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Teachers, Teaching Strategies, and Smart classroom in affecting University Students' Deep Learning

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Abstract

Nowadays, to meet the demands of social development, the talent cultivation goals of universities have gradually shifted from the "massive training of skilled talents" in the industrial era to "personalized and innovative talent cultivation" in the intelligent era. The core goal of university education has also shifted from the traditional acquisition of knowledge and skills to the cultivation and improvement of students' deep learning abilities.Therefore, promoting deep learning among learners is an important direction for the reform of higher education. During the crucial period of rapid development of higher education and transformation of university teaching, smart classrooms have flourished and have been endowed with more educational missions and higher value expectations. However, multiple factors need to work together to achieve deep learning. This paper adopts the quantitative research method and conducts a detailed study from three aspects: teaching environment, teachers, and teaching strategies. It explores whether the smart classroom can promote students' deep learning compared to traditional classrooms, as well as the influence of teachers and teaching strategies on deep learning. Research has shown that smart classroom, teachers, and teaching strategies all have a significant positive impact on students' deep learning. Based on it, this paper briefly discusses the specific aspects of each influencing factor, providing a reference for universities and teachers in the information age on how to effectively enhance students' deep learning.

Keywords: *Teachers, Teaching Strategies, Smart Classroom, Deep Learning, University*

Introduction

General Introduction

Currently, the world is undergoing an unprecedented transformation of magnitude unseen in the past century. The new round of technological and industrial revolutions have greatly changed the economic development and political patterns worldwide, and the accelerated process of global digitalization has put forward higher requirements for the goal of talent cultivation (Zheng & Wang, 2023). The most important core competencies of talents in the new era should include information literacy, computational thinking, collaborative communication ability, complex problem-solving ability, and human-computer collaboration ability (Lei, 2020). As a result, in the digital era, the goal of talent cultivation in colleges and universities should include the cultivation of students' critical thinking and problem-solving, effective communication, team co-creation, creativity, and innovation abilities (Yang et al., 2018). That is, the ability of deep learning.

In 2022, during the 77th session of the United Nations General Assembly, the United Nations convened the "Transforming Education Summit", which placed education at the center of the global political agenda and aimed to help countries revitalize themselves from the growing crisis in education and advance the achievement of the Sustainable Development Goals (SDGs) (Liu & Gu, 2023). The Summit called on governments and the international community to transform education on five major themes, one of which is: rethinking the purpose and content of education and empowering learners to acquire skills for a sustainable future (Bian et al., 2022).

Therefore, in the current society, the goal of talent cultivation in colleges and universities has gradually shifted from the "large-scale skill-based talent cultivation" in the industrial era to the "personalized and innovative talent cultivation" in the intelligent era, and the core goal of education and

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teaching in colleges and universities has also shifted from the traditional acquisition of knowledge and skills to the cultivation and enhancement of the students' deep learning and core qualities, such as problem-solving ability, teamwork ability, critical thinking ability, information literacy, digital literacy and intelligent literacy, and so on (Zheng & Wang, 2023).

In a word, the main goal of teaching reform in the 21st century is to cultivate high-quality students who possess the abilities of lifelong learning, knowledge innovation, and autonomous learning (Zhang et al., 2014). Deep learning transcends cognitive boundaries and integrates elements of the times, becoming a new learning method in current educational development, and is capable of meeting the new demands for talent cultivation in the 21st century. China's educational informatization has shifted from version 1.0 to 2.0, and its core lies in moving towards deep learning (Xing, 2018). Therefore, promoting deep learning among learners is an important direction for the reform of higher education.

Digital technology has initiated the modernization of higher education. The most direct manifestation of the integration of technology and education is to improve the learning environment by upgrading and optimizing traditional teaching facilities, the core of which is the creation of "smart learning environment" (Zheng & Wang, 2023; Khusen et al., 2024'). Smart classroom is the main scene of smart education, as well as the core and main battlefield of the digital transformation of school education (Huang & Yang, 2022). Smart classroom is becoming increasingly popular and has become the main form of classroom transformation in the era of big data and intelligence (Yang et al., 2017; Bavardi, 2024; Rizal et al., 2025).

Internationally, the "NMC horizon report", published by The New Media Consortium, has continuously identified redesigning learning spaces as a key trend in education since 2015 (Johnson et al., 2015). During the same year, the Guiding Opinions on "Internet Plus" Action issued by the State Council of China emphasized the need to gradually explore new modes of networked education. for the year 2018, the Ministry of Education published the "Opinions of the Ministry of Education on Accelerating the Construction of High-level Undergraduate Education and Comprehensively Improving the Ability of Talent Cultivation" proposed to vigorously push forward the construction of smart classrooms, promote the revolution of classroom instruction, and advance profound integration of modern information technology and education. The deep integration of modern information technology with education and teaching (Ministry of Education of the People's Republic of China, 2018).

