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Exploration of Strategies for Improving the Efficiency of College English Vocabulary Learning Based on Path Analysis Algorithm

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Abstract Based on structural equation modeling, this paper explores the compound influence mechanism of English learning self-efficacy, learning environment and interpersonal relationship on college students' English vocabulary learning effectiveness through path analysis. Stratified sampling method was used to collect 910 valid questionnaires from a university in S province, and research hypotheses were proposed. The correlations among multiple variables were exploratively analyzed through Pearson correlation analysis to construct structural equation modeling. The results showed that the standardized regression coefficients of self-efficacy, learning environment, and interpersonal relationship on the effect of English vocabulary learning were 0.813, 0.776, and 0.806.The self-efficacy dimension of self-efficacy had the highest factor loadings of self-efficacy for English vocabulary learning (0.889), and the learning environment dimension had a stronger factor loading of the school environment (0.838) in comparison to the family environment (0.706) and social environment (0.717) had stronger predictive power, and the path loadings of the interpersonal relationship dimension peer relationship (0.891) were significantly higher than teacher-student relationship (0.822) and parent-child relationship (0.786). The study verified the synergistic mechanism of self-efficacy, learning environment and interpersonal relationship, which provides the basis for multidimensional intervention strategies for college English vocabulary teaching.

Index Terms path analysis, structural equation modeling, English vocabulary learning, Pearson correlation analysis

I. Introduction

With the accelerated development of globalization, English has become one of the global languages and a bridge for transnational communication and cultural dissemination in various countries [1], [2]. Whether in study, work, life or entertainment, we can not do without the influence and penetration of English [3]. Therefore, learning English has become a necessary skill in today's society, and an important part of it is English vocabulary learning [4].

Vocabulary is the basic material of language, which is one of the three main elements of language [5]. People's thinking and communication are accomplished through the use of vocabulary and sentences composed of vocabulary, which plays a very important role in English learning, and the quantity and quality of vocabulary mastery directly affects our expression and communication ability [6]-[8]. And English vocabulary learning efficiency improvement is a key issue in the current university to improve English teaching, effective teaching strategy is to guide students to master vocabulary quickly and efficiently is an urgent problem in English learning [9], [10]. With the development of artificial intelligence, the application of path analysis algorithms in improving the learning efficiency of college English vocabulary has gradually received attention [11], [12]. In college English vocabulary learning, path optimization algorithms can effectively improve the efficiency of students' vocabulary learning by providing strategies such as personalized learning paths, efficient memorization strategies, dynamically adjusted learning plans, and immersive learning [13]-[16].

In this paper, we first determine the selection of the research object and formulate the research hypotheses in terms of self-efficacy, learning environment, and interpersonal relationship dimensions. The questionnaire method was used to collect data, and the scale structural model was tested in terms of convergent validity and discriminant validity. SPSS25.0 statistical software was used to analyze and process the data, and the correlation coefficient was used to measure the degree of association between the variables. Structural equation models were constructed and model fitness was analyzed using AMOS 21.0. Draw SEM analysis model diagram to analyze the influence path of English vocabulary learning effect.

II. Research Design of College English Vocabulary Learning Effectiveness Based on Structural Equation

In the context of globalization, English vocabulary proficiency, as a basic element of language communication, has a direct impact on the teaching effect on the cultivation of students' cross-cultural communication ability. However, the mechanism by which learners' individual differences interact with the environment on learning effects is not yet clear. In recent years, structural equation modeling has become an important analytical tool in the field of educational psychology due to its advantage in dealing with multiple causal relationships.

In this paper, we constructed a three-dimensional analytical framework that includes psychological cognition, environmental support and interpersonal interaction, and revealed the direct and indirect effects of each variable on vocabulary learning effectiveness through path analysis, so as to provide empirical evidence for the development of targeted enhancement strategies.

II. A.Subjects of study

In this paper, the overall sampling method was used to select students of freshman, sophomore and junior classes in a university in S province as the research object, a total of 950 questionnaires were distributed and 921 questionnaires were recovered, with a questionnaire recovery rate of 96.95%. After processing the recovered questionnaires, 11 invalid questionnaires (e.g., the same options, missing options, etc.) were excluded, totaling 910 valid questionnaires, and the validity rate of the questionnaires was 98.81%.

