



Article

The Ecological Construction Path of English Vocabulary Teaching Based on Markov Chain in the Perspective of Ecological Linguistics

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Abstract: The new curriculum standards have put forward new requirements for high school English vocabulary teaching, and the English vocabulary eco-classroom under the guidance of ecological linguistics theory can precisely make up for the shortcomings in the traditional vocabulary classroom and meet the challenges of the times. However, most of the existing researches on ecological classroom are combined with macro English subjects, and few of them are about English vocabulary teaching. This study takes the principles of ecological linguistics as the theoretical basis to support the conceptual construction and morphological reliance of the vocabulary ecological classroom, supplemented by modal theory as the process orientation of the four major stages in the teaching process, constructs a new vocabulary ecological classroom model based on Markov chain model, and applies the ecological classroom model to high school English vocabulary teaching to verify its teaching effects. The experimental results show that the Markov chain-based high school English vocabulary teaching under the "ecological linguistics" model can help students' interest in vocabulary learning and promote their vocabulary learning level, accounting for 15% improvement in the learning effect.

Keywords: Ecological linguistics, Markov chain, English vocabulary teaching, Teaching quality

1. Introduction

Vocabulary is not only the cornerstone of language, but also the carrier of culture. Vocabulary itself is imprinted with the history of the language and permeated with the worldview of the nation. Wilkins, a British linguist, pointed out that we can express very little without grammar, but we cannot express without vocabulary [1, 2]. The basic skills are inseparable from vocabulary, so mastering vocabulary is a necessary prerequisite for language mastery. For professors, it is not only about teaching the meaning of the vocabulary itself, but also about conveying the culture behind the vocabulary. For the learner, it is not only the information conveyed by the vocabulary but also the ability to learn the vocabulary [3]. This is a sublimation of the five-dimensional goals proposed in the previous curriculum standards. The proposed core literacy of English subject also puts forward new requirements for English teaching and indicates a new direction. Unlike other subjects, English teaching should emphasize the cultivation

of cross-cultural awareness and international perspective [4, 5].

The core literacy of English subject has also put forward new requirements for English vocabulary teaching. The teaching of English vocabulary under the guidance of the new curriculum standards should pay attention to the teaching of the cultural background knowledge conveyed by vocabulary; to the practical application of vocabulary by students; to the way of teaching vocabulary and to helping students to develop good vocabulary learning habits [6, 7]. However, the traditional English vocabulary classroom only focuses on teaching the meaning of English vocabulary, and mostly adopts the mechanical and boring mode of reading aloud and writing silently.

In this paper, by reading a lot of literature about the current situation, we find some shortcomings in the existing English vocabulary teaching. First of all, teachers mostly adopt the method of indoctrination for mechanical teaching. Due to the constraints of teaching tasks and time, teachers mostly adopt a single form of teaching, such as leading reading, mimeographing, explaining the meaning of words, and explaining usage collocation. On the whole, the classroom is teacher-centered, with teachers teaching more than students practicing, and teachers rarely pay attention to feedback from students [8]. It is easy to see that under such a teaching method, students' participation and enthusiasm are low, and it is difficult to stimulate students' learning enthusiasm and improve their vocabulary learning efficiency.

Second, teachers' teaching of vocabulary is mostly fragmented and unsystematic. This leads to students' inability to make connections between vocabularies, resulting in a heavy memory burden, low vocabulary learning efficiency, and rapid forgetting. This way of teaching ignores the intrinsic properties of vocabulary and students' cognitive level and thinking ability, and does not help students to build up a vocabulary system and network well, and breaks up the connections between vocabulary [9].

Teachers neglect the instruction of vocabulary memorization methods. According to the knowledge of English lexicography, English vocabulary can be taught in terms of etymology, root words and affixes, thus improving students' learning efficiency and interest. The lack of memorization methods and learning strategies makes students' learning of English vocabulary seem incompetent. At the same time, teachers focus only on students' grasp of vocabulary meanings and neglect students' mastery of vocabulary pronunciation. The mastery of phonetics is also one of the important tools to help students master vocabulary [10, 11].