The Ministry of Education has carried out the "Artificial Intelligence Promotion of Teachers' Team Building Action", and has explicitly proposed the " Smart Classroom Building Action", which will be specifically deployed (Sun & Jiang, 2022). The main points of the work of the Ministry of Education in 2022 clearly proposed to accelerate the digital transformation and smart upgrading of education, and to explore the construction of smart classrooms in primary and secondary schools and colleges (Ministry of Education of the People's Republic of China, 2022).

The Ministry of Education issued the "Implementation Plan for the Audit and Evaluation of Undergraduate Education and Teaching in General Colleges and Universities (2021-2025)", which included "promoting the integration of information technology and the teaching process" as a key point of the audit in terms of the index design, and set up a featured optional option of "adapting to the teaching of the 'Internet+' courses, such as smart classrooms, smart laboratories, and other construction of teaching facilities and conditions, as well as the effect of their use" (Ministry of Education of the People's Republic of China, 2021), to guide the colleges and universities to apply information technology in the creation of smart classrooms, and to make good use of the smart classrooms.

It can be seen that in the critical period of high-speed development of higher education and the transformation of university teaching, the smart classroom is endowed with more educational missions and higher value expectations (Zhang, 2020; Roushangar et al., 2024; Özbay et al., 2025).

Problem Statement

However, education is a complex system dominated by human beings. Its reform is not as simple and straightforward as the digital transformation in the vast majority of industries or fields (Yuan, 2023).

Firstly, the core ability of smart classroom is to better assist in teaching and learning, not to provide advanced equipment. Smart classroom should be oriented to the needs of teaching and learning, and it should pay attention to the cultivation of students' innovative consciousness and innovative ability (Hu et al., 2019). However, the status quo is that when schools build smart classrooms and other teaching environments, they pay too much attention to the application of new technologies in the construction of physical space (Li et al., 2021). The phenomenon of communication disconnection between the users and the builders often occurs (Chen, 2020). There is a disconnect between the ideas of the builders and the users, and the construction of smart teaching environments only focuses on how the classroom can be The construction of intelligent teaching environment only focuses on how the classroom is "built", while ignoring the needs of teachers and students "use", which directly affects the experience of teachers and students (Wang & Yang, 2022).

Secondly, by reviewing existing researches and practices, most studies focus on whether students' academic performance has improved, or whether their efficiency in memorizing concepts has increased in a short term (Wei & Ma, 2022). However, they pay less attention to the cultivation of deep learning abilities such as problem-solving in complexity, critical thinking, and transfer during the learning process of students.

Furthermore, when reviewing the existing related researches and practices, the research objects are mostly primary and secondary school students, with less attention paid to the university student group (Zhou, 2023). Teachers usually may take it for granted that university students can accept and process all abstract knowledge during course learning, and can conduct autonomous and deep learning with ease.

Meanwhile, in the smart classroom learning environment, when implementing teaching and enhancing students' deep learning ability, the teacher is a crucial element in this system. The smart teaching carried out in smart classrooms is essentially the application of smart teaching methods by the teacher in the smart learning environment, aiming to promote learners' smart learning (Gu et al., 2021). It always focuses on the transformation of students' learning methods, the improvement of learning efficiency, and the enhancement of learning quality. The result should lead to deep learning (Li, 2019). However, in the teaching practice of smart classrooms, issues such as the excessive complexity of smart technologies, the huge challenge of technical competence, the digital divide between humans and technology, and the mismatch of teaching strategies have led to controversy over whether the teaching effect of smart classrooms can achieve deep learning (Li & Zhang, 2022). Some scholars believe that the teaching in smart classrooms has a significant promoting effect on the deep learning of university students (Phoong et al., 2019; Yao et al., 2022). However, other scholars have found that the effect of smart teaching is not as good as that of traditional teaching, and it may also affect the development of students' cognition and thinking as well as the enhancement of their creativity (Li et al., 2018).

In this context, this paper adopts an empirical research method to analyze and study the deep learning of university students in smart classrooms. It explores the influence of different variables such as smart classrooms, teachers, and teaching strategies on students' deep learning, providing theoretical references and practical basis for teachers to carry out smart teaching.

Specifically, the following issues are mainly studied:

RQ1. Does the smart classroom help students achieve deep learning compared to traditional classrooms?