II. B.Research hypotheses

II. B. 1) Self-efficacy

Students with low self-efficacy believe that their abilities cannot be changed and stop when they encounter difficulties, while students with high perceived self-efficacy monitor and regulate their impulses, strive to improve their abilities, and pursue excellent grades with the aim of proving their abilities with their grades. College students' academic self-efficacy predicted students' academic performance, and there was a correlation between the two, with positive emotion regulation strategies playing a mediating effect. Meanwhile, there is a moderate correlation between self-efficacy and second language achievement. Based on this, this paper proposes the following hypotheses:

H1: English learning self-efficacy has a significant positive predictive effect on college students' English vocabulary learning effectiveness.

II. B. 2) Learning environment

Internet availability had a positive effect on academic outcomes, but academic outcomes also declined if the Internet was not used for academic purposes. Family background also has a strong correlation on students' English vocabulary learning outcomes. Meanwhile, the school's library resources, modern teaching aids and equipment, as well as teachers can have a significant impact on academic effectiveness. Family environment can predict self-efficacy, and the two show a positive correlation. Based on this, this paper proposes the following hypotheses:

H2: The learning environment has a positive and positive influence on college students' English vocabulary learning effectiveness.

H3: The learning environment has a positive and positive correlation with college students' self-efficacy in English vocabulary learning.

II. B. 3) Interpersonal relations

According to the self-determination theory, students' interpersonal relationships are significantly related to the need for commitment, and students with good interpersonal relationships are more committed to their studies and therefore achieve better academic results. Teacher-student relationship, parent-child relationship and peer relationship can affect students' academic performance, but there are differences in their influence mechanisms. Teacher-student relationship directly affects students' academic performance and has the greatest influence, while parent-child relationship indirectly affects academic performance by influencing the teacher-student relationship, and peer relationship alone affects academic performance. Based on this, this paper proposes the following hypotheses:

H4: Interpersonal relationship has a positive and positive influence on college students' English vocabulary learning effect.

H5: There is a significant positive correlation between interpersonal relationships and college students' English vocabulary learning self-efficacy.

II. C.Research tools

II. C. 1) Questionnaire design

The questionnaire on factors influencing college students' English vocabulary learning effectiveness used in this study mainly consists of two parts, the basic information survey and the survey on factors influencing academic effectiveness, with a total of 29 items. In the basic information part, students' gender, grade, school location, home location, whether they are only child, whether they are single parent, parents' educational status, mid-month family income, and English vocabulary midterm examination scores were investigated, totaling 10 questions. The English vocabulary learning effect was detected by the English vocabulary midterm exam, which was divided into four dimensions: English vocabulary, accuracy of word meaning comprehension, appropriateness of vocabulary collocation, and semantic reasoning ability, with five items for each dimension, and five points for each item, and the vocabulary exam was scored out of a total of 100 points.

A 5-point Likert scale was used to investigate the factors affecting learning effectiveness (1 stands for very unconformable, 2 stands for unconformable, 3 stands for uncertain, 4 stands for conformable, and 5 stands for very conformable). The survey items mainly consisted of three first-level dimensions of English learning self-efficacy, learning environment and interpersonal relationships, totaling 19 questions, as shown in Table 1. Among them, English learning self-efficacy totaled 4 questions, and the selection of items was mainly based on this study's definition of English vocabulary learning self-efficacy, i.e., the subjective judgment of English learners on their own ability to learn English vocabulary as well as their self-confidence, which was divided into two dimensions: students' ability to learn English vocabulary and their self-confidence in learning English vocabulary. Students' family environment, school environment and social environment have a certain correlation with their English vocabulary learning effectiveness, so a total of 9 questions were set based on the above three dimensions in the learning environment. The interpersonal relationship dimension consisted of 6 questions. Students' interpersonal relationships mainly included teacher-student relationships, peer relationships and parent-child relationships, so the interpersonal relationship section was also divided into the above three dimensions.

