Research on the Influencing Factors of Teaching Interaction on Deep Learning of Graduate Students in Smart Classroom Environment

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Abstract:

Effective teaching interaction promotes the achievement of deep learning in an important way, and the smart classroom environment provides strong support for the development of teaching interaction and the realization of deep learning. In this study, a questionnaire survey was conducted by using SPSS software for difference analysis and regression analysis, and the impact of teaching interaction on deep learning of graduate students in the smart classroom environment was explored. The results show that the teaching interaction and deep learning are at the upper middle level and still need to be further strengthened in the future; the teaching interaction and deep learning scores of students of different grades have significant differences; and the teaching interaction positively affects the deep learning of graduate students. Among the five dimensions of teaching interaction, the total effect of materialized interaction on deep learning is the largest. Therefore, in the future teaching of smart classrooms, attention should be paid to improving the quality of teaching interaction and promoting deep learning for graduate students.

Keywords*: teaching interaction, deep learning, smart classroom*

1 INTRODUCTION

In today's era of rapid development of information technology, deep learning as a powerful means to achieve high-level thinking and innovation ability of graduate students has received further attention from educators, which embodies the ability of innovation, creativity and sustainable development, so it is of great significance to explore the deep learning of graduate students for the sustainable development of graduate education.

At present, teaching interaction is widely regarded as one of the important exogenous factors in classroom teaching. In the classroom system, interaction is a key component of teachers' and students' classroom teaching behavior, and high-quality and in-depth interaction can promote learners' knowledge construction, the development of critical thinking, and the formation of deep learning capabilities such as analysis, summary, and innovation. At present, the interaction relationship between the interaction elements between teachers and students in the smart classroom is not very clear, the essence of interaction has not exceeded the traditional classroom, the information function of the smart classroom has not been fully utilized, and deep learning has not happened as we expect. Therefore, this study explores the impact of teaching interaction on deep learning in smart classroom environment through empirical methods. It is hoped to provide theoretical basis for the construction of the smart classroom environment, the innovation of teaching mode and the construction of interaction mechanism in the future, provide strategic guidance for the teaching of smart education in colleges and universities, and have a certain guiding effect on improving the deep learning of graduate students.

2 LITERATURE REVIEW AND RESEARCH HYPOTHESES

2.1 Deep learning

At present, there is no unified concept definition of deep learning in the academic community, originally

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proposed by Ferens Marton and Roger Sarcho in the process of studying students' reading styles [8] based on Bruner's classification theory of cognitive goals, which believes that deep learning is a learning method as opposed to shallow learning. Foreign scholar Houghton believes that [11] deep learning promotes the learning of knowledge and metacognitive development through the community of inquiry learning. Domestic scholar He Kekang pointed out [4] that deep learning is a new concept, method and necessary tools and resources to help learners remember and understand the basic knowledge of various disciplines, and has the ability to apply, analyze, evaluate and innovate.

2.2 Teaching interaction

Educator Dewey [3] the acquisition of learning experience is the interaction of the learning subject with the environment, the object, and the dialogue of the self. In Habermas's theory of communicative behavior [10] the "world" can be divided into three parts: the objective world, the social world, and the subjective world, which map the interaction between the learning subject and resources and tools in teaching, the interaction between the learning subject and peers, the teacher, etc., and the interaction between new and old knowledge in the mind of the learning subject. Effective classroom activities are based on teaching situations, through the interaction of observation, inquiry, cooperation and other means to obtain the ability to apply, analyze, evaluate and innovate. Kanuka [5] et al. used the SOLO taxonomy to examine the influence of different teaching interaction strategies on group interaction, indicating that teaching strategies have more effective interaction and can promote higher levels of learning; He Kekang [4] et al. believe that to achieve the goal of deep learning, a variety of teaching and learning methods and strategies must be adopted. Therefore, this study combines Habermas's communicative behavior theory and existing research, and summarizes the process elements of teaching interaction into five factors: materialized interaction, self interaction, teacher-student interaction, student-student interaction, and interaction strategy, and explores the relationship between teaching interaction and deep learning.

