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A Study on the Influencing Factors of Teaching Interaction on Deep Learning from the Perspective of Social Cognitive Theory

Lan Hong [α], Yan Ma [σ], Xi Mei Yang [ρ] & Ren Ju Tang [ω]

Abstract- Based on Social Cognitive Theory (SCT), a research model is constructed with teaching interaction as the independent variable, self-efficacy as the mediating variable, and Deep learning as the dependent variable. The research uses regression analysis and Bootstrap test to explore the impact of teaching interaction on college students' Deep learning and the mediating role of self-efficacy. The research results show that: teaching interaction positively and significantly affects college students Deep learning and self-efficacy, of which material-chemical interaction has the most significant effect on college students Deep learning (β=0.431); self-efficacy positively affects college students' Deep learning (β=0.255), and play a partial mediating role in teaching interaction and Deep learning. Finally, the research proposes to build a multi-modal interaction mechanism to promote the realization of Deep learning; to create an embodied collaborative learning context to improve the quality of teaching interaction; Learn and reference.

I. Problem Posing and Concept Definition

Deep learning is of great significance to the cultivation of students' higher-order thinking, active knowledge construction, effective knowledge transfer, and poor- structure problem-solving ability, and also has a positive role in promoting the comprehensive development of college students' scientific research and practical ability.The research is a key issue that colleges and universities pay attention to. In the current research on the influencing factors of college students' Deep learning, teaching interaction is generally considered to be one of the important exogenous factors [1], and it is a key component of the classroom teaching behavior of teachers and students. High- quality and in-depth interaction can promote learners.

The cultivation of critical thinking and knowledge construction will help learners to develop Deep learning abilities such as analysis, summary, and innovation. According to the theory of social cognition, the dynamic interaction among the external environment, individual psychology and individual cognition act together on individual behavior [2]. Teaching interaction, as one of the most direct environmental factors in the course of college students' classroom learning, directly affects the learning effect of college students. Self-efficacy, as the subjective feeling of college students on whether they can successfully complete their learning goals, may have an important or critical impact on Deep learning and higher-order thinking. Although the influence of teaching interaction behaviors such as teacher-student interaction and student-student interaction on students' Deep learning has been discussed, few scholars have explored the relationship between teaching interaction and Deep learning from the perspective of social cognitive theory. Therefore, based on social cognition theory, this study constructs a model of the influencing factors of teaching interaction on college students' Deep learning with self-efficacy as a mediating variable, explores the impact of teaching interaction on college students' Deep learning, and analyzes the mediating role of self-efficacy. It is hoped that it will provide theoretical basis for the innovation of teaching mode and the construction of interaction mechanism in colleges and universities in the future, and provide reference for educational administrators to make relevant decisions, in order to realize the Deep learning of college students.

II. Theoretical Basic and Research Assumption

a) Deep Learning Concepts

The concept of Deep learning was first proposed by Ference Marton and Roger Säljö in the process of studying students' reading styles[3], It is believed that Deep learning is a learning method opposite to shallow learning, which mainly refers to students being able to connect new and old knowledge, truly understand and apply the knowledge they have learned to solve complex problems. Domestic scholar Li Jiahou [4], based on constructivism and immersion theory, believes that Deep learning is a kind of high-level learning relative to simple memory acquisition of knowledge, and more emphasis is on students' Deep-level construction of the learned content and attention to learning activities of high emotional and behavioral engagement, and proposed teaching strategies to

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facilitate Deep learning. Later, Zhang Hao, Duan Jinju, Yu Shengquan and other scholars defined the concept and connotation of Deep learning from different perspectives. Although the focus of the research is different, the conclusions are roughly the same. It is generally agreed that Deep learning can effectively promote learning. Under the guidance of mutual communication through the learning environment, teachers, peers, etc., it emphasizes the mastery of unstructured knowledge, and actively carries out knowledge construction, cultivates critical thinking and develops the ability to solve complex problems, so as to achieve the development of higher-order thinking ability. Compared with general learning, the results of Deep learning are at a higher level, and the expected results are generally complex concepts, unstructured knowledge, or high-level problem-solving abilities. Based on this, Biggs et al. proposed the SOLO classification theory[5], which believes that Deep learning is a high-level cognitive processing, which is mainly used to evaluate the complexity of learners' learning thinking structure. Bloom proposed a classification framework for cognitive goals, thinking that learning is a process from shallow to Deep, and it mainly measures students' understanding level and learning depth [6]; then Nelson Laird et al. [7] analyzedand empirically researched the Deep learning scale and proposed that, Deep learning can be deconstructed into three interrelated parts: advanced learning, integrative learning, and reflective learning. The formation process of Deep learning is shown in Figure 1.

