

Ecological Classroom Model for Vocabulary Teaching Based on Markov Chain

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This paper explores the current English vocabulary teaching classroom based on an eco-linguistic perspective and the Markov chain, points out the ecological imbalance in the English vocabulary classroom, and proposes measures to solve the problem and strategies to build an ecological English vocabulary learning classroom, in order to provide some reference for future English vocabulary curriculum reform and curriculum design. In this paper, a random sample of 20 students from each class was taken from an advanced arts class and an advanced science class. The results show that after a semester of teaching process, the overall English scores of the arts and science classes improved, and since, the arts classes improved more and the teachers' teaching quality was better.

Keywords: eco-linguistics, Markov chain, English vocabulary teaching, teaching quality

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. Shi and Li (2021) pointed out that we can express very little without grammar, but we cannot express without vocabulary. 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 (Cox & Haebig, 2022). 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 (Li, 2022).

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; and to the way of teaching vocabulary and to helping students develop good vocabulary learning habits. 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. 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 build up a vocabulary system and network well, and breaks up the connections between vocabulary.

Again, teachers teach vocabulary in stages, usually focusing only on teaching new vocabulary and neglecting the consolidation of vocabulary already learned. According to the Ebbinghaus mnemonic method, human memory is cyclical. Neglecting the consolidation of vocabulary will only make vocabulary teaching half the effort. Helping students develop the habit of consolidation is also an important part of teachers' teaching.

In addition, teachers teach vocabulary mostly out of context and out of cultural background. This is not conducive to the development of students' cross-cultural awareness and vocabulary application skills. Vocabulary learning is a process of language input, and teaching vocabulary out of context is not conducive to students' output. In the input hypothesis, Krashen suggests that the input provided to students should be sufficient comprehensible input. The cultural background and context are the mediums for understanding vocabulary, but teachers usually ignore these important mediums and go for monotonous usage collocations and structural analysis instead.

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.

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.

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.

Related Work

Vocabulary learning is the cornerstone of language learning. In the process of English acquisition, the acquisition of any skill, such as listening, reading, writing, and translating is inseparable from the learning of

vocabulary. There is a rich body of research on English vocabulary teaching, both abroad and in China. In the long history of vocabulary development, English teaching methods have always played an indispensable role. Western research on the teaching of English vocabulary began in the late 18th century. Prior to that, most research focused on reading and grammar. In the 1920s, the Reading Method and Situational Language Teaching (SLT) became popular (Chan & Kwan, 2021). Scholars have found that reading promotes the acquisition of vocabulary. The Reading Method emphasizes the efficiency of vocabulary acquisition through extensive and effective reading, but the selection of reading texts and the establishment of vocabulary to be taught are very difficult. The situational approach of the same period emphasizes the importance of natural and authentic situational activities. Therefore, it was advocated that vocabulary instruction should take place in meaningful situations, and that situations should help students acquire vocabulary naturally. Su, Xiao, and Wang (2021) emphasized the communicative and comprehensible nature of vocabulary, as well as the need to teach vocabulary in real and meaningful situations. The status of vocabulary teaching in this period has increased significantly. Since the late 1980s, vocabulary teaching has received more and more attention from scholars, and thus the research perspectives on vocabulary teaching have become increasingly rich.

Mao and Peng (2021) emphasized the importance of situations for vocabulary acquisition, for example, and advocate that vocabulary should be presented in authentic situations and contexts, and teachers can use body language, facial expressions, pictures, and symbols to enhance teaching and learning and create natural and vivid situations. Also, Ramos-Holguín (2022) encouraged students to use their own life experiences as well as background knowledge to understand and master vocabulary. Baxter et al. (2021) emphasized that vocabulary teaching should pay attention to students' individual differences and should be based on students' learning levels, characteristics, and needs at different stages combined with word frequency.

