

Online Teaching Strategies and Their Influence on Learning Experience and Learning Effect: A Structural Equation Model Analysis

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Abstract:

Objective: This paper aims to investigate the online teaching to college students during the COVID-19 epidemic, and to explore the influence of teachers' online teaching strategies on the learning experience and learning effect of college students, as well as the combined effect of these strategies. **Research methods:** SPSS and AMOS were adopted to analyze and build structural equation model, the path relationship of curriculum design strategy, explorative strategy and interactive strategy in learning experience and learning effect was discussed. **Research findings:** It is found that three kinds of online teaching strategies, namely curriculum design strategy, explorative strategy and interactive strategy, have significant influence on the learning experience and learning effect of college students, however, there is no significant causal relationship between learning experience and learning effect. In the interaction of teaching strategies, the combination of Curriculum design strategy and explorative strategy exerts a positive significant impact on the learning effect. Curriculum design strategy and interactive strategy, has a negative significant impact on the learning experience. The combination of curriculum design strategy, explorative strategy and interactive strategy exerts a positive significant impact on learning experience. **Value:** The combination of teaching strategies should be carefully and appropriately selected in the design of teaching strategies. Only by directly using one of the three teaching strategies can a positive online learning experience and learning effect be achieved. The grade characteristics of students and the choice of learning platforms have no moderating effect on online learning experience and learning effect, while only gender has a moderating effect.

Keywords: Online teaching strategy, Learning experience, Learning effect, Structural equation model, Strategy interaction.

I. INTRODUCTION

Due to the COVID-19 pandemic, online teaching has been in its heyday, which is not only a huge challenge, but also a rare opportunity for development in the history of online teaching. It is a great test

of the quality of online teaching, and also a comprehensive inspection of the effect of online teaching. In the past, people always focused on the online teaching aid when talking about online teaching, the teaching quality varied and it was not widely recognized, which is also the current predicament of online teaching. However, the tremendous contribution made by online teaching in the past two or three decades to the development of China's higher education cannot be ignored. With the diverse and personalized demands of college students, it has become a consensus to carry out diversified online teaching to promote the educational development. Many practical achievements have been made in the study of online teaching in China, and new technologies have been applied in online teaching, such as cloud platform, university MOOCs, Rain Classroom, Wisdom Tree, HUMAN Health MOOC, Super Star, etc. Multiple teaching platforms have provided a broad stage for college teachers to carry out teaching practice, which in the meantime has expanded their vision and enhanced their ability of applying technologies, thus their workload in teaching design and content collection could be reduced and knowledge could be updated in time. However, a gap still exists in the current research on the influence of online teaching strategies on college students' learning experience and learning effect.

This study is based on the teaching-oriented online teaching mode, which is different from the learning-oriented mode. Compared with traditional classroom teaching, many scholars have attributed the shortcomings of online teaching to its lack of emotional communication. However, effective teaching strategies can make up for these shortcomings. Online teaching means more openness and freedom for students, while some questions still need to be considered. For example, if teachers add their own teaching strategies into online teaching, will it affect students' learning experience and effect? Which teaching strategy is best for online teaching? Do they interact with each other and how do they affect college students' online learning experience and learning effect? What kind of characteristics does it have? At present, limited studies have been conducted in this area, thus the purpose of this study is to explore the influence of online teaching strategies under complex theories on online learning experience and learning effect, which means whether teachers' teaching strategies are helpful to college students' learning experience and learning effect. Therefore, this study selected six colleges and universities in Guangxi Province to conduct a questionnaire survey on teaching strategies and analyzed the learning experience and learning effects of college students, in order to find an integrated mode of the appropriate online teaching strategies.

II. THEORETICAL BASIS

Most of the previous studies on online teaching focus on the following four aspects: behaviorism learning theory, cognitive learning theory, constructivism learning theory and connectionism learning theory.