RQ2. Which attributes of the smart classroom have an impact on students' deep learning?

RQ3. Does teachers have an impact on students' deep learning? Which teachers can better leverage the advantages of smart classrooms and be more conducive to enhancing students' deep learning?

RQ4. Does teaching strategies have an impact on students' deep learning? What kinds of teaching strategies are more conducive to promoting deep learning in smart classrooms?

Theoretical Background

Smart Classroom and Its Connections with Deep Learning

"Deep learning" is a concept opposite to "SurfaceLeaming". Deep learning consists of two interrelated and mutually influencing progressive stages of knowledge understanding and mastery, knowledge synthesis, and innovation (Lv & Gong, 2018). It requires both a depth of learning methods, emphasizing complex problem solving, and a depth of learning outcomes, emphasizing students' higher-order abilities in cognitive, self, and interpersonal aspects (Zhu & Peng, 2017). Therefore, deep learning is both a learning mode and a learning outcome. As a learning mode, deep learning emphasizes learners' active, positive, and deep knowledge processing and cognitive construction; as a learning outcome, deep learning emphasizes positive affective experiences such as deep motivation, higher interest and engagement in learning, and the cultivation of higher-order competencies such as problem-solving ability, cooperation and communication, metacognitive ability, and innovation ability (Chen, 2018).

Some studies suggest that being in a smart classroom objectively creates a "learner - information technology - knowledge" intelligent learning ecosystem, and through learning, students can develop human-computer collaborative thinking and change traditional learning methods, and cultivate deep learning abilities (Zhai et al., 2023). At the same time, with data analysis and adaptive services, technology empowers personalized learning, meets the needs of students' subjectivity, differentiation, and individualization (Zhu & Dai, 2023), and enables students to have an immersive and interactive learning experience, which not only helps to stimulate students' internal motivation to learn, but also trains students' thinking, and ultimately enhances the effectiveness of deep learning (Zhai et al., 2023).

Teachers and Their Connections with Deep Learning

As the overall designer and scheduler of the classroom, teachers play an irreplaceable role in the classroom teaching process (Cui & Zhu, 2022).As the direct implementer of teaching activities, teachers' professional quality, teaching skills and other personal factors are directly related to classroom teaching. The quality of learning, in turn, has a significant effect on the quality of student learning and talent training (Zhao & Zhong, 2013).

Studies have shown that teachers' educational concepts, teaching skills, subject knowledge and other teacher factors affect classroom effect and Student Deep Learning(Lan et al., 2021; McEachen & Jane Davidson, 2014; Wu et al., 2010; Zhang, 2008), teachers play an important role in promoting deep learning for students.

Therefore, in addition to the hardware environment such as smart classroom, smart teachers are also needed for the effective development of smart teaching.

But, at the same time, Smart teaching has put forward new requirements and challenges for teachers' role orientation, professional ability and information literacy (Lan et al., 2021). Therefore, this study mainly examines the teacher factors from the aspects of personal quality, teaching attitude and teaching philosophy.

Teaching Strategies and Their Connections with Deep Learning

Teaching strategies is the methods and measures taken by teachers to achieve the expected teaching purpose and plan by comprehensively considering the basic elements in the teaching process (Zhang & Zheng, 2022).

The effectiveness of classroom teaching in a smart classroom environment depends on the use of teachers and their teaching strategies (Kang, 2023). Only by timely switching and adjusting teaching strategies in accordance with the particular situation of the classroom, students, teaching content, etc., can we ensure the maximum potential of the smart classroom and each learner and achieve the greatest achievements (Feng & Lv, 2015). Therefore, the same smart classroom will produce different classroom teaching effects due to the different teaching strategies and teaching methods of teachers (McNaught et al., 2012; Ta, 2021).

(Xu et al., 2018) adopted qualitative and quantitative research, it is found that teaching strategies have the strongest influence on students' learning satisfaction and affect the cultivation of students' deep learning ability. Is this also applicable to deep learning in smart classroom environment? This article will be examined from three aspects: teaching preparation strategy, teaching method implementation strategy, and teaching evaluation strategy.

