the experimental study, and class (7) as the control class with a total of 60 students and 50 students participating in the experimental study.

2.2. Research methodology

The pre-test and post-test papers used in this study were developed by the head of the English section of the sophomore year of this major high school. He is a long-time English team leader with rich teaching experience, is skilled in integrating teaching materials and has conducted research on English tests. He was not involved in the teaching of the experimental and control classes, so he was able to maximize the interference of human factors in the test-making process. In the preparation of the test questions, the head of the preparation team organized the questions in the ratio of 6:3:1 for basic, intermediate and difficult questions. In the correction process of the test questions, a sealed-roll running operation was used and both essays were marked by the same group of teachers (3). After the results were checked, the pass rate, excellence rate, and average score of the two tests before and after the investigation were compared, so that the effect of task-based teaching on English learning could be determined.

3. Application of computational language modeling in pedagogical corpus analysis

3.1. Cosine distance

In ELT corpus analysis, the cosine distance is commonly used to compare the similarity between student effect output and teaching goals. For word embeddings obtained at different time periods, we need to use a metric to compare them and get the semantic change index of the target vocabulary. Since the representations obtained by all types of word embedding methods are vectors in a continuous real number space, the distance between them can be measured by the cosine distance metric. The cosine distance is derived from the computation of cosine similarity: $Cosine_Distance = 1 - Cosine_Similarity$. In a word embedding vector space of dimension n , the

cosine similarity between two words with vector representations u_1 and u_2 respectively is:

$$\text{Cosine}_{\text{similarity}}(u_1, u_2) = \frac{u_1^T \cdot u_2}{\|u_1\| \cdot \|u_2\|} = \frac{\sum_{i=1}^n (u_{1,i} \cdot u_{2,i})}{\sqrt{\sum_{i=1}^n u_{1,i}^2} \cdot \sqrt{\sum_{i=1}^n u_{2,i}^2}} \quad (1)$$

By calculating the vector representations of words in different time periods or in different contexts and comparing the remaining chordal distances, it is possible to detect semantic changes of words in the corpus.

3.2. Optimal transmission with Wasserstein distance

The Wasserstein distance arose from the concept of optimal transmission, which provides a measure of dissimilarity between two probability distributions. Due to its widely applicable geometric properties, many applications of this distance metric also exist in ELT corpus analysis. The distance can also be used to measure the semantic similarity of a target word in two time periods if we regard the nearest neighbors of the target word (and their embedding vector representations) in the word embedding models of the two time periods before and after as two different probability distributions.

The Wasserstein distance is a solution to the optimal transmission problem that takes into account the underlying geometry of the space and is able to obtain information from distributions with non-overlapping support. With optimal transmission, it is possible to measure the distance between the student's output distribution and the expected target distribution, which in turn reflects the student's completion of the task. We will give the definition of the Wasserstein distance.

Let $M_+^1(\mathbb{R}^d)$ denote the space of all probability distributions defined on \mathbb{R}^d , $d \in \mathbb{N}^*$. The Wasserstein distance between two arbitrary measures $\mu \in M_+^1(X)$ and $\nu \in M_+^1(Y)$ is defined by solving the Monge-Kantorovitch mass transportation problem:

$$W(\mu, \nu) = \min_{\pi \in U(\mu, \nu)} \left(\int_{X \times Y} \|x - y\|^p d\pi(x, y) \right)^{1/p} \quad (2)$$

where $V(\mu, \nu) = \left\{ \pi \in M_+^1(X \times Y) : \int \pi(x, y) dy = \mu(x); \int \pi(x, y) dx = \nu(y) \right\}$ is the set of joint probability distributions with μ and ν as edges. Our goal is to find the best way to transfer the probability mass from μ to ν while minimizing the transportation cost defined by the Euclidean distance.