In conclusion, foreign research on vocabulary teaching has been quite mature, and scholars' studies from different perspectives have contributed to the advancement of vocabulary teaching. The development of the times and the constant changes of various educational ecological factors have put forward new requirements and challenges to vocabulary teaching. Therefore, the investigation of vocabulary teaching will never stop.

In the 1970s, the communicative approach was prevalent in China. At this time, teaching emphasized the development of language use and communicative competence. Therefore, vocabulary teaching remained unappreciated. After the reform and opening up, a new chapter was opened in the study of English vocabulary teaching in China. Scholars gradually realized the importance of vocabulary, and conducted research on English vocabulary teaching from different perspectives, which made the level of vocabulary teaching in China develop rapidly.

Some scholars have explored the teaching of English vocabulary from a cultural perspective. Alsubari et al. (2022) argued that English vocabulary is a breakthrough in interpreting English culture. English cultural practices and values can be grasped through vocabulary to understand emotional culture, living culture, and cultural imagination.

The emergence of the Internet has also provided convenient conditions for vocabulary learning, and many scholars have explored vocabulary teaching in the new era of multimedia, among which research on corpora is hot. Liu et al. (2019) found that the intuitive and comprehensive vocabulary presentation and summarization in college corpora improved students' vocabulary learning efficiency and corpus analysis ability. Huei, Yunus, and Hashim (2021) explored the accuracy of corpus-based vocabulary learners' learning of target vocabulary.

In addition to the development of vocabulary instruction, another major impetus has come from the development of eco-linguistics. Eco-linguistics is an emerging discipline formed at the intersection of ecology and linguistics. In the process of the emergence and development of eco-linguistics, two paradigms have emerged, namely Haugen's paradigm and Halliday's paradigm. In 1972, Haugen, a Norwegian scholar of American origin, after examining language and ecosystems, argued that the social environment facing language systems requires as much attention as the natural environment facing biological systems (Wei & Huang, 2023). Based on a series of studies, he developed the concept of the ecology of language, in which ecological research is used to discover how ecosystems affect language systems, and on this basis, an ecological approach is used to study language tracking, language documentation and survey, language conservation, language policy, language preservation, and language activities. The Haugen paradigm considered a "metaphorical" paradigm for language research, as shown in Figure 1.

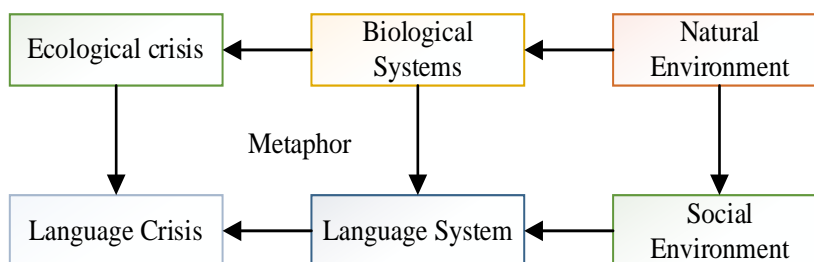


Figure 1. The eco-linguistic metaphor paradigm.

The cognitive paradigm of eco-linguistic research is considered to be a paradigm following Haugen's and Halliday's paradigms, which is based on "the premise of the interaction between language and environment" and

aims to reconstruct mental models or cognitive structures that contribute to ecological conservation through discourse construction and discourse analysis—stories. We conceptualize our perceptions of nature through language to form various "stories", which in turn influence our speech acts, which in turn further reinforce, weaken or change our perceptions of nature, and thus constituting new stories that guide, influence, and control our social practices. (Peng & Fu, 2021, p. 65)

Domestic research on eco-linguistics started late but is developing rapidly. The "Chinese Society for Research in Eco-linguistics" has carried out several large-scale international academic exchange activities, such as the International Symposium on Eco-linguistics, the National Symposium on Eco-linguistics, the Chinese Symposium on Strategic Development of Eco-linguistics, and the eco-linguistics research workshops, etc. At present, domestic research on eco-linguistics has entered a prosperous stage, and the number of academic achievements is considerable, which has strongly promoted the development of the discipline of eco-linguistics, making it a new growth point in the field of linguistics and having a positive impact on the domestic and international academic community (Wu, 2022).