TABLE I. Comparison of the four main learning theories

Behaviorism learning theory Thorndike, Skinner, Guthrie, & Hull	Cognitivism learning theory Baars & CUP (1988)	Constructivism learning theory Narayan, Rodriguez, Araujo, Shaqlaih, & Moss (2013)	Connectionist learning theory Fodor & Pylyshyn (1988)
How does learning happen in a person, which is largely unknown	Similar to computer processing, learning is thought of as some input being processed and then stored in short - and long-term memory	Learning is the attempt of learners to create knowledge from their own experience	Connectionism refers to the combination of chaos, networks, complexity and self-organization theory in the technology-driven digital age
Learning contributes to behavior change; Observed behavioral changes are more important than internal changes	Knowledge is represented by symbolic mental structures that learning helps retain in memory	Learners actively attempt to relate meaning to their own experiences, which makes it more complex and staggered;	Connectionism is driven by the rapid change of new information and knowledge
Behavior focuses on specific stimuli and outcomes	Cognitivism encourages human thinking	Knowledge is expanded when known knowledge is given new meaning	Making connections with others and other resources helps the learning process
Watson's theory of acquired learning, Skinner's cybernetics of observing behavior, Bandura's theory of observing, Thorndike: Readiness rate, Practice rate, law of Effect, Pavlov: Conditioned reflex and Basic Laws	Koehler's Epiphany theory, Tolman's teleology of cognition, Piaget's cognitive structure theory, Bruner's cognitive discovery theory, Ausubel's cognitive assimilation theory, Gagne's learning condition theory and information processing learning theory, Heider's and Weiner's attribution theory	Piaget's theory of children's stage cognition, Vygotsky's theory of cognitive communication, Sternberg's theory of intelligence, etc.	Thorndike: Rate of preparation, rate of practice, law of effect, the importance of connection

It can be seen from the Table I above that connectionist learning theory is a kind of over-learning theory from knowledge to behavior, which includes not only the cognitive part, but also the behavior, construction and connection part. Online teaching is a mixture of these four theories, and is an obscure process, including student subsystem, teacher subsystem, and teacher-student interaction subsystem. In

the process of online teaching, the subsystem of students involves students' cognition of new knowledge, as well as the recognition and criticism of others' opinions, including reshaping old knowledge and the acceptance of new knowledge. The teacher subsystem involves the teaching organization and arrangement of teachers, the diversification of teaching style and technology, the online teaching situation created for students, the triggering connection design of previous and new knowledge, and the leading and organizing activities of students. The teacher-student subsystem involves the generation and nonlinearity of teacher-student guidance process, the multi-directivity of teacher-student communication and interaction, the complexity of teacher-student emotional relationship, etc. There are external influence of various environmental factors including the family factors, social factors, existing technical support, etc., as well as the asymmetry of information among students, between teachers and students, and teachers' compound interventions of teaching organization process. Thus, the complexity theory describing web-based instructional support need adding the strategic event. Trahtenbrot Complexity theory is the theory and practice of classifying computable problems according to their own complexity and connecting these categories [1]. Trahtenbrot Teaching strategies are a diversified leading factor. [2] This study intends to study the response relationship among three proven teaching strategies on online learning experience and learning effect. According to previous literature, many scholars have proved that a good online teaching experience can promote the online learning effect of college students.[3-5]

III. THE DEFINITION OF RELATED CONCEPTIONS

3.1 Structural Equation Model

Jöreskog, a famous Swedish statistician, developed the structural equation model to study social phenomena.[6] With the continuous participation and improvement of other scholars, a mature standard has been established for the structural equation [7-11]. The reason why we choose to study the structural equation is that teaching is a latent process, some of the variables of students cannot be directly measured, and also do not conform to the linear rule, while structural equation allows researchers to measure latent variables in the process of teaching, and to explore their internal nonlinear mechanism [12-13]

3.2 Online Learning Experience

Under the guidance of certain teaching theories and ideas, online teaching is a kind of teaching mode which realizes teaching objectives through the multi-directional interaction of teachers, students and media and to collect, transmit, process and share teaching information by applying multimedia and online technology[14-16]. Online learning experience refers to the subjective feelings that students obtain in the whole process through their own experience of online learning. The quality of online learning experience directly affects students' learning effect. Therefore, positive learning experience and teaching effect are the ultimate pursuit of online teaching [17-18]

3.3 The Teaching Effect

Teaching effect refers to the actual effect produced by teachers after teaching students [19]. The effect of online learning refers to the influence of students' participation in online teaching activities on their own mental activities, both positive and negative [20]. In this paper, students' learning effect is directly equated with teachers' teaching effect, which is a strategy to control the influence caused by external factors other than teaching strategies.

