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A Teaching Model for university English Translation Based on Markov Chain and Mathematical Multiple Intelligence Theory

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Abstract The application of digitalization and intelligence-related technologies brings unprecedented opportunities and challenges to the development of university English translation teaching. In response to the current English teaching reform, this paper designs a university English translation teaching model based on mathematical multiple intelligence theory. In order to make this teaching mode better serve students and teachers, a personalized recommendation algorithm based on Markov chain is introduced on the original teaching mode. The research samples are selected, the groups as well as the questionnaires are set, the research hypotheses and methods are given, and the task of formulating the research program is finally completed. With the help of independent samples t-test, the university English translation teaching model of this paper is validated and analyzed. There are significant differences between the two in comprehension ($F=2.421$, $p=0.009<0.01$), analytical ($F=16.522$, $p=0.002<0.01$), practical ($F=6.928$, $p=0.008<0.05$), and reflective ($F=8.006$, $p=0.009<0.01$) skills, which indicates that the model of university English translation teaching based on the Markov chain and the Mathematical Multiple Intelligences Theory of University English Translation Teaching Model, which has a more obvious effect on the improvement of students' English translation ability.

Index Terms Markov Chain, Mathematical Multiple Intelligences Theory, Independent Samples t-Test, English Translation Teaching Model

I. Introduction

As far as the current teaching situation of university English is concerned, one of the more common phenomena is that English teachers in colleges and universities pay little attention to English translation teaching, there is no teaching material specialized in English translation teaching, and the teaching methods used by English teachers in colleges and universities in the process of translation teaching need to be improved and enhanced, etc. [1]-[4]. College English translation teaching has many advantages, the most notable of which is that it allows students to more deeply appreciate the differences between English and Chinese through specific content, and it can also enhance students' comprehension of English [5]-[8]. However, the current ways of teaching English translation at university are extremely limited, and the teaching effectiveness of most teaching methods is not outstanding [9]-[11].

With the deepening of the concept of university English teaching reform, and to a certain extent, it has promoted the innovation of university English translation teaching, and the theory of multiple intelligences in the era of information technology is more inclined to the use of modern information technology [12]-[15]. At present, people get information mainly from computers and the Internet, and most of the multiple intelligence theories can correspond to the corresponding network information [16], [17]. Internet technology combines various advantages in one, and its advantages in teaching also abound. College English teachers should be able to explore the teaching resources in Internet technology, enrich the teaching links and contents, and carry out the teaching work in a more innovative way, so as to promote the implementation of the theory of Multiple Intelligences into the college English teaching work [18]-[21]. In addition to the theory of multiple intelligences, Markov chain is also an effective model of university English translation teaching, the core idea of which is that “the future state depends only on the current state and has nothing to do with the past state” [22]-[24]. As a mathematical model describing state transfer, Markov chain can be better utilized to realize English translation teaching and enhance students' learning effect through learning and understanding its basic knowledge [25]-[27].

In this paper, we first design a university English translation teaching mode based on mathematical multiple intelligence theory, and find that the teaching mode lacks personalized recommendation function, and for the teaching problems reflected above, we propose to add personalized recommendation algorithms based on Markov chain on the basis of the original teaching mode, so that its teaching mode can better give back to students and teachers. In order to verify the practical application effectiveness of the university English translation teaching model based on Markov chain and mathematical multiple intelligence theory, the corresponding research program is formulated. After verifying the personalized recommendation algorithm based on Markov chain, the teaching mode of this paper is verified, aiming to promote the innovation and reform of university English translation teaching in colleges and universities.

II. Design of University English Translation Teaching Model

II. A. Teaching Model Based on the Theory of Multiple Intelligences in Mathematics

Currently, education is in a period of important changes, and university English translation teaching, as an important part of higher education, is also facing new challenges. Multiple Intelligences Theory, with its many advantages, provides an excellent guidance program for university English translation teaching mode [28]. This subsection comprehensively analyzes the connotation and characteristics of the theory of multiple intelligences, and on the basis of it, it plans and innovates the university English translation teaching mode, which is mainly embodied in the following aspects, i.e., the application of multimedia in the teaching of university English translation, the exercise of translation ability of students in colleges and universities and the enhancement of the students' English translation literacy, with the main purpose of innovating the teaching method of English translation and cultivating more students' English literacy through the innovation of the teaching method of English translation. The main purpose is to cultivate more talents of the new era by revolutionizing the teaching methods of English translation.

II. A. 1) Enhancing the level of English translation teaching at universities

At present, people's sources of information are mainly computers and the Internet, and most of the multiple intelligences theories can correspond to the corresponding network information. The Internet technology integrates various advantages, and its advantages in teaching also abound. Teachers of college English should be able to explore the teaching resources in the Internet technology, enrich the teaching links and contents, and carry out the teaching work in a more innovative way, so as to promote the implementation of the theory of Multiple Intelligences into the college English teaching work. As we know, information network technology promotes the integration of multiple intelligences theory and university English translation teaching to a certain extent. As the theory of multiple intelligences must rely on rich information resources and fully meet the actual situation, and these network information technology can meet. In addition, the functions of current information technology are constantly optimized and enriched, so the university English translation teaching has a more solid technical support. The integration of Multiple Intelligences Theory into university English teaching has improved the effectiveness of university English translation teaching.

II. A. 2) Developing students' translation skills

The ultimate goal of translation teaching is to improve students' ability in English translation. Through in-depth analysis, we can know that translation is a more complex project, which requires students to have a certain knowledge reserve, in addition, students must also have a certain grasp of the connection and difference between the two languages, so with the help of the theory of multiple intelligences to revolutionize the teaching of English translation in universities is somewhat feasible. University translation teaching can start from the following aspects, firstly, how to lead students to learn the transformation between English and Chinese, secondly, let students learn to compare and analyze the articles, in addition to enriching students' translation strategies.

II. A. 3) Focusing on the improvement of students' basic English language skills

For college students to improve their English translation ability, the first thing is to have a clearer grasp of the key grammar. Therefore, it is also very necessary to incorporate grammar teaching into university English translation teaching, because students can only grasp the translation content more accurately under the premise of mastering English grammar.