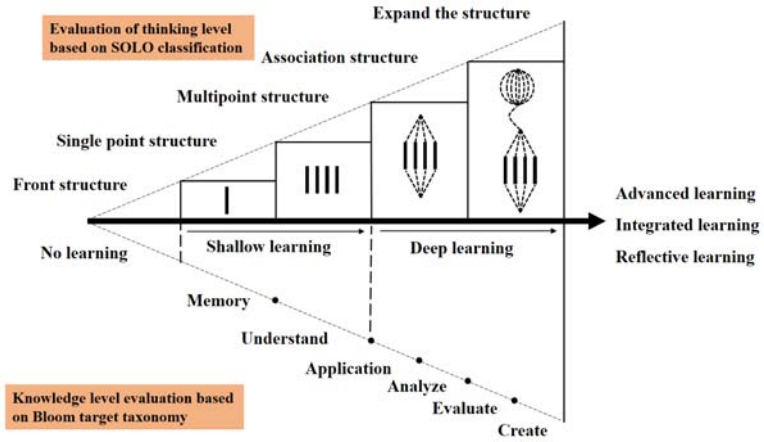

Figure 1: The formation process of Deep learning

b) The relationship between teaching interaction and Deep learning

Educator Dewey believes that the acquisition of learning experience is the interaction of the learning subject with the environment, objects, and self-dialogue [8]. Teaching is a process of interaction among teachers, students, and teaching content, andthe way and quality of their interaction play an important role in the entire teaching process. In Habermas's theory of communicative behavior [9], the "world" can be divided into three parts, namely the objective world, the social world and the subjective world, which respectively map the three aspects of classroom teaching interaction, the cognitive subject and the objective world. The relationship is expressed as the relationship between the learner and the resource and tool platform; the relationship between the learner and the social world is the interaction between the learner and the learning peers, teachers, etc.; the connection between the learner and the subjective world is the new knowledge in the learner's mind and the Interaction between old knowledge. Anderson et al. [10] pointed out in the Equivalent Interaction Theory that there is no less than one form of interaction in the interaction between teachers and students, between students and students, and between students and learning content. When the interaction reaches a high level, the interaction will be higher. Supports meaningful Deep learning (as shown in Figure 2). Therefore, this study combines Habermas' theory of communicative behavior and existing research, and summarizes the process elements of teaching interaction into four factors: materialized interaction,self-interaction, teacher-student interaction, and student-student interaction, and explores the relationship between teaching interaction and Deep learning.

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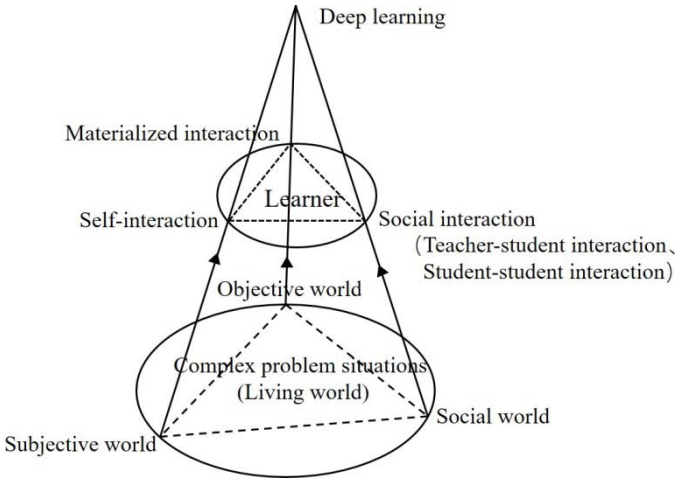