More specifically, we denote by μ_1 and μ_2 the set of k nearest word embeddings of the target word in the two vector spaces, respectively, and by c_1 and c_2 the weights of each word embedding in the two distributions $(\mu_1 \text{ And } \mu_2)$. Our task is to quantify the cost of moving a unit of mass from μ_1 to μ_2 using a chosen cost function. This problem can be solved by finding a transportation plan γ : we wish to reconfigure the mass distribution of c_1 into that of c_2 and pay the smallest possible cost for it. The Wasserstein distance is the sum of all the transports that must be made to solve the problem:

$$W(c_1, c_2) = \min_{\gamma} \sum_{i,j} \gamma_{i,j} M_{i,j} \quad (3)$$

where $M \in \mathbb{R}_{m \times n}^+$ is the cost matrix used to define the cost required to move a unit of mass from μ_1 to μ_2 . The cost function chosen for this paper is the cosine distance, which is $M = \text{Cosine_Distance}(\mu_1, \mu_2)$.

4. Application of computational linguistic modeling to the assessment of teaching effectiveness

4.1. Experimental design

In this experiment, both the experimental and control classes used the same set of textbooks, but the teaching methods were not the same. The experimental class adopted the task-based teaching method, while the control class still adopted the traditional 3P model.

4.1.1. Instructional design for control classes

The control class used the traditional 3P model for teaching English. 3P model, i.e., teaching with demonstration→drill→result as the basic steps. Taking the teaching of definite clauses as an example, when the teacher explains the usage of relational pronouns in definite clauses, the teacher first presents a set of example sentences to the students, and then the teacher explains them one by one by using these example sentences, and the students take notes mechanically. Immediately after that, the students were asked to practice repeatedly, and finally they were asked to express themselves with the grammar knowledge they had learned.

Obviously, in such a teacher-centered teaching mode, the students' subjective position is not respected, and it emphasizes the structure and function of language, and there is a lack of real communication in the classroom, and it is difficult to achieve the purpose of information exchange between teachers and students.

4.1.2. Instructional design of the pilot class

The experimental class adopted the task-based teaching method advocated by the New Curriculum for English teaching. Compared with the traditional 3P model, the task-based teaching method has changed the obsolete English teaching mode and injected a new element - task - into English teaching. Instead of teacher-oriented English teaching, the classroom is a new type of teaching method with teacher-student and student-student interaction. This teaching method breaks the original dead atmosphere of the classroom. Through the design of different tasks, students are mobilized to learn, so that they can participate in the process of teaching, experience the fun of it, and through their own efforts, gain knowledge and develop skills from it.

Therefore, the teaching design of the experimental class is centered on “how to design tasks”. However, before designing tasks, teachers must be clear that language task activities are not the same as language practice, so it is necessary to understand the essential difference between English tasks and English practice.

For example, “Students judge the correctness or incorrectness of a sentence according to the weather conditions they hear” is an exercise in language, while “Students decide what to wear according to the weather conditions they hear” is a task activity in language. In addition, teachers must master the contents of task-based English teaching, including the objectives of English teaching, the principles of task design and the implementation steps of task-based teaching method.

4.2. *Analysis of student evaluations*

The questionnaire is designed with a total of 8 questions, which can be divided into two aspects according to different emphases: students' interest and attitude towards English learning, teachers' English teaching methods, and students' satisfaction. All 8 items are multiple-choice questions, and the options are set as "A strongly agrees", "B somewhat agrees", "C generally", and "D disagrees", and the respondents make real choices according to their actual situation. Before and after the experiment, questionnaires were conducted on two classes of students.

4.2.1. Learning attitudes

Students' interest and attitude towards English learning were designed from four sub-items: "Learning English is interesting", "Learning English is very important", "Learning English is very helpful for the future", and "It takes a long time to learn English every day", and the question numbers are Q1~Q4.

The attitudes towards learning English in the experimental and control classes before the experiment are shown in Table 1. According to Table 1, we can see that students generally believe that learning English is important, and the data of choosing option D for Q2 in both classes before the experiment are below 10%. But at the same time, we also see that students still have a hard time learning English, because the students who spend a relatively long time learning English every day in the two classes before the experiment are more than 60%, which puts pressure on students' learning.