II. B. Optimization of teaching models

In order to improve the teaching effect of the above teaching model, it is proposed to add a personalized teaching resource recommendation model based on Markov chain on the basis of the university English translation teaching model based on mathematical multiple intelligence theory. The optimization contents of the specific teaching model are as follows:

II. B. 1) Markov chains

The set of a series of random variables generated every passing moment in a natural society is called a stochastic perigee, and a Markov process is a special kind of stochastic process [29]. A stochastic process is called a Markov process if the state it is in at the moment t_1 is only related to the state it is in at the moment t_0 and not to the state it was in prior to the moment t_0, and a Markov process is said to be a Markov chain if the time and the state in a Markov process are both discrete. A Markov chain is shown in Figure 1. In Fig. 1, state a is used as the initial state and at the next moment two states b and c are made simultaneously and finally state d is produced.

A Markov chain is described as follows: let the stochastic process $X\{X_n, n \in T\}, T = \{0,1,2,\ldots\}$, X, corresponding to the state space $I = \{i_0, i_1, i_2, \ldots\}$, for any $i_n \in I$, the conditional probability formula is satisfied as shown in (1):

$$P\{X_{n+1} = i_{n+1} \mid X_0 = i_0, \ldots, X_n = i_n\} = P\{X_{n+1} = i_{n+1} \mid X_n = i_n\} \tag{1}$$

Then $\{X_n, n \in T\}$ is called a Markov chain.

In the classical Markov chain-based sequential recommendation model, the transfer probability of transferring one state to another state is first obtained based on the user's historical behavioral sequence data, whose formula is shown in (2):

$$p_{ij}(n) = P\left\{X_{n+1} = j \mid X_n = i\right\} \tag{2}$$

where X_n denotes the Markov chain, and $p_{ij}(n)$ is the transfer probability at moment n, i.e., the n-step transfer probability, whose significance is the conditional probability of making a state j under the condition of state i at moment n. After that, the transfer probability is used to construct the state transfer matrix, each item in the state transfer matrix is a transfer probability, and the formula of the state transfer matrix is shown in (3):

$$P = \begin{bmatrix} p_{11} & \cdots & p_{1m} \\ \vdots & \ddots & \vdots \\ p_{m1} & \cdots & p_{mm} \end{bmatrix} \tag{3}$$

where P is the matrix consisting of transfer probabilities p_{ij} and m denotes the number of all states. Finally, the probability prediction matrix of the user's next behavior is derived from the product of the user behavior matrix and the state transfer matrix, which is shown in (4):

$$predict = \frac{B \times P}{|B|} \tag{4}$$

where B represents the user behavior matrix, the matrix consists of 0 and 1, 1 when the user makes a state, 0 when the user does not make the corresponding state. The matrix obtained is the probability matrix of the user's future behavior, through the size of the probability of sorting can be personalized recommendation. Then according to the principle of multi-attribute decision-making to calculate the comprehensive performance of each service in the recommendation results QoS, in the multi-dimensional utility merger, this paper uses the addition rule, the weight of each utility that is the performance demand calculation ω_k, utility merger function is as follows:

$$QoS_i = \omega_i q_i + \omega_2 q_i + \cdots + \omega_m q_i \tag{5}$$

QoS_i denotes the comprehensive performance of personalized recommendation S_i, based on the size of QoS_i, the recommendation results of Markov chain are reordered, and then the $top-N$ of the ordering result is recommended to the user as the final result.

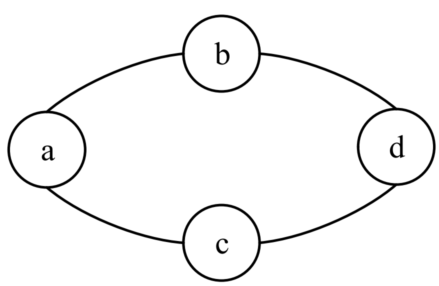


Figure 1: Markov chain display diagram

II. B. 2) Specific optimization process

Teacher behavior records are used to record teachers' various operations on the teaching platform to provide a data basis for personalized recommendation. According to the teacher's behavioral objects, teacher behavior records can be divided into resource behavior records, teaching task records and label behavior records. Resource behavior record is to record teachers' operation behaviors on resources during the interaction process of user interface (UI), including downloading, rating, collecting and browsing. Teaching task records refer to the instructional design and lesson planning operations performed by teachers during UI interactions. Tag behavior records refer to the actions performed by teachers on recommended resource tags, including selecting, modifying, deleting, and adding. The course model is used to represent the relationships between courses and the content characteristics of each lesson, and consists of course relationships and course labels based on Markov chains. In the traditional teacher-centered university English translation teaching model, course design and teaching tasks are organized according to the sequence of lessons in each subject book, so teachers will likewise follow this sequence and use the resources related to the courses. Markov chain describes a sequence of states, each state value of which depends on a finite number of previous states, therefore, a Markov chain is used to represent the sequential relationship between courses, i.e., the course prepared by the teacher's next state is only related to the course position he/she is currently in, and by using the state-transformation relationship of the Markov chain, the teacher's position in the course structure when he/she logs into the teaching platform again can be predicted, and thus more accurately recommend relevant resources. The course model is shown in Figure 2, $\alpha_i\left(i \le i \le M, M \text{ Is the number of course nodes}\right)$ denotes a state transition relationship between the state $Lesson_i$ to state $Lesson_{i+1}$, β_i denotes the probability of going from state $Lesson_i$ to state $Lesson_i$, $\alpha_i + \beta_i = 1$, and $\alpha_0 = 0$. The course labels are used to represent the content features of each lesson, which are represented using a vector space model (VSM) and can be represented by equation (6):

$$TagS_{Li} = \left\{ tag_k : w_k \mid 1 \le k \le N_t, \sum_{k=1}^{N_t} w_k = 1 \right\} \tag{6}$$

where, tag_k denotes the k th label. w_k is its weight. N_t is the number of label sets, which are initialized and adaptively adjusted by the course label adjustment module in the offline layer.