Domestic scholars have also conducted a lot of exploration on foreign language teaching under the guidance of ecological linguistics. In general, these studies have two characteristics: First, there are more studies based on theoretical exploration and introduction, and fewer studies on teaching practice and application; second, there are more studies on teaching English to non-English majors under the guidance of ecological linguistics, and fewer studies on teaching English to English majors, and even fewer studies on teaching English vocabulary in the classroom.

Strategies

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 balanced 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. 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 (see Figure 2), supplemented by a table to illustrate the teaching-related constructs (see Table 1).

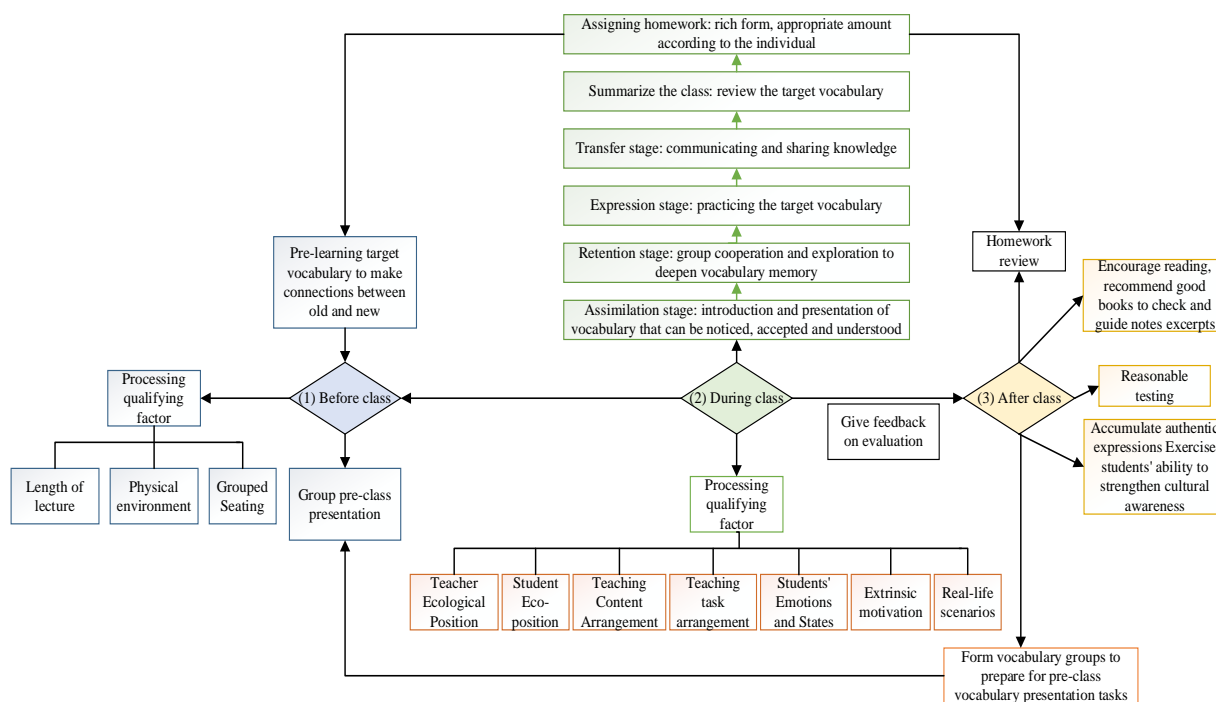


Figure 2. Flow chart of the general idea.