2.3 The relationship between teaching interaction and deep learning

Regarding the impact of teaching interaction on deep learning, studies have found that effective classroom teaching interaction can promote deep learning for students [12], which is an important factor in predicting learning effects, and the impact of deep teaching interaction on deep learning is significantly higher than that of shallow interaction [7]. Zhan, Zehui [13] et al. visually analyzed the interaction behavior patterns of teachers and students in smart classrooms and traditional multimedia classrooms through lagging sequence analysis, and pointed out that smart classrooms help to improve teacher-student interaction, richer interaction strategies, and better learning effects. Zhang Beilei [2] et al. studied the relationship between teaching interaction and deep learning in smart classrooms, designed teaching interaction strategies to promote learners' deep learning, and through quasi-experiments, the learners' deep learning level before and after interactive teaching was significantly improved, but it also had some negative effects. Based on existing research, this study proposes to explore the influence of teaching interaction on deep learning in the smart classroom environment and its inherent mechanism.

Hypothesis is proposed: Teaching interaction in a smart classroom environment has a positive predictive effect on deep learning.

3 ESEARCH DESIGN

3.1 Research tools

The survey data file of this study consists of four parts, the first part is basic information, the second part is teaching interaction, the third part is deep learning. In addition to the basic information, the scale adopts the Linkert5 review scoring method, and the score from low to high indicates the degree to which the respondents express their own conditions, of which 1 represents "completely inconsistent" and 5 represents "completely compliant". Among them, teaching interaction is revised with reference to the scale developed by Zhang Beilei [1] and Li Zhihe [6], including five secondary indicators: materialization interaction, teacher-student interaction, student-student interaction, self-interaction and interaction strategy. Deep learning [9] (deep learning) is composed of 12 questions based on 12 questions in the National Student Engagement Survey (NSSE) questionnaire by Nelson Laird et al. The specific indicators are shown in Table 1.

Table 1 Scale development

Study variables		The number of questions	scales
Level 1 Indicators	Level 2 Indicators		
teaching interaction	materialized interaction	4	5
	teacher-student interaction	3	5
	student-student interaction	4	5

	self interaction	3	5
	interaction strategy	6	5
deep learning	-	12	5

3.2 Research objects

In this study, full-time master's degree students in the southwest part of the university were selected as the target of the online questionnaire survey. A total of 232 questionnaires and 204 valid questionnaires were recovered, with an effective rate of 87%. Of the personnel surveyed, 63 (30.9 per cent) were boys and 141 (69.1 per cent) were girls. Literature and history accounted for 28.4% (58 students), science and engineering accounted for 59.8% (122 students), arts and sports accounted for 6.4% (13 students), and others accounted for 5.4% (11 students).

3.3 Research methods

In this study, SPSS26.0 software was used to analyze the experimental data and the reliability and validity analysis, and to test the significance of different demographic characteristics in the difference in the scores of various variables and the correlation between the variables. Finally, regression is used to analyze the relationship between the independent variable and the dependent variable.

4 THE RESULTS OF DATA ANALYSIS

4.1 Reliability and validity test

In order to ensure the reliability and validity of the comprehensive questionnaire, the questionnaire is tested. As shown in Table 2, the clonbach coefficient values of all structures of the questionnaire are above 0.8, indicating that the questionnaire has good reliability; the KMO value is 0.907, greater than 0.7, and the Bartlett spherical test results reach the significance level p=0.000 (<0.5), which comprehensively indicates that the questionnaire can measure the corresponding variables and the validity of the questionnaire is better.

Table 2 Reliability and validity tests of questionnaire structure

Questionnaire	Dimension	M	SD	Cronbach's Alpha		KMO
teaching interaction	materialized interaction	3.61	0.828	0.870	0.934	0.907
	teacher-student interaction	3.80	0.826	0.859		
	student-student interaction	3.81	0.748	0.839		
	self interaction	3.57	0.836	0.816		
	interaction strategy	3.69	0.757	0.888		
deep learning		3.77	0.765		0.906	

4.2 Correlation analysis of various variables

In order to test the correlation between each influencing factor and deep learning, pearson correlation coefficient method is used to test the correlation intensity. As shown in Table 3, there was a significant positive correlation between the teaching interaction and its five dimensions, and deep learning, and all of them were significant at the level of 0.01. The above results initially support the research hypothesis.