Figure 2: Three levels of teaching interaction

Regarding the relationship between teaching interaction and Deep learning, some studies have found that meaningful classroom teaching interaction can promote students' Deep learning[11], which is an important factor in predicting learning results, and the impact of Deep teaching interaction on Deep learning is significantly higher than that of shallow learning. interaction[12]. For example, Zhan, Zehui et al.[13] analyzed the teacher-student interaction behavior patterns in classrooms through a hysteresis sequence for visual analysis and pointed out that effective teacher-student interaction can promote better learning effects. Zhang Beilei[14] and others studied the relationship between teaching interaction and Deep learning in smarter classrooms, designed teaching interaction strategies to promote learners' Deep learning, and found that learners' Deep learning level was significantly improved after teaching interaction through quasi-experiments. Based on this, the following assumptions are made:

H1: Teaching interaction has a positive predictive effect on college students' Deep learning.

c) The Mediating Role of Self-Efficacy

Self-efficacy (self-efficacy) was first proposed by the famous psychologist Bandura in "Self-efficacy: Towards a Comprehensive Theory of Behavior Change". The subjective speculation of the result of whether a certain behavior is successfully completed[15], mainly refers to the individual's judgment of whether he has the confidence and ability to complete a certain task or activity, which affects the individual's thinking decision, inner motivation and subjective behavior. According to the theory of social cognition, an individual's self-efficacy is affected by the environment, atmosphere and other conditions on the one hand, and directly or indirectly affects the individual's behavior on the other hand. Therefore, research suggests that self-efficacy is an important mediating variable worth considering. And exploring the mediating mechanism of teaching interaction on college students' Deep learning will help to further clarify "how" teaching interaction affects college students'Deep learning.

The social cognition theory holds that the learning environment, the subject's cognition and the learning behavior are dynamically interacted, and self-efficacy, as the subject's antecedent cognitive factor, plays an important role in the interaction of the three [16].According to this theory, interaction behaviors such as materialized interaction (learning platform, course resources, etc.), teacher-student interaction (direct teaching, giving feedback, etc.) Subjective evaluation of achievement and ability judgment, that is, self-efficacy has an important impact on Deep learning through external environmental factors. On the one hand, previous studies have found that self-efficacy has a positive predictive effect on students' Deep learning level [17], and is one of the individual factors that affect learners' Deep learning [18]. For example, Zhou Xiaoli and Lou Zhenzhen[19] took 920 college students as their research objects, and found through a questionnaire survey that students' learning self-efficacy positively predicted their Deep learning level, and the improvement of Deep learning level could also promote their Deep learning level. Learning about the acquisition of self-efficacy. Based on the existing research, we can propose that learning self-efficacy can positively predict the level of individual Deep learning. The higher the learning self-efficacy, the higher the level of Deep learning.

On the other hand, existing research also shows that meaningful teaching interaction in the classroom is also one of the important factors affecting learning self- efficacy. E.g. Li Lin[20] conducted a questionnaire survey on 463 undergraduates and used hierarchical regression analysis to find that positive interaction can promote the self-efficacy of college students. And in a complex online learning environment, it is also found that efficient interaction can affect learners' self-efficacy [21]. Therefore, high-quality and in-

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depth teaching interaction plays a predictive role in individual self- efficacy. However, based on the above theoretical analysis and empirical research results, the following research hypotheses are put forward:

H2: Teaching interaction positively affects college students' self-efficacy;

H3: Self-efficacy positively affects the Deep learning of college students;

H4: Self-efficacy plays a mediating role between teaching interaction and collegestudents' Deep learning.

III. Theoretical Model

In summary, this study constructs a mediated theoretical model (Figure 3) based on social cognitive theory to comprehensively examine the mechanisms of action between instructional interaction and Deep learning and to explore the mediating role of self-efficacy between both instructional interaction and Deep learning.