Table 1

Pre-course Related Constructs About Vocabulary Eco-classroom

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 3). Students were grouped and seated according to their ecological status (differences in personality and classroom performance). In order to facilitate peer collaboration and reduce the effect of diffusion of responsibility, the author recommends grouping 4 students.

The specific grouping is shown in Figure 3.

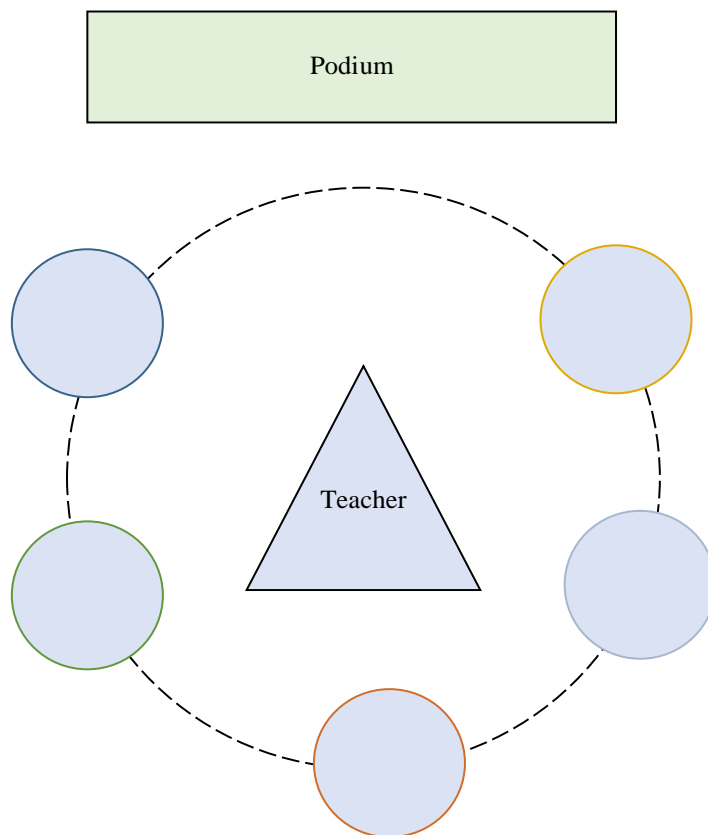


Figure 3. Schematic diagram of the grouping situation.

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.,

$$P = \begin{pmatrix} P_{11} & P_{12} & \cdots & P_{1j} & \cdots \\ P_{21} & P_{22} & \cdots & P_{2j} & \cdots \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ P_{i1} & P_{i2} & \cdots & P_{ij} & \cdots \\ \cdots & \cdots & \cdots & \cdots & \cdots \end{pmatrix} \quad (1)$$

(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.

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), and 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 and 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, and the better the teachers' teaching quality, and the greater the reward for teachers.

Case Study

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 Table 2 and Table 3.

Table 2

Group Statistics

	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 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 is shown in Table 3.

Table 3

Independent Sample Test

		Levene's test				<i>t</i> -test				
		<i>F</i>	<i>Sig.</i>	<i>t</i>	<i>df</i>	<i>Sig.</i> (Bilateral)	Mean difference	SE value	95% confidence	
								Lower	Upper	
Pre-achievement	Assuming equal variances	1.206	0.274	-0.444	97	0.658	-1.000	2.262	-5.485	3.483
	Assume not equal			-0.444	95.213	0.658	-1.000	2.262	-5.467	3.487

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.

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

Table 4

Paired Sample Statistics

	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 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. It is shown in Table 5 whether they are statistically different.

Table 5
Paired Sample Test

		Mean	SD	SEM	95% confidence interval		<i>t</i>	<i>df</i>	<i>Sig.</i> (Bilateral)
					Lower limit	Upper limit			
For 1	Pre-achievement- After	-5.622	6.384	0.904	-7.436	-3.804	-6.225	48	0.000

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 4) 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.