Table 1: Survey items of influencing factors of English vocabulary learning effect

First level dimension	Secondary dimension	Item
Self-efficacy	English vocabulary learning ability(S1)	I have sufficient ability to learn English vocabulary well(A1)
		I can skillfully apply the vocabulary and knowledge points I have learned to solve related problems(A2)
	Confidence in learning English vocabulary(S2)	When I encounter difficulties in learning English vocabulary, I believe I can solve them(A3)
		I am full of confidence in learning English vocabulary well(A4)
Learning environment	Family environment(L1)	Father or mother often supervises my English vocabulary learning(B1)
		Father or mother often emphasizes to me the importance of learning English vocabulary(B2)
		There are a lot of extracurricular reading materials on English vocabulary in my home(B3)
	School environment(L2)	I like all the English vocabulary activities arranged by the teacher in the English class(B4)
		I have as many opportunities to speak in class as other classmates(B5)
		The teacher can arrange the class content in an orderly manner(B6)
	Social environment(L3)	I can make good use of online videos, materials, etc. for learning English vocabulary(B7)
		I often use English vocabulary learning software(B8)
		I noticed that many signboards in public places use English words(B9)
Interpersonal relationship	Teacher-student relationship(I1)	My relationship with my English teacher is close and warm(C1)
		The English teacher is always good at discovering my strengths in study(C2)
	Peer relationship(I2)	In the class,I like learning English vocabulary with my classmates(C3)
		I get along very well with my classmates in the class(C4)
	Parent-child relationship(I3)	Father or mother often expresses feelings or likes to me(C5)
		I feel very close to my father or mother(C6)

II. C. 2) Model setup

Structural equation modeling (SEM) is an effective tool that can deal with latent variables that are difficult to observe directly and incorporate errors into the analysis. Therefore, this paper applies SEM to analyze the main factors

affecting college students' English vocabulary learning.SEM consists of a measurement model reflecting the relationship between latent variables and measurable variables and a structural model reflecting the relationship between latent variables. In this paper, English vocabulary learning effect as an endogenous latent variable is influenced by three exogenous latent variables including self-efficacy, learning environment and interpersonal relationship. Each latent variable is represented by measurable variables and has a structural relationship with English vocabulary learning effect. The parameters to be estimated in this paper include: the structural coefficients of the exogenous and endogenous latent variables; the measurement coefficients of the measurable variables and the latent variables; the error terms of the measurable variables; the covariance between the error terms; and the variance of the exogenous latent variables.SEM is usually expressed by the following three matrix equations:

(1) Structural model equation

$$\eta = B \cdot \eta + \Gamma \cdot \xi + \zeta \tag{1}$$

where η is the endogenous latent variable, ξ denotes the exogenous latent variable, B and Γ are the structural coefficient matrices, respectively, and ζ is the error term.

(2) Measurement model equations

$$Y = \Lambda_y \cdot \eta + \varepsilon \tag{2}$$

$$X = \Lambda_x \cdot \xi + \sigma \tag{3}$$

where Y is the endogenous latent variable measurable, X is the exogenous latent variable measurable, Λ_y and Λ_x are the respective matrices of observables, and ε and σ are the measurement error terms.

II. C. 3) Validity analysis

(1) Convergent validity

Convergent validity is tested by combining reliability (CR) and average variance extracted value (AVE), and usually $CR > 0.7$ and $AVE > 0.5$ are up to standard. The calculation results reflect that the factor loadings are in the range of 0.70~0.86, indicating high convergent validity; the CR value of each dimension is greater than 0.7, meeting the standard; the AVE value is greater than 0.5, meeting the standard; and the probability of significance P value is less than 0.001, indicating that there is a significant relationship between the three latent variables and the measured variables, and that the convergence of the scale structure model is very good.

(2) Distinguishing validity

The calculation results show that the AVE of each dimension is greater than 0.5, and the square root of AVE is greater than the correlation coefficient between the dimensions, which indicates that the scale has good discriminant validity.