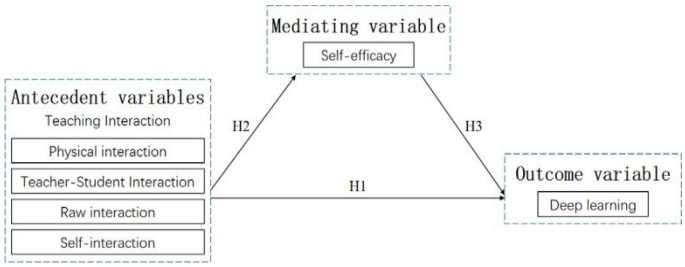

Figure 3: Research hypothesis model

IV. Method

a) Participants

This research selects some full-time college students in Southwest China as subjects to conduct a network questionnaire survey. A total of 592 questionnaires were recovered, 552 of which were valid, with an effective rate of 93.2%. Among the respondents, 211 (38.2%) were male and 344 (61.8%) were female. Literature and history accounted for 34.6% (191), science and engineering accounted for 54.5% (301), arts and sports accounted for 4.2% (23), and others accounted for 6.7% (37).

b) Measures

The questionnaire designed in this study consists of four parts, the first part is basic information, the second part is teaching interaction, the third part is self-efficacy,and the fourth part is Deep learning. Except for the basic information, the scales all adopt the Linkert 5-point scoring method. The scores from low to high indicate the degree to which the respondents' statements on the items are in line with their own situation. Among them, 1 represents "completely disagree" and 5 represents "completely agree". In order to ensure the validity of the questionnaire, all measurement indicators are derived from the existing literature, and appropriate modifications are made according to the research environment, and finally the design of the research questionnaire project is formed. Among them, teaching interaction was revised with reference to the scales developed by Zhang Beilei [22], Li Zhihe[23], etc., including four secondary indicators: materialized interaction, teacher-student interaction, student- student interaction, and self-interaction. Self-efficacy[24] (self-efficacy), referring to the self-efficacy scale (GSES) developed by Schwarzer, R. & Aristi B in 1997, a total of 5items. Deep learning [25] (Deep learning) refers to the items on Deep learning in the National Student Engagement Survey (NSSE) questionnaire by Nelson Laird et al. It consists of 12 items.

c) Data Analysis

In the study, SPSS 24.0 was used for basic data processing, including reliability and validity testing of scales, correlation analysis of variables and regression analysis. Regression analysis can effectively describe, explain or predict the influence of independent variables on dependent variables. The bias-corrected percentile Bootstrapmethod in the PROCESS plugin was used for mediation analysis.

V. Results of Data Analysis

a) Homogeneous variance deviation test

In this study, the Harman single factor method was used to test for homophily bias, and all question items of the three main variables were put together for principal component factor analysis without rotation, and a total of six common factors with eigenvalues greater than 0.6 were extracted, and the first common factor explained 36.187% of the total variance, which was less than the standard 40% threshold. Therefore, the data in this study did not suffer from common method bias and did not have a serious impact on the study results.

b) Reliability test

In order to ensure the reliability and validity of the comprehensive questionnaire, all modules of the questionnaire were tested for reliability and validity. As shown in Table 1, the values of the Clone Bach a coefficient for all structures of the questionnaire were

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above 0.8, indicating that the questionnaire has good reliability; the KMO value was 0.907, which is greater than 0.7, and the Bartlett's sphericity test results reached the significance level of p=0.000 (<0.5), which synthetically indicates that the set questionnaire can measure the corresponding variables and the validity of the questionnaire is good.

Table 1: Reliability and validity tests of the questionnaire structure

Questionnaire	Dimensionality	Average value	Standard deviation	Cronbach's Alpha		KMO
Teaching Interaction	Physical interaction	3.553	0.889	0.875	0.909	0.939
	Teacher-Student Interaction	3.685	0.927	0.857		
	Raw interaction	3.681	0.857	0.853		
	Self-interaction	3.559	0.893	0.732		
Self-efficacy	Self-efficacy	3.629	0.844	0.871		
deep Learning	deep Learning	3.635	0.700	0.895		

c) Preliminary Analysis

To test the correlation between each influencing factor and Deep learning, the strength of the correlation was examined using the Pearson correlation coefficient method. The results are shown in Table 2, where significant positive correlations were found between instructional interaction and its four dimensions, self-efficacy, and Deep learning, and all were significant at the 0.01 level. The correlation pattern between the variables was consistent with the theoretical hypothesis and supported the subsequent analysis.