Table 3 Correlation between teaching interaction and deep learning

variable	teaching interaction	materialized interaction	teacher-student interaction	student-student interaction	self interaction	interaction strategy	deep learning
teaching interaction	1.000						
1.materialized interaction	0.761**	1.000					
2.teacher-student interaction	0.842**	0.461**	1.000				
3.student-student interaction	0.833**	0.451**	0.852**	1.000			
4.self interaction	0.684**	0.514**	0.390**	0.356**	1.000		
5.interaction strategy	0.794**	0.527**	0.603**	0.631**	0.376**	1.000	
deep learning	0.582**	0.555**	0.418**	0.418**	0.497**	0.374**	1.000

Note: *** indicates significant at the 0.001 level, ** means significant at the 0.01 level, and * means significant at the 0.05 level

4.3 Analysis of demographic characteristics in different categorical variables

Independent sample t-tests and one-way ANOVA were used to examine differences in teaching interaction and deep learning scores across gender, grade, and professional categories. The results show that there are significant differences between students of different genders in teaching interaction (P=0.004) and deep learning (P=0.007), and there are significant differences in deep learning (P=0.010) among students of different grades: there are no significant differences in teaching interaction and deep learning among students in different professional categories. For details, see Table 4.

It can be found that the total means of teaching interaction (Mean=3.62>3) and deep learning (Mean=3.77>3) are slightly higher than the theoretical neutral values and are in the upper middle level. The dimensions of teaching interaction, from high to low, are student-student interaction (Mean=3.81), teacher-student interaction (Mean=3.80), interaction strategy (Mean=3.69), materialization interaction (Mean=3.61), and self-interaction (Mean=3.57).

Table 4 Demographic disparities analysis

Control variables	Statistical values	teaching interaction	deep learning
gender	*P*	0.004	0.007
grade	*P*	0.071	0.010
Professional type	*P*	0.448	0.230
	M	3.618	3.635
	SD	0.682	0.700

4.4 The mechanism of teaching interaction on deep learning for graduate students

To verify that the study hypothesis holds, the path coefficients between the 3 potential variables of the questionnaire were measured. Taking teaching interaction as the independent variable and graduate deep learning as the dependent variable, regression analysis is analyzed, and the results are shown in Table 5. Setting gender and major categories as control variables can significantly predict deep learning (B=0.685, t=9.898, p<0.01) when only included in teaching interactions, and the study hypothesis holds.

Table 5 The pathway of influence of teaching interaction on deep learning for graduate students

Result variables	Predictors	*B*	SE	t	95% confidence interval		R^2	F
					LLCI	ULCI		
Model 1: Deep learning	gender	-0.010	0.086	-0.166	-0.184	0.156	0.340	34.314
	Professional category	-0.031	0.052	-0.542	-0.131	0.075		
	Teaching interactions	0.685	0.064	9.898**	0.507	0.759		

Note: *** indicates significant at the 0.001 level, ** means significant at the 0.01 level, and * means significant at the 0.05 level

4.5 The impact of different dimensions of teaching interaction on the deep learning of graduate students

In order to measure the influence of the five sub-dimensions of teaching interaction on the deep learning of graduate students, the five sub-dimensions of teaching interaction were taken as independent variables, and the deep learning of graduate students was taken as the dependent variable, and the hierarchical regression analysis was analyzed. After controlling for gender, professional category, etc., the results are shown in Table 6.

Table 6 The influence of the five dimensions of teaching interaction on deep learning for graduate students

variable	Dependent variable: Deep learning		
	B	SE	*t*
materialized interaction	0.35**	0.06	4.87
teacher-student interaction	0.05	0.09	0.47
student-student interaction	0.14	0.10	1.30
self interaction	0.26**	0.05	3.90
interaction strategy	-0.03	0.07	-0.37
R^2	0.38		
F	25.65		

Note: *** indicates significant at the 0.001 level, ** means significant at the 0.01 level, and * means significant at the 0.05 level

5 DISCUSSION

In this study, a survey of 207 graduate students took teaching interaction as the independent variable and deep learning as the dependent variable, and the results showed that the teaching interaction positively affected the deep learning of graduate students; the materialization interaction, teacher-student interaction, student-student interaction and self-interaction in the teaching interaction had a significant positive impact on the deep learning of graduate students, of which the role of materialization interaction was more obvious, and the interaction strategy had a significant negative direct effect on the deep learning of graduate students.

(1) In the smart classroom environment, although the teaching interaction and deep learning of college students are at the upper middle level, they still need to be further improved.