III. Path Analysis of College English Vocabulary Learning

III. A. Descriptive statistical analysis of the questionnaire

III. A. 1) Impact factors

This study focuses on the descriptive statistical analysis of instructional interactions in blended learning for graduate students in terms of the indicators of mean M, standard deviation SD, skewness and kurtosis, and overall M and overall SD for each dimension. The scale is scored as 1-5 positive and the mean scores of each variable are between 4-5, so according to the analysis of descriptive statistics, it can be seen that the English vocabulary learning of the group of participants in this study is above the intermediate level. The results of descriptive statistics and normality test of the influencing factors are shown in Table 2, the standard deviation of each dimension is higher than 0.8 and lower than 1.0, which indicates that although the data fluctuation of each dimension is not big, there is still some data fluctuation in each dimension. The overall mean values of self-efficacy, learning environment, and interpersonal relationship were 4.165, 4.147, and 4.143, respectively, and the order from low to high was interpersonal relationship < learning environment < self-efficacy. Of the three dimensions, interpersonal relationships were the lowest, exposing the inherent limitations of parent-child, teacher-student interactions and shallow peer collaboration in the learning model. Comparatively, self-efficacy had the highest mean value, reflecting learners' stronger beliefs of control over their vocabulary acquisition abilities.

The normality of each measurement item was tested by skewness and kurtosis, and the data can be considered to satisfy the requirement of approximate normal distribution if the absolute value of the skewness coefficient is within 3 and the absolute value of the kurtosis coefficient is within 8. According to the analysis results in Table 2, it can be seen that the absolute values of skewness and kurtosis coefficients of all measurement question items in

this study are kept within the specified standard range. Therefore, it can be stated that the data obtained from all the measurement question items show the characteristics of approximate normal distribution.

Table 2: Descriptive statistics of influencing factors

Dimension	Item	M	SD	Skewness	Kurtosis	M	SD
Self-efficacy	A1	4.17	0.945	-1.083	0.938	4.165	0.893
	A2	4.19	0.933	-1.119	1.092		
	A3	4.22	0.917	-1.022	0.863		
	A4	4.08	0.922	-1.183	0.917		
Learning environment	B1	4.23	0.904	-1.039	1.135	4.147	0.881
	B2	4.05	0.923	-1.022	0.837		
	B3	4.11	0.921	-1.038	0.902		
	B4	4.25	0.909	-1.187	0.885		
	B5	4.16	0.915	-1.033	0.929		
	B6	4.02	0.911	-1.002	0.836		
	B7	4.17	0.933	-1.054	0.917		
	B8	4.32	0.926	-1.093	0.693		
	B9	4.01	0.937	-1.297	0.938		
Interpersonal relationship	C1	4.23	0.904	-1.089	2.089	4.143	0.862
	C2	4.22	0.928	-0.973	0.787		
	C3	4.15	0.919	-1.138	1.033		
	C4	4.09	0.935	-0.996	0.975		
	C5	4.06	0.927	-1.028	1.021		
	C6	4.11	0.934	-0.896	0.726		

Table 3: Descriptive Statistics on the Learning Effect of English Vocabulary

Dimension	Item	M	SD	Skewness	Kurtosis	M	SD
English vocabulary	Q1	4.28	0.894	-1.083	0.834	4.230	0.753
	Q2	4.17	0.882	-1.175	0.725		
	Q3	4.26	0.791	-1.274	0.802		
	Q4	4.25	0.803	-1.022	0.648		
	Q5	4.19	0.895	-1.075	0.733		
Accuracy of word meaning comprehension	Q6	4.18	0.778	-1.283	0.837	4.164	0.796
	Q7	4.22	0.921	-1.155	0.725		
	Q8	4.05	0.833	-1.092	0.801		
	Q9	4.13	0.819	-1.074	0.773		
	Q10	4.24	0.838	-1.028	0.825		
The appropriateness of vocabulary collocation and usage	Q11	4.29	0.906	-1.047	0.736	4.264	0.771
	Q12	4.26	0.828	-1.085	0.818		
	Q13	4.32	0.885	-1.297	0.739		
	Q14	4.17	0.871	-1.333	0.842		
	Q15	4.28	0.902	-1.028	0.775		
Semantic reasoning ability	Q16	4.02	0.884	-1.287	0.829	4.128	0.735
	Q17	4.14	0.893	-1.386	0.794		
	Q18	4.09	0.922	-1.042	0.668		
	Q19	4.18	0.828	-1.078	0.832		
	Q20	4.21	0.817	-1.117	0.736		

III. A. 2) Learning outcomes

The results of descriptive statistics and normality test of English vocabulary learning effect are shown in Table 3, similarly, the mean scores of all dimensions in the English vocabulary learning effect are between 4 and 5, and the study population regarding English vocabulary, accuracy of word sense comprehension, appropriateness of vocabulary collocation use and semantic reasoning ability are above the medium level.