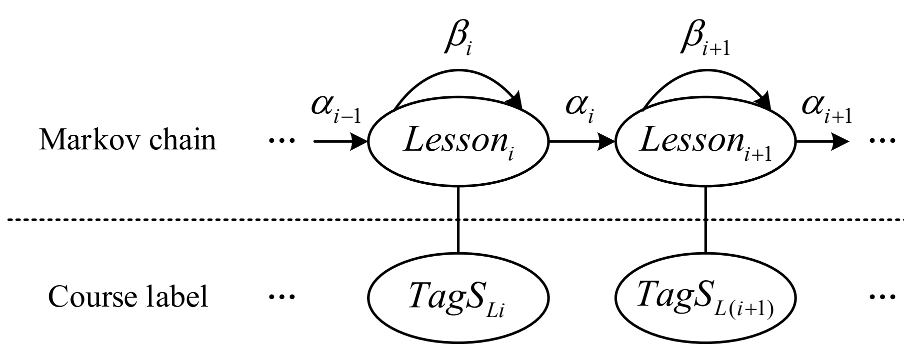


Figure 2: Curriculum model

The resource model includes (1) static attributes, which are mainly the resource owner's description of the resource, including resource title, resource keywords, resource description and resource type (e.g., image, video, audio, document, etc.). (2) Resource labels, which represent the resource content characteristics, are represented using VSM, as in equation (7), and their initialization and adjustment processes are completed by the resource label adjustment module in the offline layer. Namely:

$$TagS_{Ri} = \left\{ tag_k : w_k \mid 1 \le k \le N_{Ri}, \sum_{k}^{N_{Ri}} w_k = 1 \right\} \tag{7}$$

The teacher model consists of static attributes and dynamic course attributes. Static attributes refer to the necessary information that the user fills in when registering, such as user name, registered email address, etc. Course attributes record the teacher's position in the course model and dynamically track the user's contextual environment. Although the advantages of multiple intelligences theory in the university English translation teaching model are very obvious, and this theory still has a lot of room for development, it is also necessary to use the personalized recommendation ability of Markov chain, according to the English translation level of the students in the class to collect the appropriate learning resources and share them with the students to use these auxiliary resources to learn, and then enhance their own ability in English translation.

III. Study design

III. A. Purpose and methodology of the study

III. A. 1) Purpose of the study

The aim is to try to prove, through empirical research and data analysis, that the university English translation teaching model based on Markov Chain and Mathematical Multiple Intelligences Theory helps to cultivate students' interest in learning, enhance their confidence, and improve their communicative translation ability in the communicative function and chapter dimensions of the translated text.

III. A. 2) Research methodology

In this empirical study, the pre-test and post-test papers were designed, and the pre-experiment and post-test questionnaires and student discussions were conducted at the same time. Both the pre-test and the post-test are conducted in a closed-book written test, and the content of the test questions is selected from the "National International Business English (Level 2) Test Translation Part Questions" and "National Translation Qualification (Level) Test (Level 3)" test questions, so the reliability, validity, difficulty and differentiation of the test questions are guaranteed. Given that the questions in this test are all subjective, the scoring process includes self-assessment, other assessment and hand-in assessment in order to try to avoid the influence of the assessor's subjective factors on the scores in manual marking. The same scoring criteria were used in this study in order to be consistent with the evaluation criteria of translation ability in the formative assessment of students. The fifth item, Revision Process, which is set up for teaching needs, was not included in the evaluation in this test, so the total score of the test paper was 90. All 30 students in the class took the test, and due to the small number of students, the results were all included in the analysis, therefore, there is no factor of unreasonable data sampling.

III. B. Group Setting and Study Hypotheses

III. B. 1) Group settings

The two classes, totaling 60 students, were divided into experimental and control groups by class, all of which were students of the class of 2020 majoring in English (business English direction) in a university. The teaching mode was implemented from March 2022 to November 2022, a total of two semesters, 5 credit hours per week, a total of 30 teaching weeks, a total of 150 credit hours. The two groups of students took a pre-test of business English translation ability before the implementation of the teaching model, with the purpose of measuring the differences between the groups. Then the experimental group adopted the teaching model of “College English Translation Based on Markov Chain and Mathematical Multiple Intelligences Theory”, while the control group adopted the teaching model of College English Translation Based on Mathematical Multiple Intelligences Theory. At the end of the program, the two groups of students took a post-test of college English translation proficiency. We tried to confirm that the teaching model of “University English Translation Based on Markov Chain and Mathematical Multiple Intelligences Theory” has a facilitating effect on students' English learning through the post-test. A pre-test questionnaire, a post-test questionnaire and a student interview were also conducted. In order to avoid the negative influence of the unknown factors in the evaluation system of the new teaching model on the evaluation of students' merits and scholarships, the experimental group practiced the parallel approach of the old and new evaluation systems, evaluating the students according to the two standards at the same time.

III. B. 2) Research hypotheses

As a core part of the translation competence system, translation solution competence is characterized by higher-order thinking and contains four dimensions: comprehension, analysis, practice and reflection. In this study, it is hypothesized and verified that there is no significant difference between the university English translation competence of the experimental group of students and the control group of students before conducting this study. After the implementation of the new teaching model, it was verified that:

(1) The teaching model can effectively promote students' comprehension ability.
(2) It helps to improve students' ability to analyze learning.
(3) Improve students' reflective ability.
(4) Improve students' practical ability

III. C. Data acquisition and mathematical statistics

III. C. 1) Data acquisition

The basic data of this study were obtained by distributing questionnaires, in which 60 questionnaires were distributed to the experimental and control groups, 60 were recovered, 60 were valid questionnaires, and their recovery rate and validity rate were both 100.00%. The purpose of the questionnaire survey is to find out whether the implementation of university English translation teaching based on Markov chain and mathematical multiple intelligences theory helps students' English translation ability to improve after the implementation of Markov chain and mathematical multiple intelligences theory.

III. C. 2) Mathematical statistics

Within the scope of mathematical statistics, the validity of the university English translation teaching model based on Markov chain and mathematical multiple intelligences theory is verified by conducting independent samples t-test on the collected research data. The principle of independent samples t-test calculation is as follows:

The t-test of independent samples is used to test whether two independent samples come from the totals with the same mean, that is, to test whether the means of two independent normal totals are equal.

(1) Propose the null hypothesis

The two independent samples t-test entails testing whether the means of two aggregates are significantly different. Its null hypothesis is H_0. $\mu_1 - \mu_2 = 0$, where μ_1 and μ_2 are the means of the two aggregates, respectively [30].

(2) Selection of test statistics

The two independent samples mean test presupposes that the two independent overall distributions obey normal distributions $N = (\mu_1, 1^2)$ and $N = (\mu_2, 2^2)$, where 1^2 and 2^2 are the variances of the two overalls, respectively.

Under the condition that the null hypothesis holds, the test of the mean of two independent samples uses the t statistic. The t statistic for constructing two independent samples is selected and analyzed in two cases.