Finally, in the classroom, teachers usually focus on those students who are top achievers and expressive, while neglecting those who are weak learners and introverted, resulting in a tendency for teachers to teach at a pace that causes the distance between students to be widened and polarization to be serious. At the same time, in vocabulary teaching, teachers usually ignore the cooperative communication learning among students and replace it with teachers' lectures, which makes students' main consciousness and class participation greatly reduced [12].

To sum up, there are still many shortcomings in traditional vocabulary teaching to be solved. Facing these shortcomings of traditional vocabulary teaching, the emergence of vocabulary eco-classroom will break this deadlock. It is a kind of dynamic student-centered ecological classroom, which can not only cultivate students' interest in vocabulary learning, but also improve their vocabulary learning level.

2. Strategies

2.1. General Idea

The teaching elements can only achieve harmony with the environment if they reach an optimal spatial and temporal position in the "ecosystem" of competition and symbiosis. The environment identified by the language teaching ecosystem is a dynamic, integrated and bal-

anced environment, which should have the functions of regulating the interrelationship among the elements within the system and regulating the teaching activities, making the teaching elements interdependent, interacting and transforming with each other, etc.” [13,14]. For the ecological English vocabulary teaching classroom, we should actively consider that students, teachers and the ecological environment are in a digital era of rapid development, make full use of digital technology, multimedia and other media, adopt multimodal teaching methods, adopt different teaching strategies to mobilize the enthusiasm of learning subjects inside and outside the classroom according to the different sections of each unit of English vocabulary teaching, and fully dialogue and interact with each element of the ecological environment In this paper, the overall process of the vocabulary eco-classroom will be presented in the form of a flow chart as shown in Figure 1, supplemented by a table to illustrate the teaching-related constructs as shown in Table 1.