Table 2: Correlation between instructional interaction, self-efficacy, and Deep learning

Variables	1	2	3	4	5	6	7
1.Teaching Interaction	1.000						
2. Physical interaction	0.735**	1.000					
3. Teacher-student interaction	0.852**	0.423**	1.000				
4. Student-student interaction	0.854**	0.440**	0.862**	1.000			
5. Self-interaction	0.715**	0.459**	0.397**	0.399**	1.000		
6.Self-efficacy	0.493**	0.479**	0.353**	0.348**	0.377**	1.000	
7.Deep Learning	0.648**	0.557**	0.459**	0.472**	0.556**	0.565**	1.000

d) Study on the influence of teaching interaction and self-efficacy on Deep learningof college students

To test whether the research hypotheses were valid, the path coefficients between the three potential variables of the questionnaire were measured. Using instructional interaction as the independent variable, college students' Deep learning as the dependent variable, and self-efficacy as the mediating variable, Model 4 in PROCESS, a mediating effects analysis program developed by Hayes, was used for the analysis, and the results are presented in Table 3. first, all variables were standardized, and gender and major category were set as control variables, and when only instructional interaction was included, it significantly predicted Deep learning (β=0.662, t=19.669, p<0.01), and the research hypothesis H1 held; later, when both instructional interaction and self-efficacy were included, the direct predictive effect of instructional interaction on

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college students' Deep learning remained significant (β=0.495, t=13.376, p<0.01). The positive predictive effect of instructional interaction on college students' self- efficacy was significant (β=0.652, t=14.301, p<0.01), and the research hypothesis H2 was valid; the positive predictive effect of college students' self-efficacy on their Deep learning was also significant (β=0.255, t=8.626, p<0.01), and the research hypothesis H3 was valid. The coefficients of each path are shown in Figure 4.

Table 3: Pathways of instructional interaction and self-efficacy on Deep learning among college students

Result Variables	Predictive Variables	*B*	SE	t	R2	F
Model 1. Deep Learning	Gender	0.0493	0.047	1.0471	0.427	135.951
	Professional category	-0.034	0.029	-1.172		
	Teaching Interaction	0.662	0.035	19.669***		
Model 2. Self-efficacy	Gender	-0.032	0.064	-0.512	0.276	69.546
	Professional category	-0.017	0.039	-0.448		
	Teaching Interaction	0.652	0.045	14.301***		
Model 3. Deep Learning	Gender	0.057	0.044	1.303	0.049	134.226
	Professional category	-0.029	0.027	-1.083		
	Teaching Interaction	0.495	0.037	13.376		
	Self-efficacy	0.255	0.029	8.626***		

Note: Indicates significant at the 0.001 level.

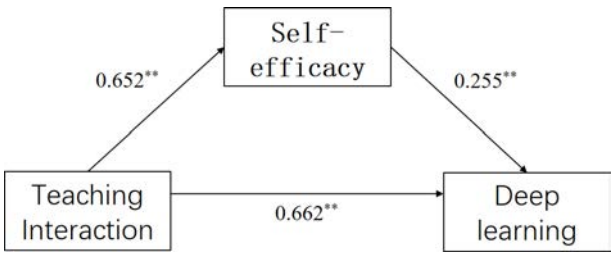

Figure 4: Pathways

To further verify the mediating effect of self-efficacy, a bias-corrected percentile Bootstrap (repeated sampling 5000 times) was used to test the mediating effect, and the results are shown in Table 4. The upper and lower limits of the Bootstrap 95% confidence interval for the direct effect of teaching interaction on the effect of Deep learning of college students were (0.442, 0.585), and the upper and lower limits of the Bootstrap 95% confidence interval for the mediating effect of self-efficacy between teaching interaction and The upper and lower limits of the Bootstrap 95% confidence interval for the mediating effect between teaching interaction and Deep learning effect are (0.108, 0.226), both of which do not contain 0. This indicates that teaching interaction not only directly predicts college students' Deep learning level, but also predicts their Deep learning through the mediating effect of self-efficacy, and college students' self-efficacy plays a partial mediating role, and this direct effect and mediating effect The direct and mediated effects accounted for 74.77% and 25.23% of the total effect, respectively, and study H4 was established.