Research Framework and Research Hypothesis

Based on the above analysis, this study extracts the most representative variables and dimensions to form the following conceptual framework:

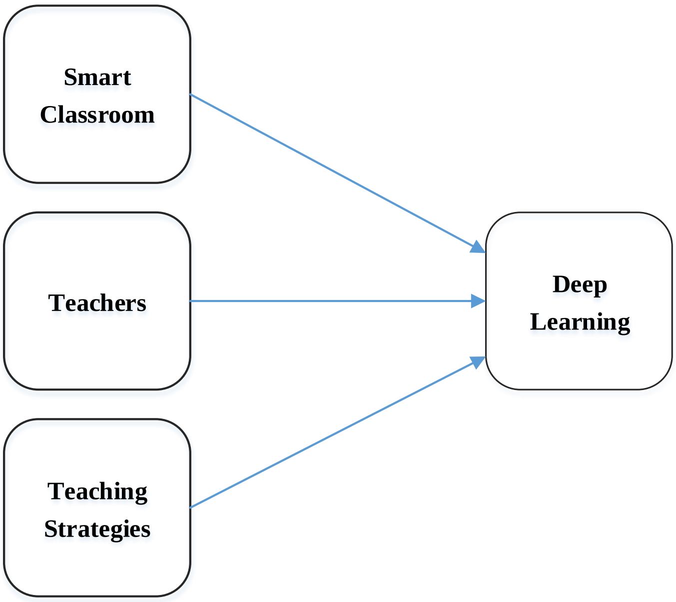

Figure 1: Conceptual Framework

To achieve the research objectives of the current study, three hypotheses are developed based on the proposed conceptual framework. These hypotheses are to be tested to explore the direct effects of Smart Classroom, Teachers, and Teaching Strategies on Deep Learning. The research hypotheses are given below.

H_1: There is significant influence of smart classroom on Deep Learning.

H_2: There is significant influence of teachers on Deep Learning.

H_3: There is significant influence of teaching strategies on Deep Learning.

Research Methodology

This study adopted the quantitative research method of questionnaire survey. Quantitative analysis especially emphasized theory-based logical reasoning, that is, putting forward research hypotheses based on one or some theoretical perspectives, and operating the research hypotheses into the relationship between variables (Walls, 2018) .

Participants and Procedures

For this study, students are the practitioners who experience smart classroom learning. Therefore, from the perspective of students, it is reasonable and feasible to collect students' perception of various observed variables as a basic approach and channel to understand the actual implementation effect and educational function of smart classrooms in colleges and universities.

Given that the construction and utilization of smart classrooms in some schools started relatively late and are not yet representative, to enhance the representativeness of the sample and the accuracy of the estimation, this study first selected two universities in Zhengzhou, China, which were among the earliest to adopt smart classrooms, had the largest scale of smart classrooms, and had the most mature usage and management. The target population for the survey was then narrowed down to undergraduate students from these two universities who had at least one semester of experience learning in smart classrooms and thus had a certain practical foundation. Finally, questionnaires were distributed to the targeted students, and it was ensured that participation was voluntary, with all respondents completing the questionnaires anonymously.

Instrument Development

Based on the existing mature scale, this study selected appropriate items to develop an initial item pool, adjusted them according to the actual situation, and finally generated a formal questionnaire. The questionnaire items were designed using Likert scale.

The composition and specific introduction of each part of the questionnaire are shown in Table 1.

Table 1: Descriptions of the Questionnaire's Layout

Section	Name of the Section	Descriptions
A	Introduction	To explain the purpose and basic information of the questionnaire to the respondents, so as to eliminate their concerns about filling in the questionnaire.
B	Demographic Information	The demographic information comprises the gender, grade, major, etc.. This section of the questionnaire provides related scrutiny of demographic information.
C	Experiential Information	The survey of observational variables, which is the main part of the questionnaire. A total of 24 questions were included in this section.

Data Analysis and Results

Data Screening

According to the research purpose, the online survey platform "Questionnaire Star" was chosen to distribute the questionnaires, which can ensure the integrity of data.

A total of 418 questionnaires were collected in this study. After that, the survey data were cleaned, and the data with basically the same answers to all questions, contradictory answers, and too short answering time were excluded. Finally, after eliminating the irrational, inconsistent or incompatible data, a total of 362 valid questionnaires were retained.

Sample Characteristics

In this study, a total of 362 valid samples were collected. In order to understand the demographic distribution characteristics of the samples, the frequency analysis function of spss27 was used to analyze the basic demographic information in the questionnaire.

The respondents were analyzed descriptively in terms of their basic information such as gender, grade, and subject respectively, and the demographic information is specified in the following table.