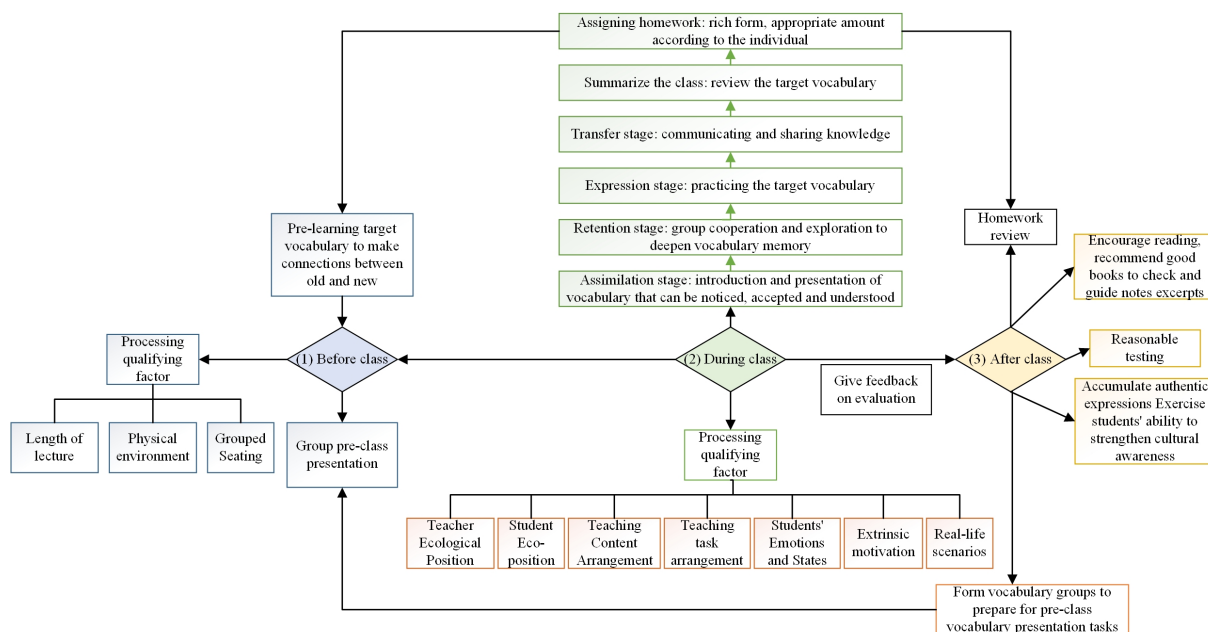


Figure 1. The General Idea

Limiting Factor	Schedule
Class Length	The vocabulary ecology class was conducted twice a week, with each session lasting 45 minutes.
Physical environment	Classes were held in a bright and spacious classroom with multimedia.
Seating arrangement & classroom grouping	Seating was arranged in round tables (see Figure 2). Students were grouped and seated according to their ecological status (differences in personality, classroom performance). In order to facilitate peer collaboration and reduce the effect of diffusion of responsibility, the author recommends grouping 4 students [15].

Table 1. Pre-course Related Constructs About Vocabulary Eco-classroom

In general, test results for students should ideally fit the normal distribution; however, based on the data gathered, the students’ results on the three quizzes display a distribution that is negatively skewed, as seen in Figure 1. To confirm whether the original data set satisfies the normal distribution, we will remove the data in this paper that have a significant degree of skewness at both ends and the normal distribution graphs of the data with scores less than 60, as shown in Figure 2. After removing scores of less than 60 a second time, it is clear from comparing Figure 1 and 2 that the students’ quiz results are more concentrated and convergent to the normal distribution. The specific grouping is shown in Figure 2.

2.2. Markov Chain-based Assessment of Vocabulary Teaching Quality

1. Markov chain: If $X = \{X_n, n \geq 0\}$ is a stochastic process with state space $S = \{i_0, i_1, i_2, \dots, i_{n+1}, \dots\}$.
2. One-step transfer probability: The conditional probability is abbreviated as and satisfies

$$\sum_j p_s = 1, i, j \in S.$$

3. One-step transfer probability matrix: The matrix consisting of one-step transfer probabilities, i.e.,

$$P = \begin{pmatrix} p_{11} & p_{12} & \cdots & p_{1j} & \cdots \\ p_{21} & p_{22} & \cdots & p_{2j} & \cdots \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ p_{i1} & p_{i2} & \cdots & p_{ij} & \cdots \\ \cdots & \cdots & \cdots & \cdots & \cdots \end{pmatrix}. \tag{1}$$

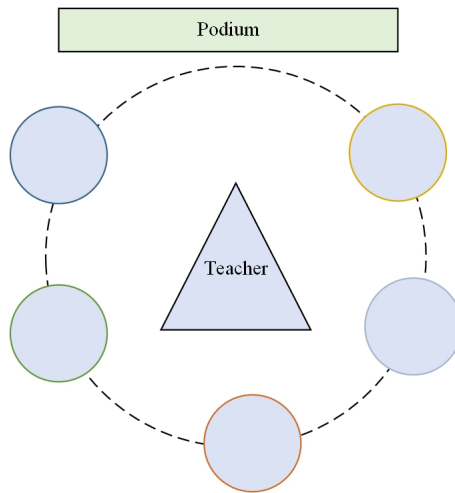


Figure 2. Schematic Diagram of the Grouping Situation

4. Flush Markov chain: When the conditional probability is only related to i, j and the time interval, but not to the moment n , such a Markov chain is said to be flush, and its transfer probabilities are smooth. That is, regardless of the initial state, after enough probability transfers, there exists a limiting distribution π such that $\pi_p = \pi, \sum_{j \in S} \pi_j = 1$, and π is the unique solution of this smooth system of equations [16].