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Table 4: Decomposition of total, direct and mediated effects

	Effect Value	Boot Standard error	95% confidence interval		Relative Effect Value
			Boot CI lower limit	Boot CI higher limit	
Intermediary Effect	0.167	0.029	0.108	0.226	25.23%
Direct effect	0.495	0.037	0.422	0.585	74.77%
Total effect	0.662	0.034	0.432	0.841	100%

e) The impact of the teaching interaction sub-dimension on the Deep learning ofcollege students

To measure the effects of the four sub-dimensions of instructional interaction on college students' Deep learning, the four sub-dimensions of instructional interaction were used as independent variables, college students' Deep learning as dependent variables, and self-efficacy as mediating variables, respectively, and Model 4 in PROCESS was used for analysis. After controlling for gender, major category, etc., theresults are shown in Table 5, M1~M4 indicate the relationship model of the influence of the four dimensions of the independent variable instructional interaction on the mediating self-efficacy; M5~M8 indicate the relationship model of the influence of thefour dimensions of the independent variable instructional interaction on the dependentvariable Deep learning; M9 indicate the relationship model of the influence of the mediating variable self-efficacy on the dependent variable Deep learning; M10~M13 indicate the relationship model of the mediating variable self M10~M13 represent the mediating effect model of the mediating variable self-efficacy in the mechanism of the influence of the four dimensions of the teaching interaction of the independent variableon the dependent variable Deep learning; the above 13 models constitute a complete verification of the hierarchical regression analysis of the influence relationship of the independent variable on the dependent variable and the mediating effect of the mediating variable in the study. The mediating effect sizes are shown in Table 6.

Table 5: The effect of four dimensions of instructional interaction on Deep learning of college students

Dependent variable		Gender	Professional category	Physical interaction	Teacher-Student Interaction	Raw interaction	Self-interaction	Self-efficacy	R2	F
	M1	0.030	-0.027	0.452***					0.230	54.656
Since	M2	0.031	-0.043		0.319***				0.127	26.461
I follow Sensitivity	M3	0.018	-0.033			0.340***			0.122	25.381
	M4	0.023	-0.027				0.354***		0.143	30.426
Deep degree Learning	M5	0.117	-0.044	0.431***					0.320	85.829
Practice	M6	0.110	-0.059		0.339***				0.221	51.791
	M7									
		0.093	-0.048			0.377***			0.230	54.567
Deep degree Learning	M5	0.117	-0.044	0.431***					0.320	85.829
	M6	0.110	-0.059		0.339***				0.221	51.791

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Practice	M7	0.093	-0.048			0.377***			0.230	54.567
	M8	0.090	-0.039				0.428***		0.315	84.157
	M9	0.139	-0.042					0.461***	0.330	90.080
Deep	M10	0.107	-0.036	0.288***				0.318***	0.433	104.320
degree Learning Practice	M11	0.099	-0.043		0.218***			0.378***	0.403	92.209
	M12	0.086	-0.036			0.249***		0.376***	0.410	95.204
	M13	0.082	-0.030				0.308***	0.341***	0.461	116.847

As can be seen from Table 5, the four dimensions of instructional interaction have a differential effect on college students' Deep learning, in which physical interaction, teacher-student interaction, student-student interaction, and self-interaction have a significant positive effect on college students' Deep learning evenly. However, in terms of effect values, physical interaction ($\beta=0.431$, $P<0.001$) has the greatest effect on college students' Deep learning, self-interaction ($\beta=0.428$, $P<0.001$) is the second, student-student interaction ($\beta=0.377$, $P<0.001$) is smaller, and teacher-student interaction has the least significant effect on college students' Deep learning.

To further test the mediating effect of self-efficacy between the sub-dimension of instructional interaction and Deep learning, Bootstrap test was applied and the results are shown in Table 6. The confidence intervals of the mediating effects of physical interaction, student-teacher interaction, student-student interaction, and self-interaction through self-efficacy on Deep learning of college students at the sample 5000 and 95% confidence intervals were (0.100, 0.194), (0.079, 0.167), (0.084, 0.176), and (0.077, 0.172), respectively, all of which did not contain 0, indicating that self-efficacy partially mediated the influence paths of physical interaction, teacher-student interaction, student-student interaction, and self-interaction on Deep learning. Among them, the strongest mediating effect is the mediating effect of self-efficacy in the path of influence of student-student interaction on college students' Deep learning, accounting for 33.95% of the total effect; the weakest mediating effect is the mediating effect of self-efficacy in the path of influence of self-interaction on college students' Deep learning, accounting for 28.27% of the total effect.