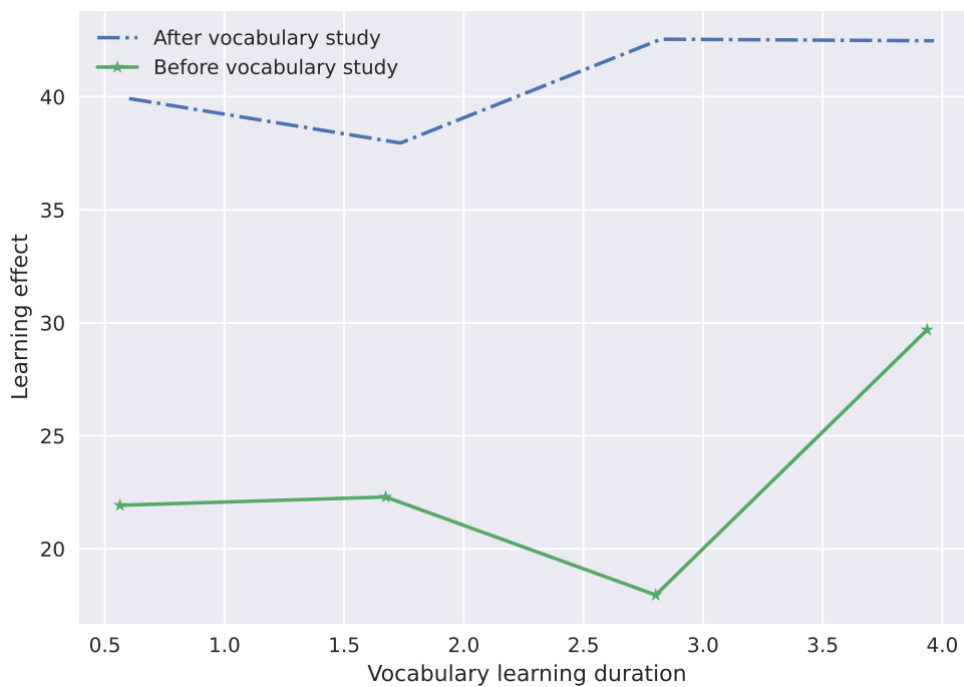


Figure 4. Vocabulary learning effect graph.

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 5).

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 6 and Figure 7), 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.