3.4 Teaching Strategies

Teaching strategies are techniques that teachers use to help students become independent and strategic learners[21]. Four teaching methods in Constructivist Learning theory: Inquiry Learning, Scaffolding Teaching, Situational teaching and cooperative Learning [22]. However, the four teaching strategies are not independent, but have overlaps, especially in the actual application. It is found that two or more kinds of teaching strategies are often combined. Therefore, according to different emphasis of the strategies, this paper classifies the online teaching strategies into curriculum design strategy, explorative strategy and interactive strategy.

IV. RESEARCH HYPOTHESIS

Gagne proposed ADDIE curriculum design model, which has provided a general curriculum design model for online teaching. Subsequently, his model has been widely used in teaching design and training of seed industry [23-24]. The letters "ADDIE" stands for: Analysis, Design, Develop, Implement and Evaluate [25] understands curriculum design strategy in his paper and book as factors to be considered in curriculum conceptualization and creation [26]. Therefore, this study selected the curriculum design part of Gagne to design the questionnaire. **H1a: Curriculum design strategy has a positive and significant influence on college students' learning effect; H1b: Curriculum design strategy has a positive and significant influence on college students' learning experience.**

Exploration refers to the cognitive triggering of participants in online teaching and the teaching strategy of exploring them Oliver [26]. When Oxford, R et al. explored language teaching strategies, focusing on: 1) the effects of adding or not adding language tasks in the process of strategy assessment; 2) How the students reported different strategies when the language task was easy and difficult. It means that there is an important interaction between task difficulty and student proficiency. Oxford, Cho, Leung, & KIM. Therefore, explorative teaching strategy is defined as a teaching design strategy with teaching tasks being the learning objectives. **H2a: Explorative strategy has a positive and significant impact on college students' learning effect; H2b: Explorative strategy has a positive and significant impact on college students' learning experience**

Interactive teaching strategy refers to the teaching strategy that integrates new knowledge and old knowledge to solve problems raised by teachers. Kazanidis investigated the influence of officially recognized "interactive classroom teaching" on primary school teachers' interaction and discourse style when teaching national literacy and numeracy strategies [27-29], and found that students should actively participate in discussions, raise questions and express opinions. Smith, Hardman, Wall, & Mroz believe that this strategy can help improve students' sense of achievement and learning effect [30]. **H3a: Interactive strategy has a positive and significant impact on college students' learning effect; H3b: Interactive strategy has a significant negative impact on college students' learning experience.**

When Janiak et al. studied the relationship between teaching system and teaching effect [31], and found that good learning experience is a necessary prerequisite for learning effect [32]. Therefore: **H4: Online learning experience of college students has a positive and significant effect on promoting learning.**

Freeman believes that online teaching has certain interaction effects. The interaction refers to the interaction between students and their ideas, rather than human-computer interaction. **H5a: Teachers' curriculum design teaching strategy interacts with explorative teaching strategy, which can improve students' learning effect; H5b: Teachers' curriculum design teaching strategy interacts with explorative teaching strategy to enhance college students' online learning experience; H6a: Teachers' curriculum design teaching strategy interacts with interactive teaching strategy, which can improve the learning effect of college students; H6b: Teachers' curriculum design teaching strategy interacts with interactive teaching strategy, which can improve college students' online learning experience; H7a: Teachers' explorative teaching strategy interacts with interactive teaching strategy, which can improve the learning effect of college students; H7b: The explorative teaching strategy of teachers interact with the interactive teaching strategy, which can improve the online learning experience of college students; H8: Teachers' curriculum design teaching strategy, explorative teaching strategy and interactive teaching strategy interact with each other to improve the learning effect of college students; H9: Teachers' curriculum design teaching strategy, explorative teaching strategy and interactive teaching strategy interact with each other to improve the learning experience of college students.** Based on relevant literature and assumptions, the structural equation model of Fig 1 is constructed.