Table 1. Attitudes towards English learning before the experiment

		Experimental class				Comparison class			
		A	B	C	D	A	B	C	D
Q1	Number of people	12	18	10	8	11	16	17	6
	Percentage	25%	37.5%	20.83%	16.67%	22%	32%	34%	12%
Q2	Number of people	16	20	8	4	13	19	15	3
	Percentage	33.3%	41.67%	16.67%	8.33%	26%	38%	30%	6%
Q3	Number of people	14	17	7	10	9	21	13	7
	Percentage	29.17%	35.42%	14.58%	20.83%	18%	42%	26%	14%
Q4	Number of people	5	27	10	6	9	23	12	6
	Percentage	10.42%	56.25%	20.83%	12.5%	18%	46%	24%	12%

The English learning attitudes of the experimental and control classes after the experiment are shown in Table 2. It can be seen that the English learning attitude of students in the experimental class has changed significantly. Originally, the students thought that English learning was still more important, and after the experiment, the students' interest in English learning has become stronger, and the number of students who agreed that learning English was interesting has increased from 62.5% to 81.25%, and the amount of time they spent on learning English every day has decreased, and the number of students who spent a long time on English learning has decreased to 27.09%, indicating that the students' efficiency in English learning has become higher. This indicates that the students' English learning efficiency has become higher. And there is no significant difference in the data of the control class.

Table 2. Attitude towards learning English after the experiment

		Experimental class				Comparison class			
		A	B	C	D	A	B	C	D
Q1	Number of people	22	17	6	3	10	17	18	5
	Percentage	45.83%	35.42%	12.5%	6.25%	20%	34%	36%	10%
Q2	Number of people	20	20	6	2	14	18	15	3
	Percentage	41.67%	41.67%	12.5%	4.16%	28%	36%	30%	6%
Q3	Number of people	19	17	7	5	9	21	11	9
	Percentage	39.58%	35.42%	14.58%	10.42%	18%	42%	22%	18%
Q4	Number of people	2	11	19	16	8	24	13	5
	Percentage	4.17%	22.92%	39.58%	33.33%	16%	48%	26%	10%

4.2.2. Satisfaction

The design of teachers' English teaching methods and students' satisfaction items was carried out from four sub-items: "teachers encourage students to participate in classroom interaction", "teachers adjust the teaching rhythm in time according to students' conditions", "teachers stimulate students' interest in learning English through a variety of means", and "English classroom atmosphere is relaxed and happy", and the question numbers are Q5~Q8.

The teacher's English teaching methods and students' satisfaction before the experiment are shown in Table 3. From Table 3, we can see that students in both experimental and control classes are not very satisfied with the teacher's traditional 3P mode teaching method, and the number of students who think that the teacher provides students with the opportunity to participate in the classroom is below 20%. Because of the lack of communication, the teacher could not adjust the pace of teaching according to the students' situation, which indirectly affected the classroom atmosphere, and the number of students who thought the classroom atmosphere was not relaxing enough accounted for about half of the students (45.83% in the experimental class and 50% in the control class). This shows that teachers should consider the needs of students when teaching English and mobilize students to participate in it together, and the learning effect is guaranteed only when students are satisfied. In addition, more than half of the students thought that teachers did not stimulate students' interest in learning English through various means.