Table 2: Demographic Information

Categories	Characteristics	Frequency	Percent
Gender	Male	142	39.2
	Female	220	60.8
Grade	First Grade	159	43.9
	Second Grade	105	29
	Third Grade	86	23.8
	Fourth Grade	12	3.3
Subject	Liberal Arts	151	41.7
	Science	58	16
	Engineering	102	28.2
	Medicine	4	1.1
	Arts and Sports	47	13
Experience of learning in smart classroom	More Than One Semester	235	64.9
	More Than Two Semesters	55	15.2
	More Than Three Semesters	53	14.6
	More Than Four semesters	19	5.2

Reliability Analysis

In this study, all the main factors were measured in the form of scales. Therefore, testing the data quality of the measurement results is an important prerequisite to ensure that the subsequent analysis is meaningful. The internal consistency of each dimension was first analyzed through the Cronbach's Alpha coefficient reliability test method. The value of Cronbach's Alpha ranges from 0 to 1. The higher the coefficient value of the test result, the higher the reliability. It is generally accepted that for a variable to have good reliability, the Cronbach's Alpha must be greater than 0.7.

Table 3: Reliability Analysis

Variables	Item	CITC	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
SC	SC1	0.739	0.87	0.892
	SC2	0.65	0.885	
	SC3	0.636	0.886	
	SC4	0.764	0.866	
	SC5	0.738	0.87	
	SC6	0.77	0.865	
TE	TE1	0.82	0.875	0.906
	TE2	0.766	0.884	
	TE3	0.721	0.894	
	TE4	0.711	0.896	
	TE5	0.811	0.874	
TS	TS1	0.86	0.926	0.940
	TS2	0.805	0.931	
	TS3	0.732	0.937	
	TS4	0.784	0.933	
	TS5	0.785	0.933	
	TS6	0.798	0.932	
	TS7	0.87	0.925	
DL	DL1	0.772	0.885	0.905
	DL2	0.729	0.89	
	DL3	0.72	0.892	
	DL4	0.72	0.891	
	DL5	0.765	0.885	
	DL6	0.745	0.888	

From the above table, it can be seen that the Cronbach's Alpha of each variable is greater than 0.7, which indicates that the variables have good internal consistency. The CITC values are all greater than 0.50. If any one of the items is deleted, the Cronbach's Alpha will be lower than that of the corresponding variable. Therefore, the question items were all retained. The above shows that the reliability of the questionnaire in this study is good, and there is a good correlation between the analyzed items.

Exploratory Factor Analysis

The exploratory factor analysis was conducted using SPSS. The KMO and Bartlett's test of Sphericity were performed, and the results are shown in the following table.

Table 4: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.952
Bartlett's Test of Sphericity	Approx. Chi-Square	6215.993
	df	276
	Sig.	.000

From the above table, we can get KMO=0.952, which is greater than 0.7, and the value of Bartlett's Test of Sphericity is significant (Sig.<0.001), indicating that the questionnaire data meets the prerequisite requirements for factor analysis.

Therefore, further analysis was conducted. During factor extraction, the principal component analysis method was employed, and the common factors were extracted based on the condition that the characteristic roots were greater than 1. During factor rotation, the variance-maximizing orthogonal rotation was used for factor analysis. The analysis results are shown in the following table.

Table 5: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	10.834	45.143	45.143	10.834	45.143	45.143	5.139	21.411	21.411
2	2.447	10.195	55.338	2.447	10.195	55.338	4.214	17.556	38.967
3	2.081	8.671	64.009	2.081	8.671	64.009	3.887	16.195	55.162
4	1.610	6.710	70.719	1.610	6.710	70.719	3.734	15.557	70.719
5	.611	2.544	73.263						
6	.542	2.259	75.522						
7	.527	2.197	77.718						
8	.477	1.986	79.705						
9	.441	1.836	81.540						
10	.416	1.734	83.274						
11	.401	1.673	84.947						
12	.377	1.569	86.516						
13	.352	1.468	87.984						
14	.345	1.436	89.420						
15	.331	1.377	90.797						
16	.326	1.359	92.156						
17	.301	1.256	93.412						
18	.288	1.200	94.612						
19	.264	1.100	95.712						
20	.245	1.021	96.733						
21	.237	.989	97.722						
22	.190	.794	98.515						
23	.180	.749	99.264						
24	.177	.736	100.000						

As can be seen from the above table, a total of 4 factors were obtained, with a total explanatory power of 70.719%, which is greater than 50%. This indicates that the 4 selected factors are representative.