First, the quality of teaching interaction between college students in the smart classroom environment needs to be further improved, especially the materialization interaction. Smart classroom is a

technology-rich new learning environment, students do not use for a long time, the teacher's intelligent function is not fully mastered, in the teaching process, teachers should be conscious to guide students to rationally use the function of the smart classroom, so that students make full use of its advantages for efficient learning, effectively promote the interaction between the student's body and the environment, stimulate students' interest in learning, so as to help improve the classroom teaching effect and achieve deep learning. In order for students and teachers to better adapt to the intelligent school environment, schools should organize corresponding teaching teachers to carry out training on the use of smart classrooms, so that teachers can make full use of equipment for efficient teaching and improve students' learning effect.

Second, the deep learning level of college students in the smart classroom environment needs to be further improved, especially the high-level learning ability. Although the total value of the deep learning level is slightly higher than the theoretical neutral value, it is at the upper-middle level, and there is still room for improvement. In the specific dimensions of deep learning in the smart classroom environment, reflective learning scores are the highest, indicating that in the technology-rich environment, after classroom learning, they are good at retrospectively summarizing and reflecting on what they have learned; however, the high-order learning ability is relatively weak, and students are still lacking in high-input learning with high-order thinking as the main cognitive activity.

(2) Teaching interaction has a significant positive impact on graduate students' deep learning.

From Figure 3, it can be seen that the teaching interaction has a significant positive effect on the deep learning of graduate students, and its direct effect is 0.34, which verifies the important role of teaching interaction on the deep learning of graduate students. From Table 7, it can be seen that the materialization interaction, teacher-student interaction, student-student interaction and self-interaction in the teaching interaction have a significant positive effect on the deep learning of graduate students, and the total effect of the materialization interaction is the largest, indicating that in the smart classroom, the comfortable physical environment, rich learning resources, convenient learning tools and good interaction have created a high-quality learning space and learning atmosphere for students' learning, which is more conducive to the realization of deep learning for graduate students.

REFERENCES

[1] Chen Beilei. Research on the Influence of Teaching Interaction in Smart Classroom on Deep Learning of College Students[D].Central China Normal University, 2018.

[2] Chen Beilei, Zhang Yi, Yang Bing, Xiong Jie, Lin Li. Research on Teaching Interaction in Smart Classroom Promoting Deep Learning for College Students [J]. Research on E-education, 2019, 40(03):90-97.10.13811/j.cnki.eer.2019.03.013.

[3] Dewey. Art is Experience[M].Gao Jianping, trans. Beijing: The Commercial Press, 2005

[4] He Kekang. Deep Learning: The Transformation of Learning Methods in the Internet Age[J]. Educational Research, 2018, 39(5): 111-115

[5] Kanuka, H. (2011). Interaction and the online distance classroom: Do instructional methods effect the quality of interaction?. Journal of computing in higher education, 23(2), 143-156.

[6] Li Zhihe, LI Sizhe, WANG Yuanchen, ZHANG Chunyu. Design and Verification of Deep Learning Evaluation Scale for College Students in Embodied Cognitive Environment [J]. Electrochemical Education Research, 2020,41(12):92-98.

[7] Lu Qiang. Research on the Influence of Teaching Interaction Level on Online Deep Learning of College Students[J].Research on E-education, 2021, 42(03): 34-41.10.13811/j.cnki.eer.2021.03.005.

[8] Marton, F., & Säaljö, R. (1976). On qualitative differences in learning—ii Outcome as a function of the learner's conception of the task. british Journal of educational Psychology, 46(2), 115-127.

[9] National Survey of Student Engagement. (2004). Student Engagement: Pathways to Collegiate Success: 2004 Annual Survey Results. National Survey of Student Engagement, Center for Postsecondary Research, Indiana University Bloomington, School of Education.

[10] Wang Yin, Huang Cuiyao. Habermas's Interaction Theory and Network Interaction[J].Guangxi Social Sciences, 2003(08):45-47

[11] Warren Houghton Deep and Surface Approaches to Leaning[EB/OL] http.www.heacademy.ac.uk/resources/detail/subjects/engineering/Deep-and-Surface-Appoaches-to-Learning.2014-04-06.

[12] Wang Zhiyan. Design of teaching interaction activities in smart classrooms to promote students' deep learning [J].China Vocational and Technical Education, 2019(35):82-87.

[13] Zhan, Z., Wu, Q., He, W., Cheng, S., Lu, J., & Han, Y. (2021). K12 teacher-student interaction patterns

in the smart classrooms. International Journal of Innovation and Learning, 29(3), 267-286.