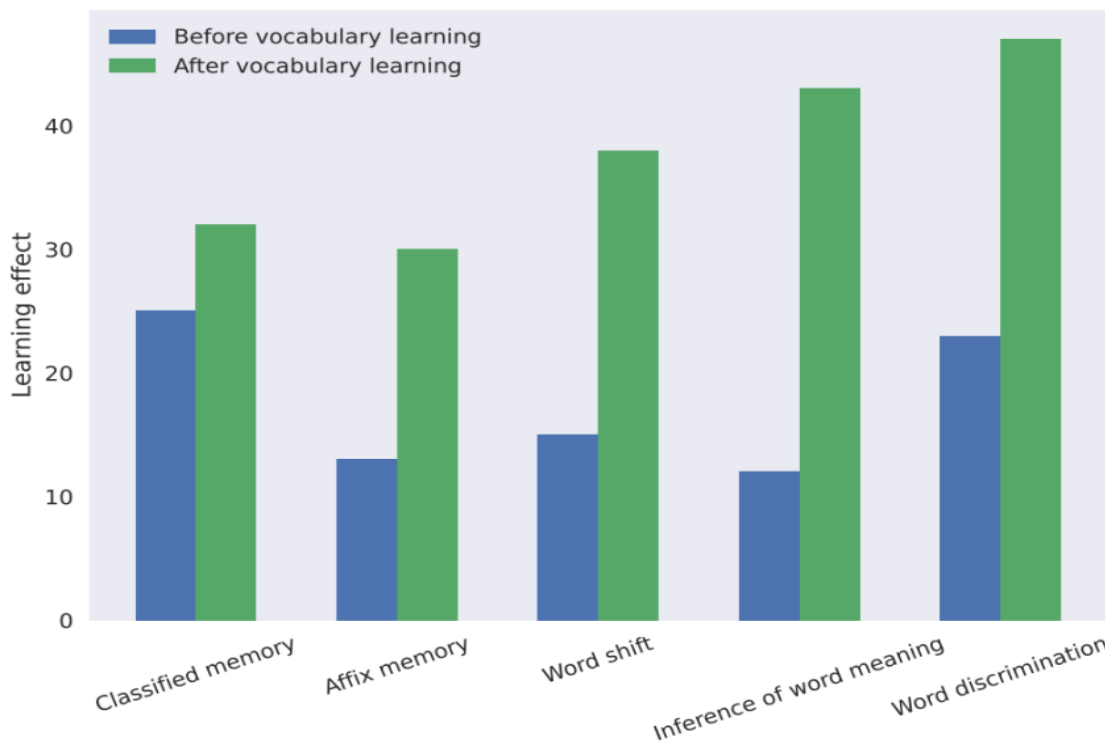


Figure 5. Comparison of vocabulary learning ability.

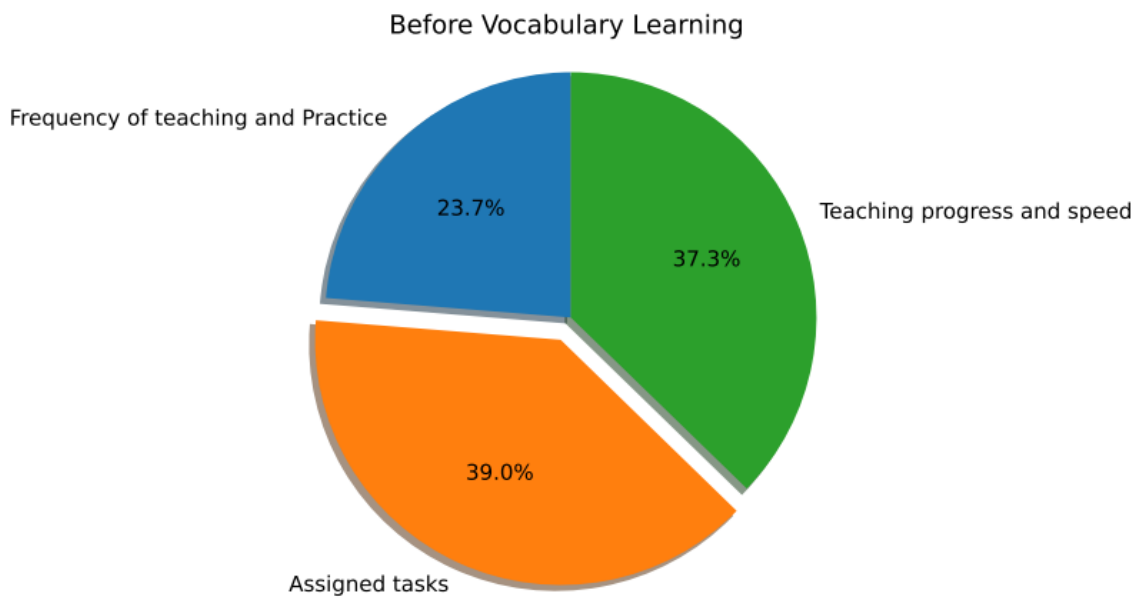


Figure 6. Fitness of limiting factors without applying our vocabulary teaching construction framework.