Table 6: Rotated Component Matrix

	Component			
	1	2	3	4
TS1	**.873**	.148	.181	.115
TS7	**.868**	.152	.165	.187
TS6	**.797**	.152	.184	.210
TS2	**.786**	.182	.267	.141
TS5	**.765**	.187	.230	.195
TS4	**.744**	.201	.236	.245
TS3	**.709**	.226	.228	.196
DL6	.097	**.801**	.114	.193
DL5	.179	**.791**	.174	.167
DL1	.181	**.785**	.224	.144
DL2	.154	**.768**	.182	.145
DL4	.218	**.762**	.136	.106
DL3	.184	**.760**	.136	.148
SC1	.218	.203	**.745**	.208
SC6	.206	.211	**.729**	.337
SC4	.314	.155	**.726**	.256
SC2	.176	.204	**.725**	.083

	Component			
	1	2	3	4
SC5	.259	.182	**.725**	.227
SC3	.184	.102	**.707**	.164
TE1	.232	.175	.185	**.823**
TE5	.248	.202	.202	**.801**
TE2	.259	.135	.230	**.774**
TE4	.150	.198	.197	**.754**
TE3	.154	.180	.258	**.743**

From the above table, it can be seen that the maximum factor loadings of each measurement item (indicated by bold numbers) are all greater than 0.5, and the cross-loadings (indicated by non-bold numbers) are all less than 0.4. Each item falls into the corresponding factor, demonstrating good structural validity.

Confirmatory Factor Analysis

This study has 4 variables and consists of a total of 24 measurement items. After conducting confirmatory factor analysis using AMOS 26, the following figure and table were obtained.

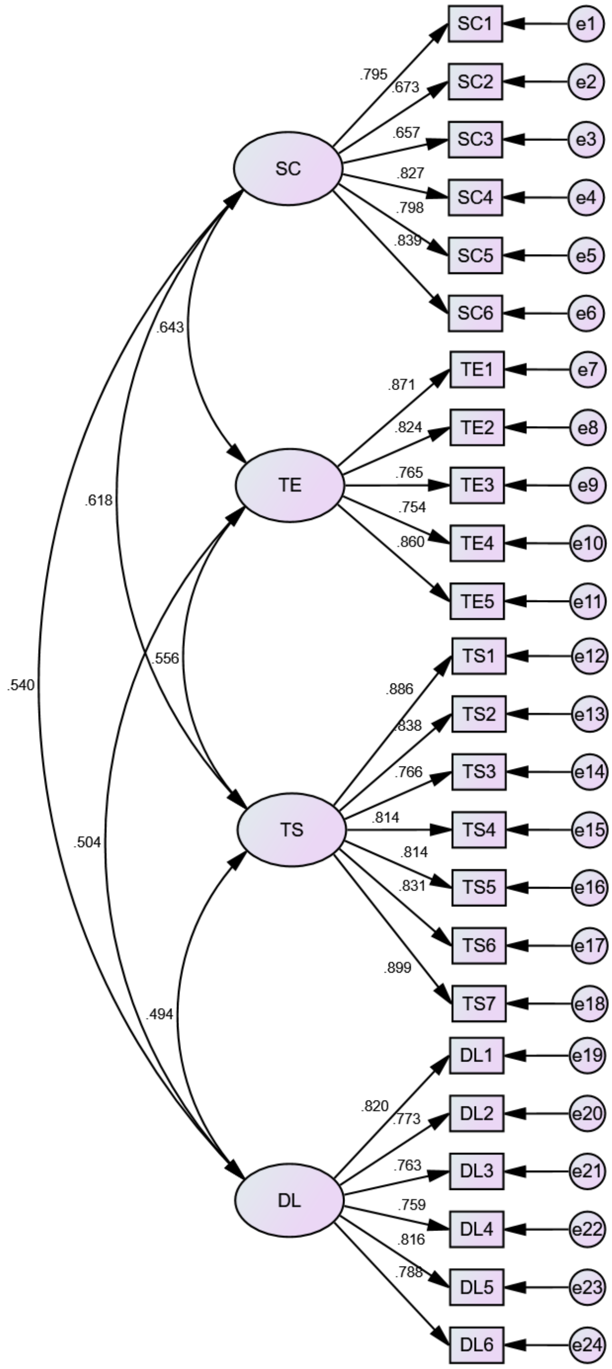

Figure 2: The Confirmatory Factor Analysis Model

Table 7: Goodness-of-fit of the Confirmatory Factor Model

Model Fitting Indicators	Optimal Standard Value	Statistic	Fitting Performance
CMIN	——	334.122	——
DF	——	246	——
CMIN/DF	<3	1.358	Good
RMR	<0.08	0.036	Good
GFI	>0.9	0.931	Good
AGFI	>0.9	0.916	Good
NFI	>0.9	0.948	Good

Model Fitting Indicators	Optimal Standard Value	Statistic	Fitting Performance
IFI	>0.9	0.986	Good
TLI	>0.9	0.984	Good
CFI	>0.9	0.986	Good
RMSEA	<0.08	0.032	Good

From the above table, it can be seen that the value of CMIN/DF is 1.358, which meets the standard of being less than 3. GFI, AGFI, NFI, TLI, IFI, and CFI all reach a standard of above 0.9. RMR is 0.036, which is less than 0.08. RMSEA is 0.032, which is also less than 0.08. All the goodness-of-fit measures meet the common research standards, so it can be concluded that this model has a good fitness.