Table 6: Mediated path effects of self-efficacy

Intermediary Pathway Role	Total Effect	Direct Effect			Intermediary Effect			
			95% Confidence Interval			95% Confidence Interval		
Self Sense of efficacy	Effect Value	Effect Value	Boot CI lower limit	Boot CI higer limit	Effect Value	Boot CI lower limit	Boot CI higer limit	Percentage of
Physical interaction	0.431	0.276	0.376	0.486	0.144	0.100	0.194	33.41%
Teacher- Student Interaction	0.339	0.218	0.165	0.271	0.121	0.079	0.167	35.69%
Raw interaction	0.377	0.249	0.192	0.305	0.128	0.084	0.176	33.95%
Self-interaction	0.428	0.307	0.255	0.360	0.121	0.077	0.172	28.27%

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VI. Research Conclusion

a) The relationship between teaching interaction and Deep learning of collegestudents

The results of this study showed that instructional interactions significantly and positively predicted college students' Deep learning with a direct effect of 0.495, indicating that instructional interactions have a strong explanatory predictive effect on college students' Deep learning, and that high-quality, meaningful instructional interactions are an important way to facilitate the achievement of Deep learning, which is a key factor influencing college students' Deep learning.

In addition, the hierarchical regression analysis revealed (see Table 5) that all dimensions in different forms of instructional interactions had a significant positive effect on the Deep learning of college students, and there were significant differences. The role of physical interaction ($\beta=0.431$, $p<0.001$) was more significant, indicating that teachers and students are good at using various teaching hardware devices for communication and negotiation, interactive learning, joint construction of the learned knowledge points, and continuous self-development. In the process of teaching interaction, learners actively participate in learning activities, actively transfer knowledge and self-reflect, thus promoting their cognitive and ability enhancement andultimately achieving Deep learning.

Self-interaction ($\beta=0.428$, $p<0.001$) is second only to physical interaction in termsof its impact on Deep learning among college students, and interaction with the self as a reflective behavior promotes continuous negotiation and communication between the learning individual and the self. When learners resonate with the new knowledge learned and the old knowledge in their minds, instead of remaining in the simple memorization and understanding of knowledge, it facilitates students to reflect on what they have learned from within, to make correct predictions about learning, and thus maintain active interest in learning and desire to know, and to achieve a reconstruction of knowledge and understanding.

The influence of student-student interaction ($\beta=0.377$, $p<0.001$) and teacher- student interaction ($\beta=0.339$, $p<0.001$) on college students' Deep learning is not significant enough. The reason for exploring the social interaction (student-student interaction and teacher-student interaction) as an important part of classroom teaching activities may be, on the one hand, because there is no perfect interactive learning mechanism between teachers and students. Students' learning feedback, guidance and encouragement from teachers and other external environments do not actively evoke, stimulate and strengthen students' learning motivation; on the other hand, there may be homogeneity among students, for example, peers do not actively share learning resources and experiences among themselves, and there are fewer collaborative learning activities such as communication and mutual evaluation among groups, which do not stimulate students' learning motivation. Therefore, in the teaching process, teachers should pay attention to the improvement of teaching level and interaction skills, and students should be more active in interacting with their peers, etc.

b) The mediating role of self-efficacy

Based on the validation of the relationship between instructional interaction and college students' Deep learning, this study further identified a partially mediating role of self-efficacy between the two. First, the results of this study showed that general self- efficacy positively predicted college students' Deep learning with an effect size of 0.255, which is a key factor influencing college students' Deep learning, probably because college students with high self-efficacy have higher beliefs about successfully reaching learning goals, and can choose appropriate ways to deal with bottlenecks when they encounter them, find effective strategies to solve problems, and avoid ineffective shallow learning.

Second, this study also showed that instructional interactions positively predicted college students' self-efficacy with an effect size of 0.652. When students perceived instructional help from teachers, peers, and others, it enhanced learners' willingness and motivation to learn, effectively increasing their positive perceptions of self and efficiently completing learning tasks, and thus their self-efficacy was enhanced.