In this paper, the most general five-level classification method is used to classify students' grades into five levels in descending order: first level [90, 100], second level [80, 90), third level [70, 80), fourth level [60, 70), and fifth level [0, 60), then the one-step transfer probability is $p_{ij} = \frac{n_{ij}}{n_i}$, where n_{ij} denotes the number of students whose grades are transferred from level i to level j after stage instruction, n_i denotes the number of students whose grades are at level i . By the properties of Markov chains, this transfer change can be noted as a one-step transfer probability matrix: $p = (p_{ij})_{5 \times 5} = \left(\frac{n_{ij}}{n_i}\right)_{5 \times 5}$.

The teaching process can be viewed as a chi-square Markov chain, and it is known from its smoothness and ergodicity that there must exist a unique limiting distribution $\pi = (\pi_1, \pi_2, \pi_3, \pi_4, \pi_5)$ as the unique solution of the set of smooth equations $\pi_p = \pi, \sum_{j=1}^5 \pi_j = 1$.

This indicates that after a sufficiently long teaching process, the proportion of each achievement level that students may achieve will tend to stabilize, and this stabilization is only related to the teacher's teaching level and not to the differences in students' foundations. According to the linear weighted synthesis method in the multi-attribute comprehensive evaluation model, the quantitative index of English vocabulary teaching quality evaluation can be obtained $S = \sum_{j=1}^5 \pi_j \mu_j$, in which μ_j is the score assigned to each grade, and the teacher teaching quality can be compared by the magnitude of S value, and the larger S indicates the better teacher teaching quality.

The change of students' performance between grades obviously corresponds to the progress or regression of performance, when $i > j$, it means progress, and vice versa. The penalty factor $2(i - j)$ is introduced, and the degree of students' progress or regression can be measured by the positive or negative and magnitude of the penalty factor. By multiplying each element of the transfer probability matrix p_{ij} with the penalty factor, we can construct the improvement matrix $p^* = (2(i - j)p_{ij})_{5 \times 5} = \left(2(i - j)\frac{n_{ij}}{n_i}\right)_{5 \times 5}$ and obtain the quantitative index $E = \sum p^* = \sum_{i=1}^5 \sum_{j=1}^5 \left(2(i - j)\frac{n_{ij}}{n_i}\right)$ to indicate the cumulative degree of improvement or regression of student performance.

In the process of teaching, even if students' performance regresses, the value of teachers' work should not be completely eliminated. The greater the degree of students' progress, the greater the reward weight for teachers. By constructing the reward weight matrix $(w_{ij})_{5 \times 5}$, we can obtain the quantitative index of English vocabulary teaching quality evaluation $W = \sum_{i=1}^5 \sum_{j=1}^5 w_{ij}p_{ij}$, the greater the W , the greater the degree of students' progress, the better the teachers' teaching quality, and the greater the reward for teachers.

3. Case Study

3.1. Classroom Comparison of Vocabulary Instruction

In order to compare the vocabulary level before the experiment with that of the control class, this paper conducted a sampling test on the results of the experiment before the experiment, as shown in Tables 2 and 3.

	Class	N	Mean	SD	SEM
Pre-achievement	Experimental	50	77.19	10.288	1.454
	Control class	50	78.17	12.226	1.728

Table 2. Group Statistics

Table 2 provides descriptive statistics of the results. The average value obtained by the experimental course in the achievement pre-test is 77.19, while the average value obtained by the control course in the achievement pre-test is 78.17. The size of these values indicates that there is little difference between them, but whether they reach the level of statistical difference shown in Table 3.

Pre-achievement		Levene's test		t-test						
		F	Sig.	t	df	Sig. (Bilateral)	Mean Difference	SE value	95% confidence	
		Assuming equal variances	Assume not equal					Lower	Upper	
		1.206	.274	-.444	97	.658	-1.000	2.262	-5.485	3.483
				-.444	95.213	.658	-1.000	2.262	-5.467	3.487

Table 3. Independent Sample Test

It can be seen that when the index level is 0.05, the value of experimental control class is 0.658, which is higher than 0.05. Therefore, these two parallel categories can be used as the experimental category and the control category in the experiment [16].

To compare the test results of the laboratory classroom, a pair of sample tests were carried out in Table 4 and 5.