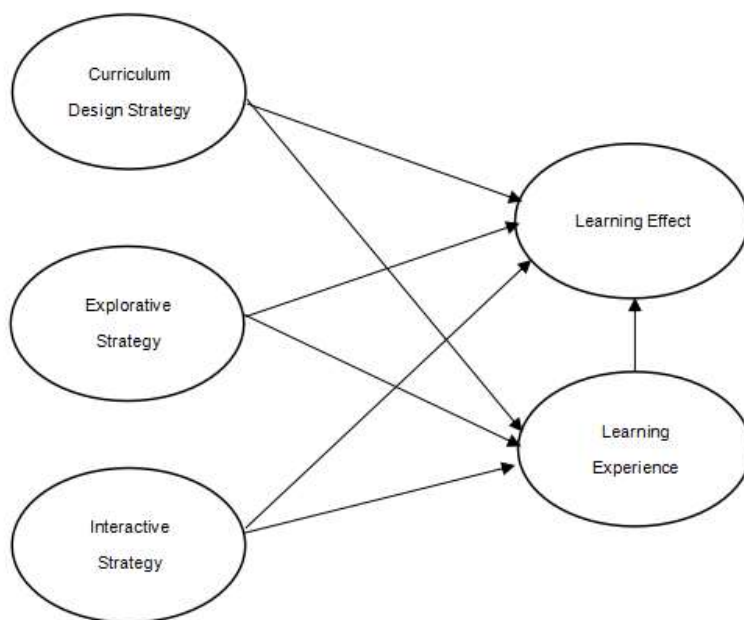


Fig 1: The structural models of three online teaching strategies on learning experience and learning effect

V. RESEARCH METHODOLOGY

5.1 Pre-testing

In order to preliminarily test the reliability of the model, 150 college students were selected for measurement, and it was found that each loading factor and compound reliability reached above 0.7. One item that did not reach above 0.7 was deleted, but the reliability needed to be further tested, since the validity of the reliability is sensitive to samples [33-34].

5.2 Sampling

This study distributed online questionnaires to college students from six universities in Guangxi, including Guangxi University, Guangxi Normal University, Guilin University of Technology, Guangxi Medical University, Youjiang Medical College for Nationalities, and Guilin Medical College. As the ratio of female students to male students in Guangxi Normal University, Guangxi Medical University, Youjiang Medical College for Nationalities and Guilin Medical University is 1:3, 259 male samples and 831 female samples basically conform to the sampling ratio. We contacted representatives of colleges and universities through the student union of these universities and initiated the collection of online questionnaires. As an incentive to initiate the activity, we randomly distributed a WeChat red envelope.

5.3 After the Test

Afterwards, we randomly selected 200 college students from these six universities for measurement, and found no significant difference in the measurement effect before and after the T-test. Barge (2007)

VI. THE RESULTS

6.1 The Geographical Distribution

In terms of population distribution, most of them are local people in Guangxi, among which Nanning and Hechi occupy the majority. The distribution outside the province is sporadic. More than 70 percent of the gender samples were female. In terms of grades, the proportion of freshmen was 44.31 percent, which is the highest. The proportion of sophomore samples was 41.28%. In addition, 71.83% of the samples chose "Chinese university MOOC" for online teaching, as shown in Table II.

TABLE II. Basic characteristics of samples

Items	Options	N	Percentage (%)	Cumulative percentage (%)
Gender	Male	259	23.76	23.76
	Female	831	76.24	100
Grade	freshmen	483	44.31	44.31
	sophomores	450	41.28	85.6
	Juniors	134	12.29	97.89
	Seniors	23	2.11	100
Major web platforms	Wisdom tree	163	14.95	14.95
	Chinese University MOOCs	783	71.83	86.79
	Super star pan	10	0.92	87.71
	Satellite for class	67	6.15	93.85
	The rain classroom	67	6.15	100
Total		1090	100	100

6.2 Reliability and Internal Validity

As can be seen from Table 3, confirmatory factor analysis (CFA) was conducted for a total of 5 factors and 21 analysis items. Chau According to the requirements of Fornell and Larcker index, AVE

values corresponding to all factors in this study are all greater than 0.5, and CR values are all higher than 0.7, indicating that the analyzed data have good convergence validity [35]. Fornell & Larcker Sobel believes that the comparison of AVE and Square's multiple correlation coefficients shows that AVE exceeds the correlation coefficient in all cases, [36] which indicates that each variable structure has discriminant validity Sobel, which means the validity of online teaching strategy [36-37]. The minimum AVE square root value corresponding to these five factors is 0.856, which is greater than the maximum correlation coefficient of 0.853, indicating good discriminative validity of research data (see Table 5). The effective sample size of this analysis is 1090, which is 10 times more than the number of analysis items, and the sample size is moderate[38-39], it can be seen from Table 6 that the goodness of fit and the overall statistics of this structural equation meet the standard of model fitting [40].