Finally, self-efficacy plays a partly mediating role between instructional interaction and Deep learning, comparing the direct and indirect effects of instructional interaction on Deep learning, the size of the direct effect accounts for 74.77% of the total effect, which is larger than the indirect effect. On the one hand, it shows that it wants to indirectly influence college students' Deep learning through the external environment factor of teaching interaction, and self-efficacy is one of the important individual factors, which again verifies that teaching interaction is the result of the joint action of external environment and individual factors; on the other hand, it shows that improving college students' self-efficacy is conducive to the realization of teaching interaction on college students' Deep learning. Taken together, it highlights the importance of self-efficacy in teaching and learning, which is important for understanding the inner mechanism of teaching interaction and constructing an effective teaching interaction model.

VII. Research Recommendations

The results of the data study indicate that the three elements of instructional interaction, self-efficacy, and Deep learning among college students are

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interrelated and influence each other, and the internal logic among each factor provides ideas for the realization of Deep learning among college students, and the following recommendations are made based on the results of the study.

a) *Building a multimodal interaction mechanism to enhance the effect of Deeplearning*

Physical interaction is a positive facilitating influence factor for Deep learning among college students, and the proportion of its influence is the highest among the four categories, so improving the level of physical interaction is an effective way to promote Deep learning among college students. Building a multimodal interaction mechanism, aiming at developing learners' Deep learning, creating complex problem situations based on real life, organizing classroom teaching activities, and interacting meaningfully with resources, tools, and the environment are effective ways to promote learners' Deep learning. Firstly, taking learners as the center of classroom learning activities and teachers as the auxiliary, taking actual problem situations as the starting point of classroom interaction activities, redefining the inner relationship between classroom teaching interaction elements, making full use of classroom resources, tools and platforms, reconstructing the interaction mechanism of classroom teaching, promoting Deep interaction of learning communities, and realizing learners' Deep understanding of knowledge. Secondly, learners achieve a comprehensive understanding of the objective world, subjective world and society through multimodal interaction, and achieve solutions to practical complexities in the internal processing of multimodal information.

b) *Create an embodied collaborative learning context to improve the quality ofteaching interaction*

The effect of social interaction (student-student interaction and student-teacher interaction) on Deep learning among college students is not significant, so improving the level of interaction among students is another reliable way to promote Deep learning.Embodied cognition theory suggests that students cannot learn without the participation of the body, and environmental conditions affect the mental process of learning memory through the body. Collaborative learning is the process of developing learning habits, acquiring applied skills, and completing collaborative tasks in the process of dialogue and communication among students through collaboration in small groups or learning communities with a common learning goal in mind. By combining the two, we create an embodied collaborative learning context, support learners' embodied interaction and Deep experience, maximize learners' potential, cultivate individuals' awareness of effective independent interaction with peers, reflectively participate in knowledge construction in the process of communicating with peers, realize knowledge construction and creation, and effectively promote interaction depth and shared communication among peers, who will actively share their own knowledge and opinions in the learning process. knowledge, opinions, etc., which triggers learners to think Deeply, improves the quality of teaching interaction, and then develops personal Deep cognitive ability and realizes the Deep occurrence of knowledge construction.

c) *Establishing a diversified interactive incentive system to enhance students' self-efficacy*

Research shows that self-efficacy can positively predict college students' Deep learning and play a mediating role in the process of teaching interaction on Deep learning; therefore, improving students' self-efficacy is an important factor to be considered to enhance their Deep learning. Based on this, it is proposed to establish an effective multi-interaction incentive mechanism to mobilize college students' learning initiative, enthusiasm and creativity during teaching implementation, to establish a fair and open reasonable incentive system, to fully consider students' individual differences, so as to establish a scientific student incentive mechanism, and to supplement the incentive mechanism on this basis. For example, during the teaching process, students are rewarded for their excellent performance (adding usual points, prizes, etc.), actively guided to actively participate in classroom activities, stimulate students' thinking and inquiry, and cultivate their creative thinking and innovative ability, which not only control students' learning load and enhance their self-efficacy, but also guarantee the quality of their teaching interactions and improve learning effectiveness. When students are in the process of high-quality interaction, they believe that their behavior and efforts are fully affirmed by teachers and students, so they will show more positive learning attitudes, take the initiative to communicate with others, rationalize their learning plans,and demonstrate higher learning quality.

d) *Data Availability*

The data used to support the findings of this study are available from thecorresponding author upon request.

Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict ofinterest.

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