The overall mean scores of English vocabulary, accuracy of lexical comprehension, appropriateness of lexical collocation use and semantic reasoning ability are 4.230, 4.164, 4.264 and 4.128 respectively, and the order from lowest to highest is semantic reasoning ability < accuracy of lexical comprehension < English vocabulary < appropriateness of lexical collocation use. Semantic reasoning ability is the lowest among the four dimensions, reflecting students' obvious shortcomings in implicit semantic association construction and cross-contextual meaning derivation, which may stem from the lack of training in deep logical analysis of discourse and decoding of cultural contexts in the traditional teaching mode. The second-lowest lexical comprehension accuracy indicates that although learners have basic vocabulary decoding skills, there are still structural deficiencies in their ability to analyze complex semantic networks such as temporal evolution of polysemous words, domain specificity and conceptual metaphors.

The skewness coefficient of each measurement item in the English Vocabulary Learning Test paper is within 3 in absolute value, and the kurtosis coefficient is within 8 in absolute value, which satisfies the requirement of approximate normal distribution.

III. B. Correlation analysis of influencing factors and learning outcomes

Correlation analysis measures the degree of association between variables from a quantitative perspective using the correlation coefficient, which is used to analyze the extent to which multiple influences affect a variable. In this analysis the correlation between multiple variables is explored through Pearson correlation analysis, the correlation coefficient is a real number between [-1, +1]. When the correlation coefficient is between -1 and 0, it indicates that there is a negative correlation between the variables. When the correlation coefficient is between 0 and 1, it indicates a positive correlation between the variables. When the correlation coefficient is 0, there is no correlation between the two. The closer the correlation coefficient is to 1, the stronger the correlation between the variables, and when the correlation coefficient is closer to 0, the weaker the correlation between the variables.

The results of the correlation analysis between each influential factor of English vocabulary, accuracy of word meaning comprehension, appropriateness of vocabulary collocation use and semantic reasoning ability and the effect of English vocabulary learning are shown in Table 4, with "**" indicating that the correlation is significant at the 0.01 level (two-tailed). It can be seen that the correlation coefficient r between each variable in this analysis is greater than 0, indicating that there are interconnections and influences between the factors. Self-efficacy is significantly and positively correlated with English vocabulary ($r=0.829$, $p<0.01$), accuracy of lexical comprehension ($r=0.702$, $p<0.01$), appropriateness of vocabulary collocation use ($r=0.688$, $p<0.01$), and semantic reasoning ability ($r=0.831$, $p<0.01$). Learning environment showed a significant positive correlation with English vocabulary ($r=0.738$, $p<0.01$), accuracy of lexical comprehension ($r=0.697$, $p<0.01$), appropriateness of vocabulary collocation use ($r=0.823$, $p<0.01$), and semantic reasoning ability ($r=0.702$, $p<0.01$). Interpersonal relationships were significantly and positively correlated with English vocabulary ($r=0.665$, $p<0.01$), accuracy of lexical comprehension ($r=0.801$, $p<0.01$), appropriateness of vocabulary collocation use ($r=0.812$, $p<0.01$), and semantic reasoning ability ($r=0.765$, $p<0.01$).

The synthesis can indicate that in this analysis, all the variables are significantly correlated with each other, and the degree of influence between the variables can be further explored through structural equation modeling.