Table 4 provides descriptive statistics of the results of the experimental course in the background and subsequent measurements. It is worth noting that the average value of previous measurements in laboratory classrooms is 77.18, and the average value of laboratory classrooms is 82.80. As shown in Table 5, whether they are statistically different.

	Class	Mean	N	SD	SEM
For 1	Pre-achievement	77.17	50	10.288	1.454
	After	82.81	50	8.235	1.165

Table 4. Paired Sample Statistics

For 1	Pre-achievement- After	Mean	SD	SEM	95% confidence interval		t	df	Sig.(Bilateral)
					Lower limit	Upper limit			
		-5.622	6.384	.904	-7.436	-3.804	-6.225	48	.000

Table 5. Paired Sample Test

It is noted that at the index level of 0.05, the control test value before and after the laboratory course is 0.000, which is less than 0.05. Therefore, it is considered that there is a significant difference between the measured values before and after the laboratory course, which is significantly higher than the past.

In summary, it can be seen (see Figure 3) that the vocabulary eco-classroom as a whole has a positive effect on students' vocabulary learning outcomes. However, it is worth noting that 14% of the students reported that they did not participate well in the classroom after the experiment. Another 14% of the students reported that they were inefficient or inattentive.

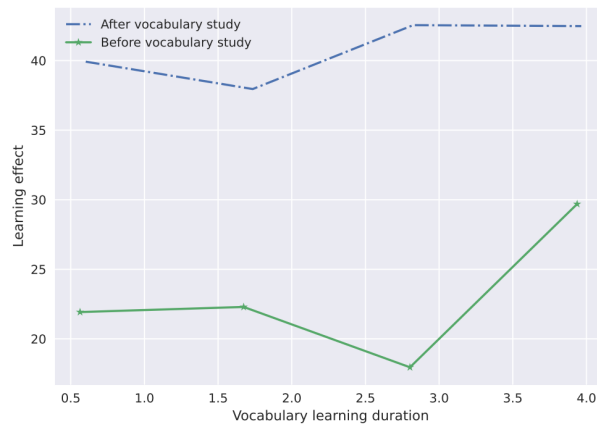


Figure 3. Vocabulary Learning Effect Graph

In this paper, questions were set from vocabulary classification memory ability, word formation memory ability, word change ability, vocabulary discrimination ability, vocabulary speculation ability, and vocabulary usage ability. By comparison, it was found that the mastery of each ability was more optimistic after the experiment (see Figure 4).

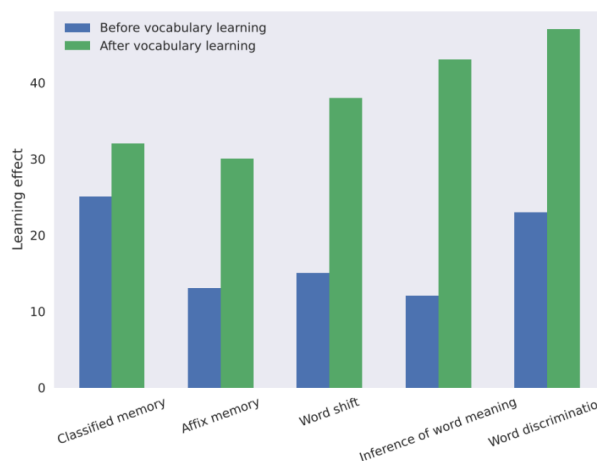


Figure 4. Comparison of Vocabulary Learning Ability

In the early and follow-up survey questionnaires, three questions were raised: the frequency of teaching practice, the number of teaching assignments, teaching speed and speed. Through the comparison of pre-test and post test (see Figure 5 and 6), it can be seen that vocabulary ecology is more acceptable to students than vocabulary ecology before the experiment in terms of teaching and learning frequency, workload, learning speed and speed.