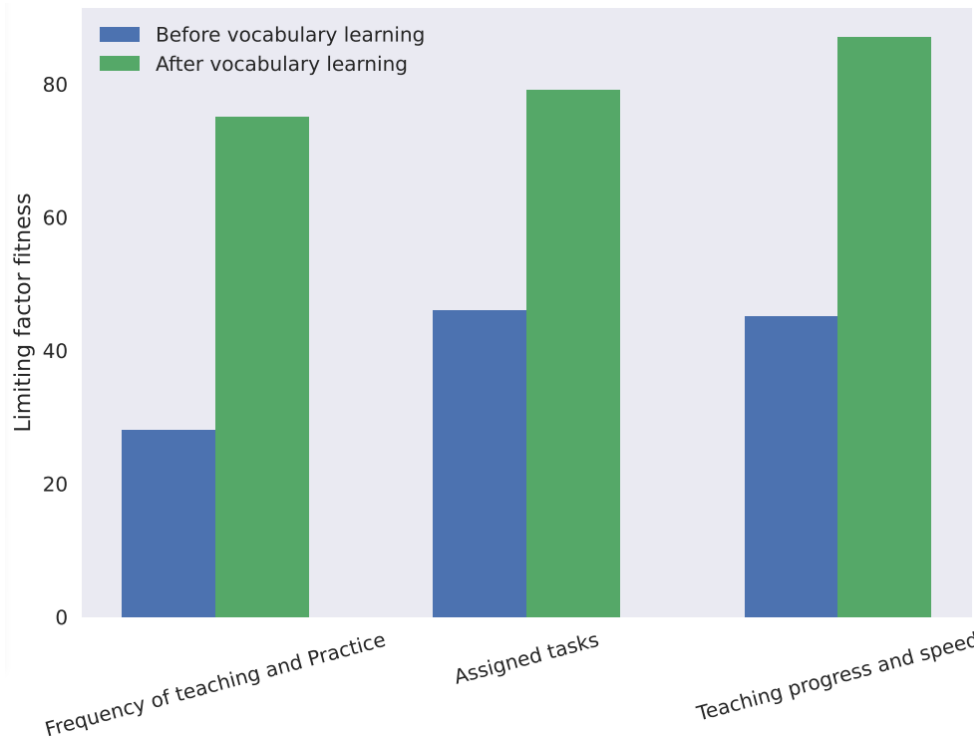


Figure 7. Qualifying factor suitability graph.

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. 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).

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	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 7
Statistics of English Grade Transfer in Science 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

The resulting one-step transfer probability matrices for student achievement in the two classes are:

$$P_{\text{Liberal Arts}} = \begin{pmatrix} \frac{1}{2} & \frac{1}{4} & \frac{1}{4} & 0 & 0 \\ \frac{3}{8} & \frac{1}{4} & \frac{1}{4} & \frac{1}{8} & 0 \\ \frac{1}{4} & \frac{1}{2} & \frac{1}{4} & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & \frac{1}{2} & \frac{1}{2} & 0 \end{pmatrix}, \quad P_{\text{Science}} = \begin{pmatrix} 0 & \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ \frac{1}{4} & \frac{1}{8} & \frac{5}{8} & 0 & 0 \\ 0 & \frac{1}{5} & \frac{1}{5} & \frac{3}{5} & 0 \\ 0 & \frac{2}{3} & \frac{1}{3} & 0 & 0 \\ 0 & 0 & \frac{1}{2} & \frac{1}{2} & 0 \end{pmatrix} \quad (2)$$

Using the system of smooth equations $\pi_p = \pi$, $\sum_{j=1}^5 \pi_j = 1$, we obtain the limiting distribution

$$\pi_{\text{Liberal Arts}} = \left(\frac{48}{129}, \frac{40}{129}, \frac{36}{129}, \frac{5}{129}, 0 \right), \pi_{\text{Science}} = \left(\frac{1}{13}, \frac{4}{13}, \frac{5}{13}, \frac{3}{13}, 0 \right).$$

The distribution of grades in the above steady state shows that: 37.2% of the grades in the arts classes were 1st, 31.0% were 2nd, 27.9% were 3rd, 3.9% were 4th, and 0% were 5th, with most grades concentrated in 1st, 2nd, and 3rd grades; 7.7% of the grades in the science classes were 1st, 30.8% were 2nd, 38.5% were 3rd, 23.1% were 4th, and 0% were 5th, with most grades concentrated in 2nd and 3rd grades. The majority of the grades were in the second and third grades. It can be seen that after one semester of teaching, the arts class is higher than the science class in terms of grade ranking, and the teachers of the arts class should focus on transferring differences in teaching, while the teachers of the science class should pay more attention to cultivating excellence.