Table 4: Correlation analysis results of each influencing factor and learning effect

	English vocabulary	Accuracy of word meaning comprehension	The appropriateness of vocabulary collocation and usage	Semantic reasoning ability
Self-efficacy	0.829	0.702	0.688	0.831
Learning environment	0.738	0.697	0.823	0.702
Interpersonal relationship	0.665	0.801	0.812	0.765

III. C. Analysis of structural equations

III. C. 1) Model Fit

In this study, model fitness was analyzed using AMOS 20.0, and the results of the analysis are shown in Table 5, where the chi-square degrees of freedom ratio (X^2/df) is 1.286, which is less than the critical value of 2. The values of Goodness of Fit Index (GFI), Relative Fit Index (CFI) and Normal Fit Index (NFI) were 0.974, 0.992 and 0.939 respectively, which were greater than the desirable value of 0.900.The value of Adjusted Goodness of Fit Index (AGFI) was 0.943, which was greater than the desirable value of 0.800. The values of standardized root mean square covariance (SRMR) and root mean square of approximation error (RMSEA) are 0.037 and 0.041,

respectively, which are smaller than the critical value of 0.05. According to the reference value of the causal model fitness index, the model constructed in this study has a good fit, and the path analysis conducted accordingly can be supported by empirical data.

Table 5: Analysis Results of Model Adaptability

Adaptation index	X^2/df	GFI	CFI	NFI	AGFI	SRMR	RMSEA
Ideal value	<2.000	>0.900	>0.900	>0.900	>0.800	<0.050	<0.050
Actual value	1.286	0.974	0.992	0.939	0.943	0.037	0.041

III. C. 2) Path analysis

The results of the path analysis among the variables of the structural equation model in this study are shown in Figure 1. The path coefficient of self-efficacy on English vocabulary learning effectiveness is 0.83 ($p<0.01$), which indicates that students with high self-efficacy significantly improve vocabulary learning effectiveness through mechanisms such as monitoring learning behaviors and regulating cognitive resources, which fits the motivational mechanism of self-efficacy in the selfdetermination theory, and strongly supports the H1 hypothesis. The direct effect of learning environment on English vocabulary learning effectiveness is 0.74 ($p<0.01$), in which environmental elements such as family background and teaching resources indirectly promote vocabulary mastery by optimizing learning conditions, which verifies the H2 hypothesis; at the same time, the learning environment shows a significant positive correlation with the sense of self-efficacy (path coefficient of 0.66, $p<0.01$), which confirms the empowering effect of the environmental support on the individual's perceived ability The hypothesis H3 is valid because it is in line with the expectations of the educational ecology theory. The path coefficient of interpersonal variables on vocabulary learning effect reached 0.79 ($p<0.01$), supporting hypothesis H4; the path coefficient between interpersonal relationships and self-efficacy was 0.69 ($p<0.01$), indicating that positive interpersonal interactions indirectly enhance self-efficacy through enhancing the sense of competence, which echoes with the theory of social cognitive theory's observational learning mechanism, and hypothesis H5 is empirically supported. The coefficients of each path reached the significant level ($p<0.05$), and the research hypothesis system was fully verified.