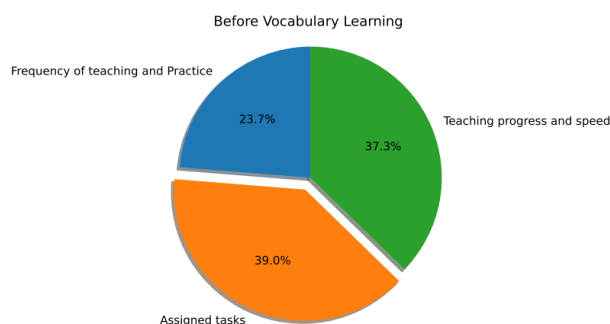


Figure 5. Fitness of Limiting Factors Without Applying Our Vocabulary Teaching Construction Framework

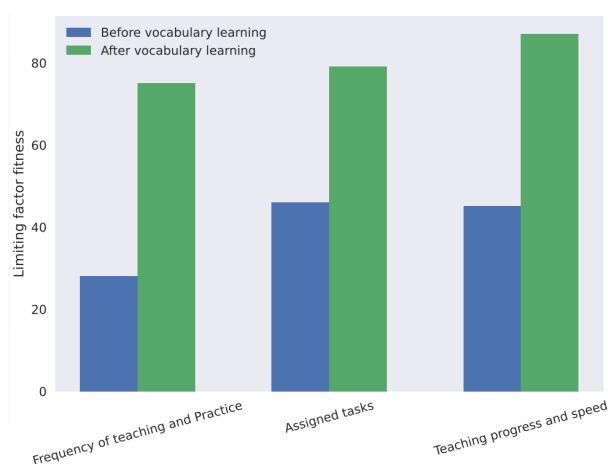


Figure 6. Qualifying Factor Suitability Graph

3.2. Teaching Quality Comparison

Taking the teaching process of English vocabulary in the public foundation course of a university as an example, the university adopts a tiered teaching mode, firstly, the new students are arranged into three types of classes: advanced, intermediate and elementary according to their entrance English scores in descending order, and the classes of each tier are then split into arts and science classes according to the nature of students' majors. A classroom test is conducted at the beginning of the semester, and then a final test is organized after a semester of teaching process, and the teaching quality of each class is compared and analyzed by analyzing the results of the two tests. In this paper, a random sample of 20 students from each class was taken from an advanced arts class and an advanced science class (hereinafter referred to as the arts and science classes). The transfer of the number of students in each level according to the five-level classification method is as follows (see Tables 6 and 7).

4. Conclusions

Vocabulary acquisition includes both vocabulary acquisition interest and vocabulary acquisition habit, acquisition attitude, acquisition effect and acquisition ability. However, most of the

	Semester Final Exam					
		90-100	80-89	70-79	60-69	0-59
Beginning of semester exams	90-100	1	1	1	0	0
	80-89	2	2	3	1	0
	70-79	0	1	1	0	0
	60-69	0	0	1	1	0
	0-59	0	0	2	0	0

Table 6. Statistics on The Transfer of English Grade Levels in the Liberal Arts Classes

	Semester Final Exam					
		90-100	80-89	70-79	60-69	0-59
Beginning of semester exams	90-100	0	1	1	0	0
	80-89	1	1	1	0	0
	70-79	0	1	5	2	0
	60-69	0	0	1	0	0
	0-59	0	2	0	1	0

Table 7. Statistics of English Grade Transfer in Science Classes

existing studies have focused only on vocabulary acquisition effects or vocabulary acquisition habits and have studied them separately. This paper explores the current English vocabulary teaching classroom based on an ecological linguistic perspective, points out the ecological imbalance in the English vocabulary teaching classroom, and proposes measures to solve the problem and strategies to build an ecological English vocabulary teaching classroom, in order to provide some reference for future English vocabulary teaching curriculum reform and curriculum design.

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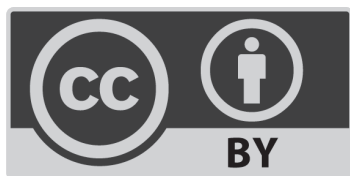
Conflict of Interest

The authors declare no conflict of interests.

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