In the stable state, each grade is assigned a corresponding score: 90, 80, 70, 60, 50, and the quantitative index of students' teaching quality evaluation is obtained as $S \approx 80.155$ for literature and $S \approx 72.305$ for science, which indicates that the teachers of literature class have better teaching quality than science class.

Each element of the one-step transfer probability matrix is multiplied by the penalty factor $2(i - j)$ to obtain the new transfer probability matrix, i.e., the progress degree matrix:

$$P_{\text{Liberal Arts}}^* = \begin{pmatrix} 0 & -\frac{1}{2} & -1 & 0 & 0 \\ \frac{3}{4} & 0 & -\frac{1}{2} & -\frac{1}{2} & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 1 & 0 \end{pmatrix}, P_{\text{Science}}^* = \begin{pmatrix} 0 & -1 & -2 & 0 & 0 \\ \frac{1}{2} & 0 & -\frac{5}{4} & 0 & 0 \\ 0 & \frac{2}{5} & 0 & -\frac{6}{5} & 0 \\ 0 & \frac{8}{3} & \frac{2}{3} & 0 & 0 \\ 0 & 0 & 2 & 1 & 0 \end{pmatrix} \quad (3)$$

Quantitative indicators of the quality of English vocabulary teaching can be obtained $W_{\text{Liberal Arts}} \approx \frac{21}{4} = 5.25, E_{\text{Science}} = \frac{107}{60} \approx 1.78$.

$E_{\text{Liberal Arts}} > 0, E_{\text{Science}} > 0$ indicates that after a semester of teaching process, the overall English scores of the arts and science classes improved, and since $|E_{\text{Liberal Arts}}^*| > |E_{\text{Science}}^*|$, the arts classes improved more and the teachers' teaching quality was better.

Constructing the reward weight matrix:

$$(w_{ij})_{5 \times 5} = \begin{pmatrix} 1 & \frac{1}{3} & \frac{1}{9} & \frac{1}{27} & \frac{1}{81} \\ 3 & 1 & \frac{1}{3} & \frac{1}{9} & \frac{1}{27} \\ 9 & 3 & 1 & \frac{1}{3} & \frac{1}{9} \\ 27 & 9 & 3 & 1 & \frac{1}{3} \\ 81 & 27 & 9 & 3 & 1 \end{pmatrix} \quad (4)$$

In summary, based on the three perspectives, the three English vocabulary teaching quality evaluation models were constructed using the chi-square Markov chain, and the results were consistent: The transformation of progress occurred more significantly in the achievement level of the arts class, i.e., the progress was greater, which was obviously related to the teachers' teaching process, so the teachers' teaching quality was better in the arts class than in the science class.

Conclusion

In conclusion, the studies on vocabulary teaching and learning are a hundred and one, and each of them has promoted the development of vocabulary teaching and learning, and laid a solid foundation for the later studies. Vocabulary acquisition includes both vocabulary acquisition interest and vocabulary acquisition habit, acquisition attitude, acquisition effect, and acquisition ability. However, most of the existing studies have focused only on vocabulary acquisition effects or vocabulary acquisition habits and have studied them separately. In other words, they only focus on the results of vocabulary acquisition or focus on one aspect of the vocabulary acquisition process in a generalized way, but there are few comprehensive studies that take all aspects of

vocabulary acquisition into account. 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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