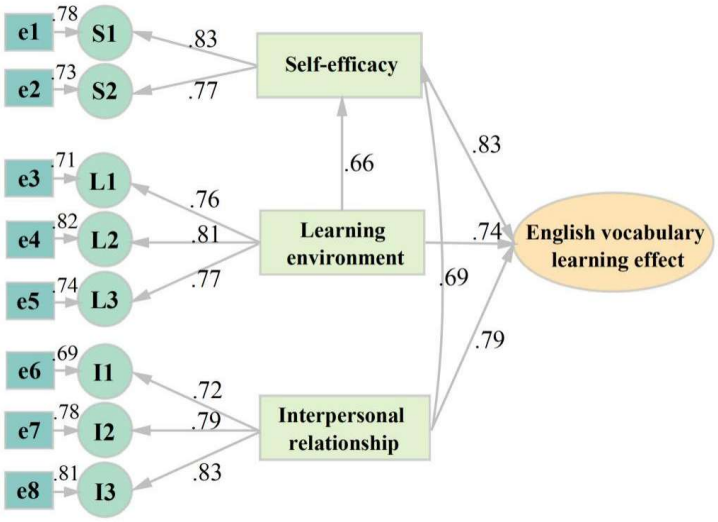

Figure 1: Results of path analysis among variables

III. C. 3) Parametric analysis

The data processed by SPSS 25.0 pre-analysis were imported into AMOS software for parameter estimation using the great likelihood method, and the standardized regression coefficients of the potential variables of the model are shown in Table 6. The P-value of the causal relationship between English vocabulary learning effect and self-efficacy, learning environment and interpersonal relationship is significant. The standardized regression coefficient of self-efficacy on English vocabulary learning effectiveness is 0.813, indicating that it has the strongest explanatory power for learning effectiveness, which coincides with the mechanism of self-efficacy in self-determination theory that affects goal attainment through the allocation of cognitive resources, and verifies the central role of the H1 hypothesis. The path coefficient of learning environment on vocabulary learning effectiveness is 0.776, and the standardized coefficient of interpersonal variables on learning effectiveness reaches 0.806.

Table 6: Results of standardized regression coefficient estimation

Causal relationship	Standardized coefficient	P value
English vocabulary learning effect←Self-efficacy	0.813	**
English vocabulary learning effect←Learning environment	0.776	**
English vocabulary learning effect←Interpersonal relationship	0.806	**
Self-efficacyt←Learning environment	0.734	**
Self-efficacyt←Interpersonal relationship	0.728	**

The standardized regression coefficients of the latent variables of the final model and the standardized path coefficients of each latent variable with the observed variables are shown in Table 7. The self-efficacy dimension of self-efficacy has the highest factor loading of self-efficacy in English vocabulary learning (0.889), suggesting that subjective sense of competence is a key factor driving learning behavior. The learning environment dimension of school environment (0.838) has stronger predictive power compared to family environment (0.706) and social environment (0.717). The path loadings of the interpersonal relationship dimension peer relationship (0.891) were significantly higher than teacher-student relationship (0.822) and parent-child relationship (0.786).

Table 7: Results of standardized coefficient estimation

Causal relationship	Standardized coefficient	P value
English vocabulary learning effect←Self-efficacy	0.813	**
English vocabulary learning effect←Learning environment	0.776	**
English vocabulary learning effect←Interpersonal relationship	0.806	**
Self-efficacyt←Learning environment	0.734	**
Self-efficacyt←Interpersonal relationship	0.728	**
Self-efficacy←English vocabulary learning ability	0.693	**
Self-efficacy←Confidence in learning English vocabulary	0.889	**
Learning environment←Family environment	0.706	**
Learning Environment←School environment	0.838	**
Learning environment←Social environment	0.717	**
Interpersonal relationship←Teacher-student relationship	0.822	**
Interpersonal relationship←Peer relationship	0.891	**
Interpersonal relationship←Parent-child relationship	0.786	**

IV. Conclusion

Based on structural equation modeling, this paper explores the effects of self-efficacy, learning environment and interpersonal relationship on college students' English vocabulary learning, and proposes strategies to improve college students' English vocabulary learning effectiveness based on the results of path analysis.

The overall mean values of self-efficacy, learning environment, and interpersonal relationship are 4.165, 4.147, and 4.143, respectively, and the order from low to high is interpersonal relationship < learning environment < self-efficacy. The overall means of English vocabulary, accuracy of lexical comprehension, appropriateness of vocabulary collocation and semantic reasoning ability are 4.230, 4.164, 4.264 and 4.128 respectively, and the order from low to high is semantic reasoning ability<accuracy of lexical comprehension<English vocabulary<appropriateness of vocabulary collocation.

The path coefficient of self-efficacy on English vocabulary learning effect is 0.83 ($p<0.01$), which strongly supports the H1 hypothesis. The direct effect value of learning environment on English vocabulary learning effect is 0.74 ($p<0.01$), which verifies the H2 hypothesis; at the same time, learning environment and self-efficacy show a significant positive correlation (path coefficient of 0.66, $p<0.01$), so the H3 hypothesis is valid. The path coefficient of interpersonal variables on vocabulary learning effect reached 0.79 ($p<0.01$), supporting hypothesis H4; the path coefficient between interpersonal relationships and self-efficacy was 0.69 ($p<0.01$), and hypothesis H5 was empirically supported. All path coefficients reached the significant level ($p<0.05$), and the research hypothesis system was fully verified.