When the two overall variances are unknown but equal, i.e., $\mu_1^2 = \mu_2^2$, the constructed test statistic is:

$$t = \frac{X_1 - X_2 - (\mu_1 - \mu_2)}{S_v \sqrt{\frac{1}{n_2} + \frac{1}{n_2}}} \tag{8}$$

where n_1 and n_2 are the two-sample capacities, respectively. S_1 and S_2 are the two-sample standard deviations, respectively, and, $S_v^2 = \frac{(n_1 - I)S_1^2 + (n_2 - I)S_2^2}{n_1 + n_2 - 2}$, and the statistic quantity obeys a t distribution with degrees of freedom $n_1 + n_2 - 2$.

When the two overall variances are unknown and unequal, i.e., $\mu_1^2 \neq \mu_2^2$, the constructed t test statistic is:

$$t = \frac{X_1 - X_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \tag{9}$$

This statistic obeys a t distribution with modified degrees of freedom:

$$df = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{\left(\frac{S_1^2}{n_1}\right)^2}{n_1} + \frac{\left(\frac{S_2^2}{n_2}\right)^2}{n_2}} \tag{10}$$

In statistical analysis, if the variances of two totals are equal, it is called satisfying variance chi-square. Determining the chi-squaredness of the variances of two independent samples is the key to constructing and selecting the two independent samples t-test statistic. The LeveneF variance chi-square test can be utilized to test whether the variances of the two totals are significantly different.

To perform the LeveneF variance alignment test, the null hypothesis is first formulated. $H_0 : \mu_1^2 = \mu_2^2$ performs the test procedure, if the probability ρ value is less than the given significance level (usually 0.05), then the null hypothesis H_o is rejected, and the two aggregates are considered to be unequal in terms of variance. Otherwise the two overall variances are considered not significantly different.The formula for calculating the value of the F statistic in the F test is:

$$F = \frac{\max({S_1}^2, {S_2}^2)}{\min({S_1}^2, {S_2}^2)} \sim F(n_1 - 1, n_2 - 1) \tag{11}$$

where $n_1 - 1$ is the degree of freedom of $\max(S_1^2, S_2^2)$ and $n_2 - 1$ is the degree of freedom of $\min(S_1^2, S_2^2)$.

(3) Calculate the observations of the test statistic and the probability of their occurrence

Given the null hypothesis, the test value 0 is brought into the $\mu_1 - \mu_2$ portion of the t statistic to obtain the observed value of the test statistic as well as the probability ρ value computed from the distribution function of the t distribution.

(4) Given the significance level, the statistical inference result

When the probability ρ value of the test statistic is less than the significance level, the null hypothesis is rejected and the overall mean is considered to be significantly different from μ_0. Conversely, the null hypothesis is accepted and the two overall means are considered not significantly different.

IV. Analysis of empirical studies

IV. A. Analysis of the optimization of the teaching model based on Markov chain

In this paper, although we obtain the user's personalized needs to recommend services for the user, the recommendation results are presented to the user in the form of a list of services, i.e., the recommendation algorithm does not determine a particular service for the user, but lists a sequence of services that the user is most likely to use, and it is up to the user to decide exactly which service to use. Therefore, as long as the user uses one of the services in the recommendation sequence, the recommendation can be considered successful, so this experiment uses NDCG (Normalized Discounted Cumulative Gain) to measure the effectiveness of the recommendation results, instead of using MAE (Mean Absolute Error) and RMSE (Standardized Mean Absolute Error) to do so. Because the latter two metrics are accuracy metrics, they are mostly applied to program recommendations with scoring metrics. Predictive scoring and target scoring can facilitate the calculation of these two metrics. It is less convenient for items without scoring. Moreover, personalized recommendation is to give the recommendation sequence, because even if the recommendation can give the sequence of related items that the user prefers, while the accuracy of the prediction of the item rating is still unsatisfactory. Combining the above factors, this paper chooses NDCG as the metric.

IV. A. 1) Experimental preparation

(1) NDCG Metrics

NDCG is a popular metric for measuring search engine algorithms that uses NDCG to measure QoS alignment and the results of the measurement reflect the superiority of predictive methods over comparative methods. In this paper, NDCG is also used to measure whether the recommendation algorithm is effective or not.The value of NDCG can be calculated by equation (12):

$$NDCG_k = \frac{DCG_k}{IDCG_k} \tag{12}$$

where DCG_k and $IDCG_k$ are the discounted cumulative gain of the recommended outcome sequence and the discounted cumulative gain of the ideal outcome sequence, respectively, and DCG_k can be computed by Eq. (13):

$$DCG_k = resl_1 + \sum_{i=2}^{k} \frac{resl_i}{\log_2 i} \tag{13}$$

where k denotes the number of items used for calculation, greater than 1 less than the maximum number of results n, $resl_i$ denotes the score of the item in position i in the sequence of results, and $IDCG_k$ is the optimal sequence of items obtained by manual sequencing, using DCG_k's Calculation method is calculated to obtain, its value is the largest in a variety of item sequences, DCG the idea is that the higher-scoring items, if ranked in the back of the list, then in the statistics of the scores, it is hard to change the score of this result is discounted. The DCG_k calculated in this way must be less than the $IDCG_k$. Therefore, the value of $NDCG_k$ is greater than 0 and less than 1. The greater the value, the closer the resultant sequence is to the ideal item sequence, i.e., the more accurate it is.

However, in this experiment, the recommended sequence of results is sorted in descending order according to the computed QoS value, so NDCG is always equal to 1 if the above formula is used. Considering that the teaching process has several attributes, the IDCG value of each attribute for each service is calculated first, and then the average of the sum of the IDCG values of each attribute for each service is obtained as the IDCG value of the service, in this way, the contribution of each attribute of the teaching process to the position of the service in the sequence of results is taken into account. The calculation formula is as follows:

$$IDCG_k = \frac{\sum_{i=1}^{m} IATT_{ki}}{m} \tag{14}$$

$$IATT_{ki} = att_{1i} + \sum_{j=2}^{k} \frac{att_{ji}}{\log_2 j} \tag{15}$$

where $IATT_{ki}$ denotes the IDCG value of the first k service attribute i and att_{ji} denotes the value of attribute i, also in descending order.