Table 8: The Results of Confirmatory Factor Analysis

Variables	Item	Factor Loading	CR	AVE
SC	SC1	0.795	0.895	0.59
	SC2	0.673		
	SC3	0.657		
	SC4	0.827		
	SC5	0.798		
	SC6	0.839		
TE	TE1	0.871	0.909	0.666
	TE2	0.824		
	TE3	0.765		
	TE4	0.754		
	TE5	0.86		
TS	TS1	0.886	0.942	0.7
	TS2	0.838		
	TS3	0.766		
	TS4	0.814		
	TS5	0.814		
	TS6	0.831		
	TS7	0.899		
DL	DL1	0.82	0.907	0.619
	DL2	0.773		
	DL3	0.763		
	DL4	0.759		
	DL5	0.816		
	DL6	0.788		

As shown in the above table, the standardized factor loadings of each measurement indicator for every variable are all above 0.6, the composite reliability (CR) is all above 0.7, and the average variance extracted (AVE) is all above 0.5, indicating that each variable has good convergent validity.

Differential Validity and Correlation Analysis

This study employed a rigorous AVE method to assess the discriminant validity. The square root value of AVE for each factor must be greater than the correlation coefficient of each pair of variables, indicating that there is discriminant validity among the factors (Fornell & Larcker, 1981).

Table 9: Discriminant Validity

	SC	TE	TS	DL
SC	**0.768**			
TE	.575**	**0.816**		
TS	.580**	.526**	**0.837**	

	SC	TE	TS	DL
DL	.484**	.461**	.472**	**0.787**

From the above table, it can be seen that the square root values of AVE for each factor are all greater than the standardized correlation coefficients outside the diagonal (the lower triangular part represents the correlation coefficients). Therefore, this study has discriminant validity.

Structural Equation Model

The calculation was carried out using AMOS, and the estimation was conducted using the maximum likelihood method. The results are shown in the following figure.