The standardized regression coefficient of self-efficacy on English vocabulary learning effect is 0.813, the path coefficient of learning environment on vocabulary learning effect is 0.776, and the standardized coefficient of interpersonal variables on learning effect reaches 0.806. Self-efficacy dimensions of self-efficacy in the English vocabulary learning self-efficacy (0.889) has the highest factor loadings, and in the dimensions of the learning

environment, the school environment (0.838) has the highest factor loadings compared to the home environment (0.706). In the learning environment dimension, school environment (0.838) has stronger predictive power than family environment (0.706) and social environment (0.717), and the path loadings of the interpersonal relationship dimension of peer relationship (0.891) are significantly higher than those of teacher-student relationship (0.822) and parent-child relationship (0.786).

The above path analysis results indicate that building good interpersonal relationships, enhancing students' self-efficacy in English learning, and creating a harmonious and cordial English learning environment can help college students improve their English vocabulary learning.

References

[1] Melitz, J. (2016). English as a global language. In The Palgrave handbook of economics and language (pp. 583-615). London: Palgrave Macmillan UK.
[2] Mohammed, M. A. A. (2020). English language and globalization. Intl J of Novel Research in Education and Learning, 7(1), 5-11.
[3] Mauranen, A. (2018). Second language acquisition, world Englishes, and English as a lingua franca (ELF). World Englishes, 37(1), 106-119.
[4] Wang, Y., & Treffers-Daller, J. (2017). Explaining listening comprehension among L2 learners of English: The contribution of general language proficiency, vocabulary knowledge and metacognitive awareness. System, 65, 139-150.
[5] Vu, D. V., & Peters, E. (2021). Vocabulary in English language learning, teaching, and testing in Vietnam: A review. Education Sciences, 11(9), 563.
[6] Akopyants, A. M., Kiseleva, A. V., Getmanskaya, M. Y., Vartanova, K. Y., & Kicheva, I. V. (2019). Assimilation of the English language vocabulary in the tourism sphere. In Perspectives on the use of New Information and Communication Technology (ICT) in the Modern Economy (pp. 839-845). Springer International Publishing.
[7] Siddiq, M., Arif, I. M. Q., Shafi, S. C., & Masood, M. H. (2021). A survey research analysis of effectiveness of vocabulary learning through English vocabulary corpus. International Journal of Education and Pedagogy, 3(2), 1-13.
[8] Alharbi, A. M. (2019). Building vocabulary for language learning: Approach for ESL learners to study new vocabulary. Journal of International Students, 5(4), 501-511.
[9] Lei, Y., & Reynolds, B. L. (2022). Learning English vocabulary from word cards: A research synthesis. Frontiers in Psychology, 13, 984211.
[10] Afzal, N. (2019). A study on vocabulary-learning problems encountered by BA English majors at the university level of education. Arab World English Journal (AWEJ) Volume, 10.
[11] Lehmann, T. H. (2023). Using algorithmic thinking to design algorithms: The case of critical path analysis. The Journal of Mathematical Behavior, 71, 101079.
[12] Gomes, C. M. A., Nascimento, E., & Peres, A. J. S. (2019). Investigating causal relations in personality by combining path analysis and search algorithms. In 3rd World Conference on Personality, World Association for Personality Psychology (WAPP), Hanoi, Vietnam.
[13] Zhu, J. (2021). Adaptive optimisation algorithm for online teaching behaviour. International Journal of Continuing Engineering Education and Life Long Learning, 31(3), 405-417.
[14] Tapalova, O., & Zhiyenbayeva, N. (2022). Artificial intelligence in education: AIEd for personalised learning pathways. Electronic Journal of e-Learning, 20(5), 639-653.
[15] Kobayashi, K., & Little, A. (2018). Explicit instruction of memory vocabulary learning strategies in an ESP context. Journal of Second Language Teaching & Research, 6(1), 20-49.
[16] Suri, I. (2016). Strategies for Teaching English Abroad: The Immersion Classroom. Journal of Education and Educational Development, 3(1), 123.