Table 3. English teaching methods and students' satisfaction before the experiment

		Experimental class				Comparison class			
		A	B	C	D	A	B	C	D
Q5	Number of people	3	6	20	19	2	6	25	17
	Percentage	6.25%	12.5%	41.67%	39.58%	4%	12%	50%	34%
Q6	Number of people	8	13	18	9	7	15	19	9
	Percentage	16.7%	27.08%	37.5%	18.75%	14%	30%	38%	18%
Q7	Number of people	3	15	14	16	2	17	11	20
	Percentage	6.25%	31.25%	29.17%	33.33%	4%	34%	22%	40%
Q8	Number of people	5	9	12	22	3	13	9	25
	Percentage	10.42%	18.75%	25%	45.83%	6%	26%	18%	50%

The teacher's English teaching style and students' satisfaction after the experiment are shown in Table 4. According to the data changes in Table 4, we can see that the satisfaction of the students in the experimental class with the teacher's English teaching increased, and the percentage of students who thought the classroom atmosphere was relaxing and enjoyable increased to 68.75%. This is because the task-based teaching method provides students with more opportunities to participate in classroom teaching. The time for the teacher to give focused explanations is decreasing, but the students' participation is higher, so the students are more receptive and the results are better. And there is no significant change in the satisfaction level of the control class.

Table 4. English teaching methods and students' satisfaction after the experiment

		Experimental class				Comparison class			
		A	B	C	D	A	B	C	D
Q5	Number of people	13	19	10	6	3	6	24	17
	Percentage	27.09%	39.58%	20.83%	12.5%	6%	12%	48%	34%
Q6	Number of people	18	20	8	2	7	16	18	9
	Percentage	37.5%	41.67%	16.66%	4.17%	14%	32%	36%	18%
Q7	Number of people	18	15	12	3	2	15	11	22
	Percentage	37.5%	31.25%	25%	6.25%	4%	30%	22%	44%
Q8	Number of people	24	9	10	5	3	16	8	23
	Percentage	50%	18.75%	20.83%	10.42%	6%	32%	16%	46%

4.3. Analysis of Teaching Effectiveness

After the experimental cycle, students in the experimental and control classes were tested in English (out of 150 points) and the performance data were tested and analyzed using statistical software.

The analysis of variance of grades and the data of grades are shown in Tables 5 and 6. As can be seen in Tables 5 and 6, the mean of the total grades of the experimental class after the experiment was 119.4973, the standard deviation was 1.86743, and the standard error of the mean was 0.24860. The mean of the total score of the control class was 84.0835 with a standard deviation of 1.58543 and a standard error of mean of 0.21894. The difference in the performance of the two classes, the experimental class and the control class, is significant, and from the analysis of variance data, $\text{sig}=0.00<0.05$, it can be concluded that the difference in the performance of the two classes is significant, thus verifying that the empirical study of the task-based teaching method in high school English language teaching regarding the students' learning effect has a significant effect.

Table 5. Analysis of differences in performance

Class - Total grade	Paired Differences					t	df	Sig.
	Mean	Std. Deviation	Std. Error Mean	95% Confidence interval of the Difference				
				Lower	Upper			
	-25.3864	4.3834	.3862	-24.6465	-22.2867	-69.978	132	.000

Table 6. Performance data after the experiment

	Mean	N	Std. Deviation	Std. Error of Mean
Experimental class	119.4973	48	1.86743	.24860
Comparison class	84.0835	50	1.58543	.21894
Total	101.7904	98	3.58632	.34752

5. Conclusion

This paper proposes to use computer language modeling to analyze the effect of adopting task-based teaching method on the effect of English learning, and design a controlled experiment to verify it.

The number of students who agreed that learning English was interesting increased from 62.5% to 81.25%, the number of students who spent a relatively long time learning English every day decreased to 27.09%, and the number of students who thought the classroom atmosphere was relaxing and enjoyable increased to 68.75%. There was no significant difference in the data of the control class, indicating that the task-based teaching method is beneficial to the students' learning attitude and satisfaction.

After the experiment, the mean of the total grade of the experimental class was 119.4973, the standard deviation was 1.86743, and the standard error of the mean was 0.24860. The mean of the total grade of the control class was 84.0835, the standard deviation was 1.58543, and the standard error of the mean was 0.21894. The validation of the variability of the grades showed that $\text{sig}=0.00<0.05$, and the variability of the grades of the two classes was significant, thus verifying that the task-based teaching method has the same significant effect in the enhancement of learning effect.

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