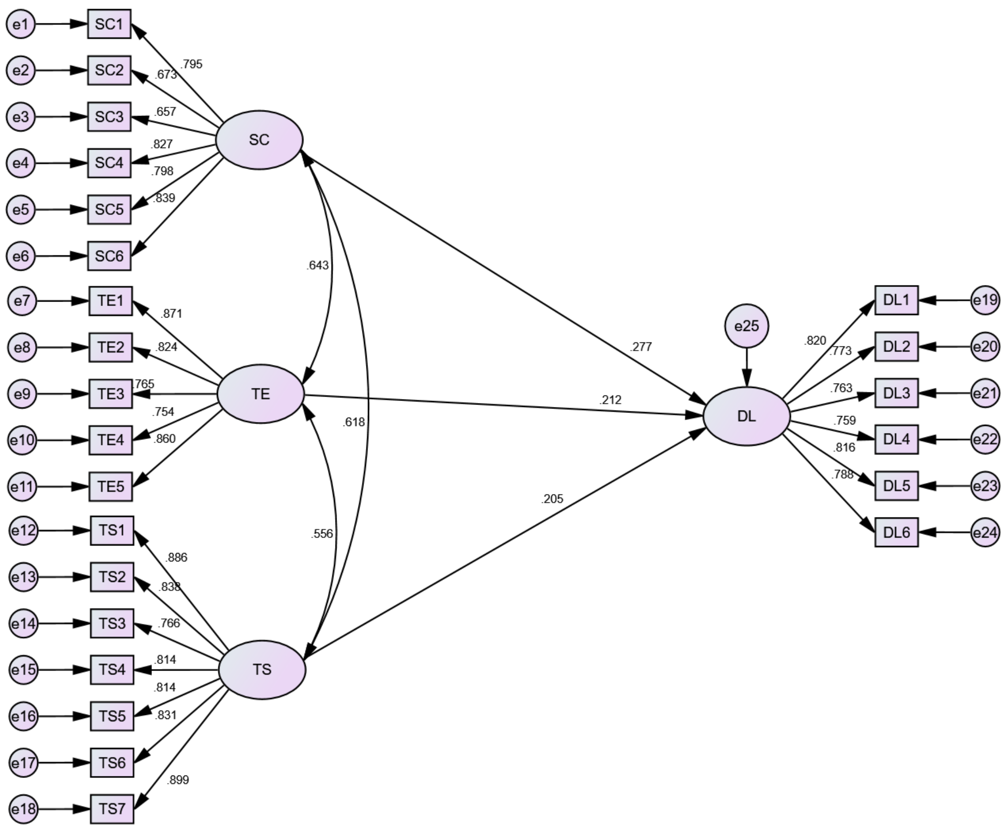

Figure 3: The Structural Equation Model

Table 10: Goodness-of-fit of the Structural Model

Model Fitting Indicators	Optimal Standard Value	Statistic	Fitting Performance
CMIN	——	334.122	——
DF	——	246	——
CMIN/DF	<3	1.358	Good
RMR	<0.08	0.036	Good
GFI	>0.9	0.931	Good
AGFI	>0.9	0.916	Good
NFI	>0.9	0.948	Good
IFI	>0.9	0.986	Good
TLI	>0.9	0.984	Good
CFI	>0.9	0.986	Good
RMSEA	<0.08	0.032	Good

From the above table, it can be seen that the value of CMIN/DF is 1.358, which meets the standard of being less than 3. GFI, AGFI, NFI, TLI, IFI, and CFI all reach above 0.9. RMR is 0.036, which is less than 0.08. RMSEA is 0.032, which is also less than 0.08. All the fitting indicators meet the general research standards, so it can be concluded that this model has a good fit.

Hypothesis Testing

Based on the research questions and conceptual framework, this study proposed three research hypotheses H1-H3, corresponding to the three paths in the structural equation model, namely SC (Smart Classroom) to DL (Deep Learning), TE (Teachers) to DL (Deep Learning), and TS (Teaching Strategies) to DL (Deep Learning).

According to the analysis results obtained from the AMOS software, the path coefficients and significance levels of the three paths in the structural equation model are shown in Table 10.

Table 11: Path Coefficients and Significance of the Structural Equation Model

No.	Paths	Standardized Coefficients	Standard Error (S.E.)	Critical ratio (C.R.)	Significance (P)
H1	SC--->DL	0.277	0.087	3.685	***
H2	TE--->DL	0.212	0.07	3.063	0.002
H3	TS--->DL	0.205	0.057	3.132	0.002

******* *indicates P < 0.001*

From the above table, it can be seen that the critical ratios (C.R.) of the three paths, H1, H2, and H3, are all greater than 1.96. The β value of SC on DL is 0.277, $p < 0.05$. The β value of TE on DL is 0.212, $p < 0.05$. The β value of TS on DL is 0.205, $p < 0.05$. This indicates that at the 0.05 significance level, Smart Classroom, Teachers, and Teaching Strategies have a significant positive impact on Deep Learning. Paths H1, H2, and H3 have all been verified and the three hypotheses are established.

Implications and Discussion

The present study examined the relationships among smart classroom, teachers, teaching strategies, and student deep learning in higher education. Through the research, the previously raised research questions were well answered.

Regarding RQ1, research has shown that smart classrooms have a significant positive impact on students' deep learning. That is to say, smart classrooms help students achieve deep learning compared to traditional classrooms. This is in line with the view of Brooks. (Brooks, 2011) believes that independent of any other influencing factors, the technologically enhanced learning spaces significantly and positively affects student learning outcomes. Differences in classroom equipment and types will affect students' attitude, interest, learning atmosphere and other factors (Byers et al., 2018; Zhai et al., 2016; Zhang et al., 2018), and further directly affects students' deep learning.

Regarding RQ2, research has shown that the physical design, learning data, equipment and technology of smart classrooms have an impact on students' deep learning. For example, if the equipment and software of the smart classroom are useful,easy to use, stable and have a very low failure rate even have the function of collecting students' learning data, it will have positive impact on students' deep learning.

Regarding RQ3, research has shown that teachers have a significant impact on students' deep learning. Teachers who have a high level of professional knowledge, excellent teaching skills, good information technology literacy, full of teaching enthusiasm and advanced teaching philosophy can better leverage the advantages of smart classrooms and be more conducive to enhancing students' deep learning.

Regarding RQ4, research has shown that teaching strategies have a significant impact on students' deep learning. It includes teaching preparation strategies, teaching method implementation strategies, teaching evaluation strategies. For instance, optimized teaching content, abundant classroom interaction, diverse teaching methods, effective learning cooperation, excellent academic support, and appropriate diversified evaluation are all positive, and are more conducive to promoting students' deep learning in smart classrooms.

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