(2) Experimental Data

Since the recommendation model proposed in this paper is for the translation teaching service on the English learning platform, the actual data can not be collected, so the experimental data in this paper is generated by a randomized algorithm to simulate the data relationship between the services. Generate 100 points in a unit range by matlab, each point represents a cloud service, and then judge the distance between two points, if the distance between two points is less than the set threshold, then connect the two points, otherwise do not connect. The 100 points are then numbered and the distance between the points represents the connection between them. In addition to the closeness of the relationship between the services, we also randomly generated four attribute values for each service. In the realistic service attributes, there are attributes whose larger values have a greater positive impact on the Qos of the service, and there are attributes whose larger values have a greater negative impact on the Qos. So it may be that a larger attribute value does not mean that the recommendation performance is superior, however, it is possible to transform these attribute values into a characterization value through negative correlation, and the larger this characterization value is, the more superior the performance in that area is. The attribute values used in the experiment are assumed to be the transformed characterization values. The larger these values are, the better the performance of the corresponding aspect.

IV. A. 2) Data analysis

In order to verify the recommendation effect of the Markov chain proposed in this paper on the English translation teaching model, the recommendation method proposed in this paper is compared with other nine reference methods. It is shown as follows:

(1) User-based collaborative filtering method (UVS) using vector similarity: this method calculates the similarity between users by vector similarity and uses the calculated similarity for QoS worthy prediction.

(2) Item-based collaborative filtering method (IVS) using vector similarity: this method calculates the similarity between items by vector similarity and will be used for Qos prediction.

(3) User and Item Based Collaborative Filtering Approach (UIVS) using Vector Similarity: this approach combines user based and item based approaches and calculates similarity between users, items by vector similarity.

(4) User-based collaborative filtering method using Pearson correlation (UPCC): this method calculates the similarity between users through PCC and uses similar users for QoS prediction.

(5) Item-based Collaborative Filtering Approach (IPCC) using Pearson Correlation: this approach is widely used in educational enterprises such as training and education. This approach uses PCC for similarity calculation and uses similar items for QoS prediction.

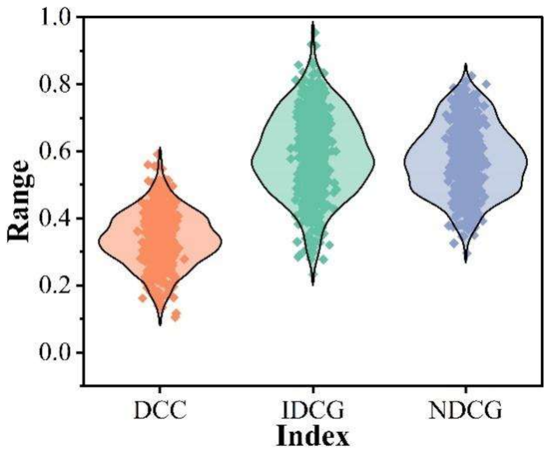
(6) User-based and Item-based Collaborative Filtering Approach using Pearson Correlation (UIPCC): this approach combines user-based and item-based collaborative filtering approaches and uses PCC for similarity calculation.

(7) Greedy Algorithm (Greedy): this method is proposed to rank the items of a collection. This method treats rated items and unrated equally, but this method does not guarantee the correct ranking of ratings.

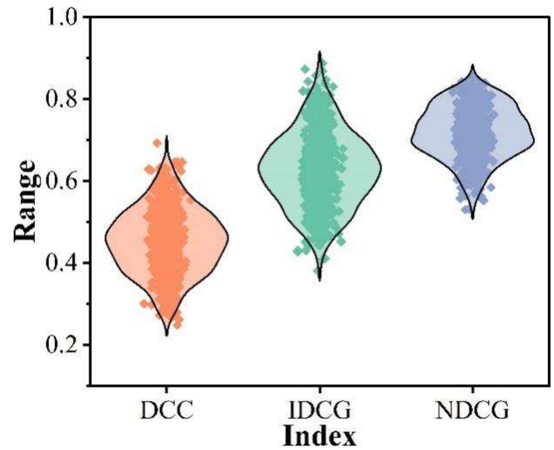
(8) CloudRank1: This method calculates the usage values between items and uses these values for the prediction of QoS ranking.

(9) CloudRank2: This method takes the trustworthiness of the service into account and improves the ranking of the method in (8) to make the ranking more accurate.

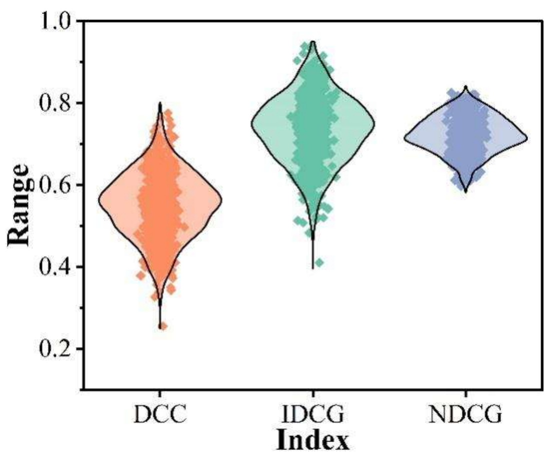
Under the guidance of the above evaluation indexes and experimental data, the performance of different recommendation algorithms is compared and analyzed, and the results of the comparison of the performance of different recommendation algorithms are shown in Fig. 3, where (a) to (j) denote the UVS, IVS, UIVS, UPCC, IPCC, UIPCC, Greedy, CloudRank1, CloudRank2, and this paper's algorithms, respectively. From the perspective of DCC, IDCG and NDCG evaluation indicators, compared with the other 9 algorithms, the index data of the algorithm in this paper are distributed in the range of 0.93~0.97, which reflects that the personalized recommendation algorithm based on Markov chain is much better than the other 9 algorithms of the same type in the college English translation teaching mode, and at the same time ensures the rigor of the subsequent verification and analysis results of the English translation teaching model based on Markov chain and mathematical multiple intelligence theory.



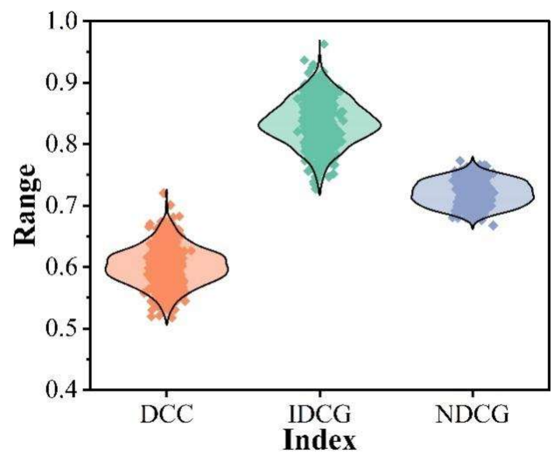
(a)UVS



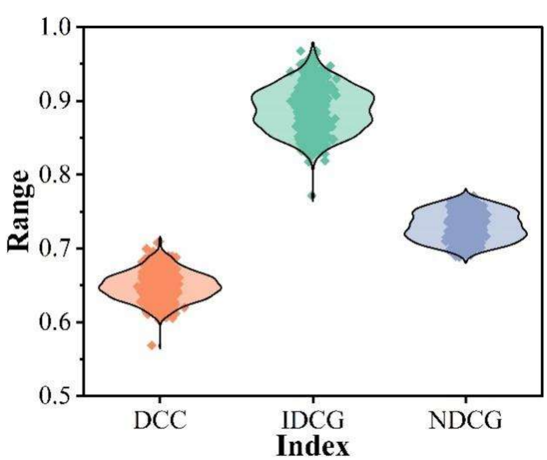
(b)IVS



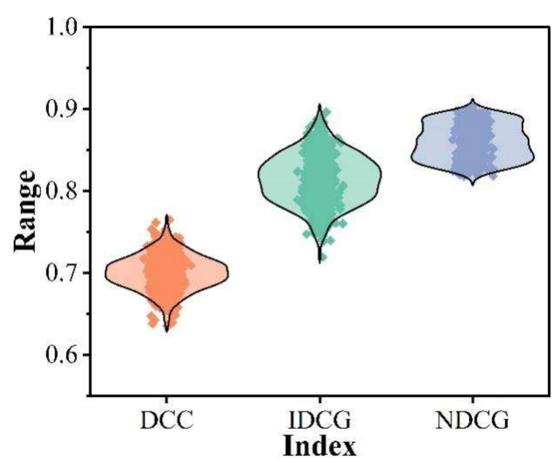
(c)UIVS



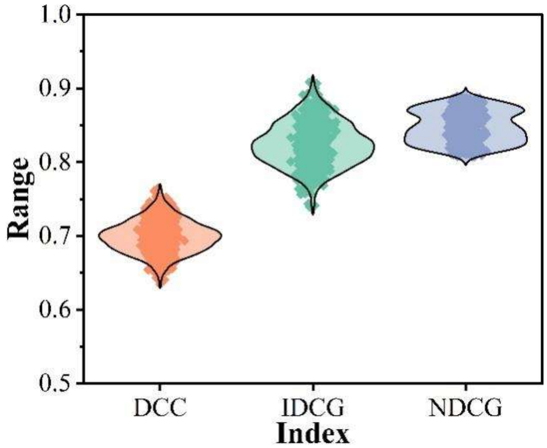
(d)UPCC



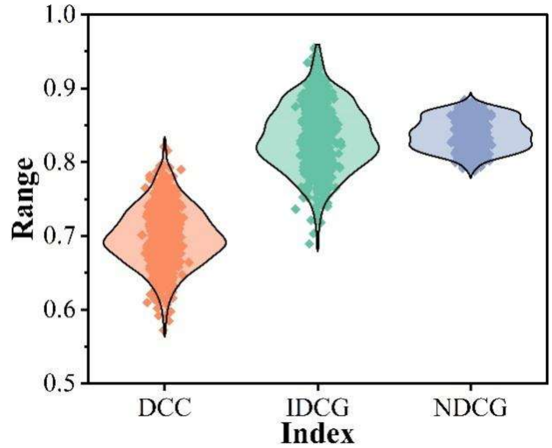
(e)IPCC



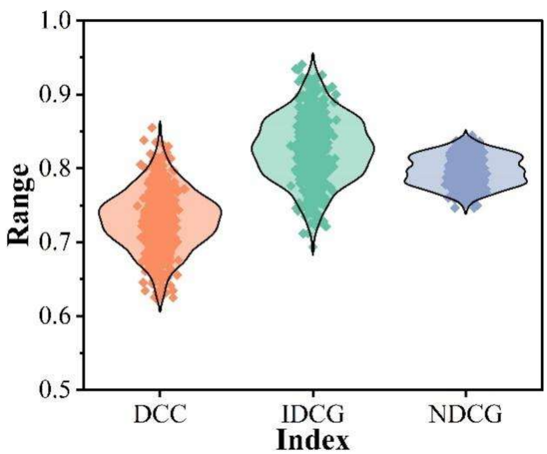
(f)UIPCC



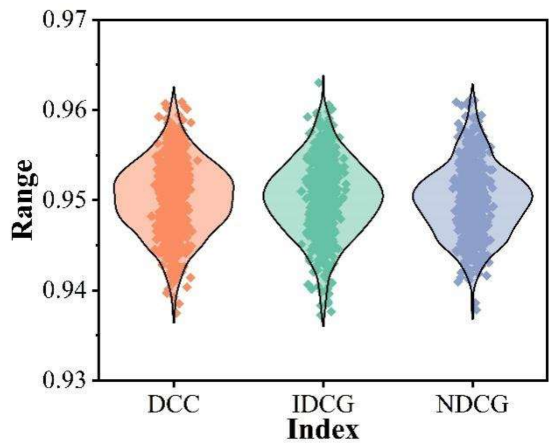
(g)Greedy



(h)CloudRank1



(i)CloudRank1



(j)Ours

Figure 3: Performance comparison of different recommendation algorithms

IV. B. Teaching model validation analysis

Based on the experimental data, this subsection follows the idea of whole-to-local analysis, discusses and explores from the perspective of the English translation teaching process, the impact of the English translation teaching mode on students' translation ability in this paper. Through the previous description, it is known that the process of students' translation competence development contains four dimensions: comprehension, analysis, practice and reflection. This study first analyzes the overall changes in the competence of the experimental group and the control group from a macroscopic point of view, and then discusses in detail the changes in the internal dimensions of the competence of the two groups of students.

IV. B. 1) Comparative analysis of changes in overall trends

In this study, the Translation Competence Evaluation Scale was distributed to students in the experimental group and the control group in the 1st, 5th, 10th, 15th, 20th, 25th, and 30th weeks respectively, and students were invited to make anonymous peer evaluations on the mutual evaluation platform, and a total of 60 valid scales for self-assessment, other-assessment, and teacher-assessment were collected in the end (30 scales for the experimental group and 30 scales for the control group). In this study, firstly, the mean values of all ratings at each stage were calculated to draw a comparative trend graph of changes in the overall effect of university English translation proficiency (as shown in Fig. 4), and secondly, the differences in the mean values of self-assessment, other-assessment and teacher-assessment of the experimental group and the control group were compared and analyzed in detail in order to show the changes in the trend of the two groups of students' university English translation proficiency. The English translation competence of students in both the experimental and control groups shows an upward trend, in which the development level of music translation competence of students in the experimental group is significantly higher than that of the control group. There is no significant difference between the values of the experimental group and the control group from week 1 to week 20 (P>0.05), and by the period of week 25 to week 30, the students' translation ability in the experimental group improves at a higher rate than that of the control group, which indicates that the addition of Markov chains to the university English translation teaching model based on the mathematical theory of multiple intelligences is able to improve the students' English translation ability.

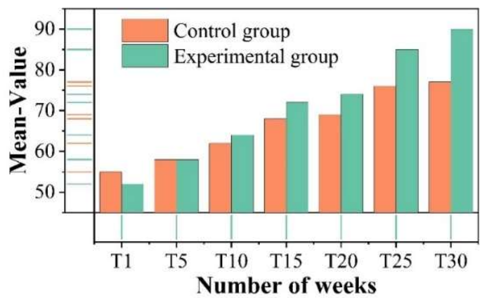


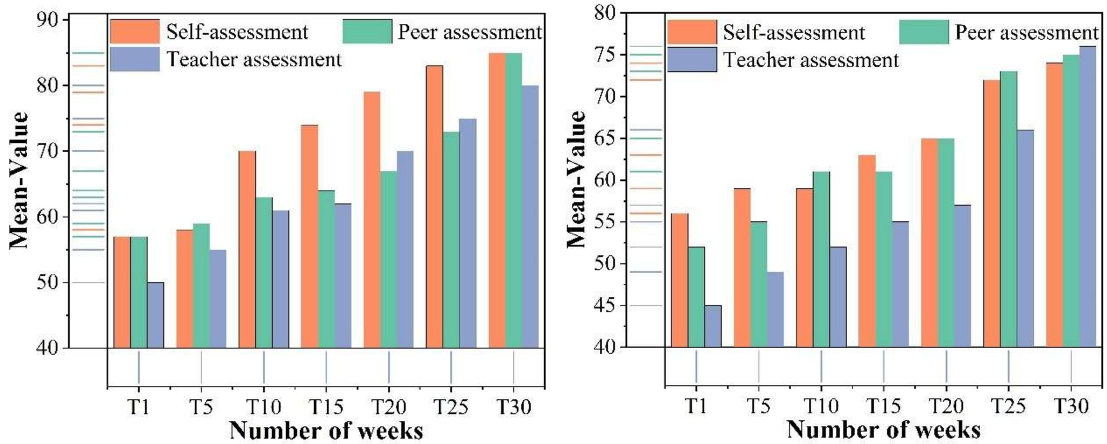
Figure 4: A comparison of the overall effect of college English translation ability

In addition, this study further calculated the mean values of self-assessment, other-assessment and teacher-assessment at different stages of learning in order to show more objectively the changes in the level of competence development of the two groups of students at different stages. First, this study tested the consistency of the ratings of self-assessment, other-assessment and teacher-assessment through correlation analysis. The results show that the scoring values of self-assessment, other-assessment and teacher-assessment in the experimental and control groups are not significantly different (p=0.003>0.05), i.e., the three assessment modes have a high degree of internal consistency. Next, this study plotted the overall trend of the mean values of the three evaluation modalities as shown in Figure 5, where (a)~(b) correspond to the experimental and control groups, respectively. Both the experimental and control groups differed in the changes of self-, other- and teacher-assessment abilities at different stages. First, in terms of self-assessment, both the experimental group and the control group show a fluctuating upward trend, but the mean value of the experimental group is higher than that of the control group, which indicates that the experimental group students have a higher level of self-perception of their competence and believe that their English translation competence has been greatly improved since the formal instruction. Second, in the dimension of other's assessment, the mean values of both the experimental group and the control group show a high level, but the values after the 20th week show that the mean score of other's assessment of the experimental group is higher than that of the control group, indicating that the students in the experimental group have a higher level of recognizing their peers' English translation ability after the 20th week, and they think that the teaching mode of the inquiry paper has a significant positive impact on the English translation ability of their peers. Third, in the teacher evaluation dimension, the mean values of English translation ability of the experimental group are all higher than that of the control group, indicating that teachers evaluate the English translation ability of the experimental group students higher than that of the control group.

The combination of the above overall trend and specific evaluation results shows that the overall level of English translation ability of students in the experimental group is higher than that of the control group, indicating that the university English teaching model based on Markov chain and mathematical multiple intelligences theory has a positive impact on the improvement of students' English translation ability. The conclusion of this study is consistent with the results of previous studies, that is, the model can stimulate students' sense of inquiry, promote the effective application and transfer of knowledge and skills, and enhance students' English translation ability.

IV. B. 2) Comparative analysis of changes in internal dimensions

After the overall trend change comparison, this study further micro-comparisons the internal dimensions of English translation competence between the experimental group and the control group. Based on the results of the self-assessment data of the English Translation Competence Evaluation Scale, this study verifies the effects of the teaching mode of this paper on the internal dimensions of students' English translation competence horizontally and vertically, respectively. Among them, horizontally, this study utilizes SPSS 26.0 software to analyze the covariance of the questionnaire data of the experimental group and the control group in the last week, and to compare the competence development of the two groups of students at the end of the teaching experiment. Longitudinally, this study utilized SPSS 26.0 software to conduct paired-samples t-tests on the pre- and post-test data of the students in the experimental class to further analyze the changes in the internal dimensions of competence before and after their participation in the teaching experiment.



(a)Experimental group (b)Control group

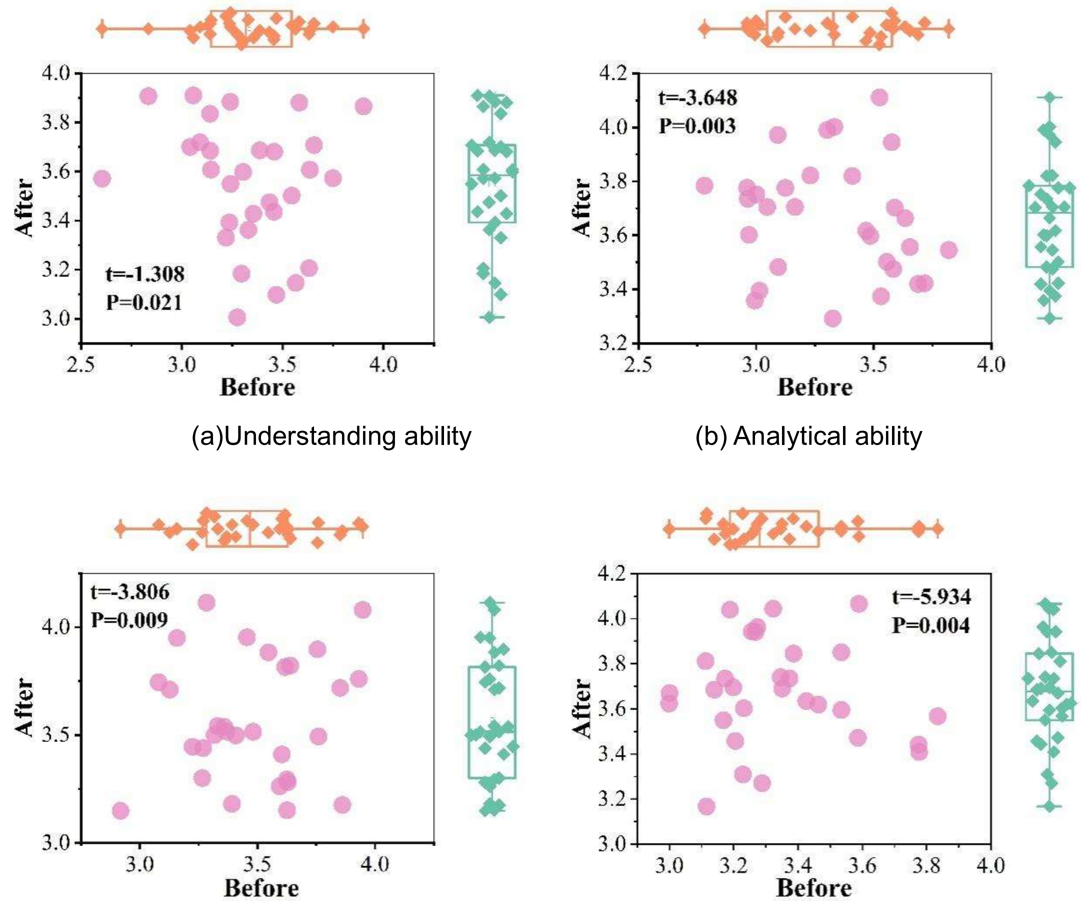
Figure 5: Self-evaluation, other evaluation, teacher evaluation changes

According to the previous section, English translation competence consists of comprehension, analytical, practical and reflective abilities, which play an important role in the four major translation problem solving processes: problem identification, problem analysis, problem solving and assessment and reflection. In order to exclude the influence of preexperimental problem solving ability on the posttest values of the two groups of students, this study takes the pre-test value of competence as a covariate and group as a fixed factor, and the results of the covariance analysis of the posttest values of competence of the two groups of students are shown in Table 1. The mean values of the experimental group in all four dimensions were higher than those of the control group, and the experimental group and the control group had significant differences in comprehension (F=2.421, p=0.009<0.01), analytical ability (F=16.522, p=0.002<0.01), practical ability (F=6.928, p=0.008<0.05), and reflective ability (F=8.006, p=0.009< 0.01) were significantly different.

Table 1: Post-test covariance analysis results

ABILITY DIMENSION	PRE AND POST TEST	SUM OF SQUARES OF TYPE III	DF	MEAN SQUARE	F-VALUE	P-VALUE
UNDERSTANDING ABILITY	Covariate (pre-test)	0.159	1	0.159	2.421	0.009
	Group	0.102	1	0.106		
ANALYTICAL ABILITY	Covariate (pre-test)	0.008	1	0.008	16.522	0.002
	Group	0.848	1	0.847		
PRACTICAL ABILITY	Covariate (pre-test)	0.004	1	0.004	6.928	0.008
	Group	0.357	1	0.357		
REFLECTIVE ABILITY	Covariate (pre-test)	0.026	1	0.026	8.006	0.009
	Group	0.519	1	0.519		

In order to gain a deeper understanding of the status of the improvement of the internal dimensions of the experimental group's competence, this study analyzed the paired-sample t-test of the pre- and post-tests of the experimental group, and the results of the paired-sample t-test of the pre- and post-tests of the experimental group's competence are shown in Fig. 6, in which (a) to (d) are the comprehension, analytical, practical, and reflective competence, respectively. The posttest values of all dimensions of the experimental group's competence were greater than the pretest, and the students' comprehension (t=-1.308, p=0.021<0.05), analytical (t=-3.648, p=0.003<0.05), practical (t=-3.806, p=0.009<0.01), and reflective (t=-5.934, p= 0.004<0.01) were significantly different. The results of this study show that the English translation teaching model based on Markov chain and mathematical multiple intelligences theory stimulates students' comprehension, analytical, practical and reflective abilities more, and is more capable of improving students' higher-order thinking, such as logical reasoning, in-depth analysis and self-improvement, when they face English translation problems.



(a)Understanding ability (b) Analytical ability

(c)Practical ability (d)Reflective ability

Figure 6: Ability test before and after paired sample t test results

V. Conclusion

This paper designs an English translation teaching model based on mathematical multiple intelligences theory for the predicament of English translation teaching in colleges and universities, and in order to further improve the teaching model, on the basis of which, it integrates the Markov chain, so as to make its teaching model better serve the English translation classroom. In summary, the English translation teaching model is validated and analyzed. Students in the experimental group and the control group have significant differences in comprehension ($F=2.421$, $p=0.009<0.01$), analysis ($F=16.522$, $p=0.002<0.01$), practice ($F=6.928$, $p=0.008<0.05$) and reflection ($F=8.006$, $p=0.009<0.01$), which indicates that On the basis of the English translation teaching model based on mathematical multiple intelligence theory, adding Markov chain helps students' English translation ability to improve, and provides instructive value for the innovation of English translation teaching in colleges and universities.

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