TABLE III Survey results of the questionnaire

Factors	Items	Mean	Standard Deviation	Standard load factor	CR	AVE
Course Design Strategy	Q1. In the online course, the lecturer explained the important topics of the course	3.613	0.855	0.869	0.94	0.74
	Q2. The course teacher communicated important course objectives	3.793	0.867	0.834		
	Q3. Deadline for notification of important learning tasks by the course instructor	3.774	0.851	0.834		
	Q4. Course instructors provided participatory guidance in learning tasks	3.805	0.872	0.903		
Learning effect	Q5. I can explain the core concept of online courses	3.634	0.871	0.86	0.938	0.783
	Q6. I think the problem-solving methods in this course are very practical	3.540	0.888	0.91		
	Q7. I used the course knowledge in my life	3.687	0.867	0.892		
	Q8. The course advisor helped us discover new concepts in the course	3.445	0.96	0.875		

Explorative strategy	Q9. Through thinking about the course content and online discussion, I understand the basic concepts	3.419	0.933	0.852	0.935	0.746
	Q10. We looked for questions and answers about the new course before class	3.494	0.898	0.831		
	Q11. To solve the problem, I explored multiple sources of information	3.606	0.878	0.907		
	Q12. In order to answer questions, we brainstormed during the course and explored other relevant information	3.475	0.882	0.873		
	Q13. I began to appreciate other points of view discussed online	3.48	0.885	0.885		
	Q14. I tried to combine new information to answer new questions in the course	3.486	0.871	0.838		
	Q15. I was impressed by the discussion of the other participants	3.341	0.898	0.923	0.942	0.844
Interactive strategy	Q16. Students were encouraged to express different views on topics that contribute to their learning	3.418	0.876	0.944		
	Q17. The course I have taken made it easier for me to communicate with other students	3.319	0.916	0.892		
Learning experience	Q18. It's very convenient to study online	3.194	1.029	0.911	0.919	0.733
	Q19. It is easy to learn with online courses	2.972	1.058	0.894		

Q20. I have not found any problems in the process of learning online courses	2.8	1.055	0.818
Q21. I am confident to use online courses to study instead of learning in classroom	2.745	1.083	0.799

6.3 Discrimination Validity

Table IV shows that the minimum AVE square root value corresponding to the five factors is 0.856, which is greater than the maximum correlation coefficient of 0.853, indicating that the discriminant validity of the research data is acceptable. The five latent variables have certain discriminant validity, which can be used as the latent variables constructed in this study.

TABLE IV. Concept discrimination validity: Pearson correlation and AVE square root value

	(1)	(2)	(3)	(4)	(5)
Curriculum Design Strategy (1)	0.860				
Learning effect (2)	0.813	0.885			
Explorative strategy (3)	0.71	0.786	0.864		
Interactive strategy (4)	0.642	0.763	0.853	0.919	
Learning experience (5)	0.426	0.54	0.633	0.702	0.856

Note: Diagonal line is AVE square root value

6.4 Fitting Index

The results in Table 5 show that the value of χ^2/df in the structural equation model established in this study is 3.402, which is between 3-5 and within an acceptable range. All the other indicators meet the relevant requirements, thus the structural equation model can be used to explain the research problem of this study.

TABLE V. Fitting indicators of structural equations

Indicators	χ^2	df	p	χ^2/df	GFI	RMSEA	RM R	CFI	NF I	NNF I
Judgment Standard	-	-	>0.0 5	<3	>0.9	<0.10	<0.0 5	>0.9	>0. 9	>0.9
Value	500.15 8	147	0	3.402	0.957	0.047	0.02 8	0.98 6	0.9 8	0.98
Other Indicators	TLI	AGF I	IFI	SRM R	AIC	BIC				
Judgment Standard	>0.9	>0.9	>0.9	<0.1	Smaller better	Smaller better				
Value	0.98	0.93 2	0.98 6	0.032	36676.2	37095.69				

6.5 Path Coefficients in the Model

As can be seen from Table 6, when curriculum design strategy has an impact on learning effect, the standardized path coefficient is 0.498 and the path presents significance at 0.01 level ($z=23.889$, $P=0.000 < 0.01$), indicating that situational strategies have a significant positive impact on learning results. In addition, there was no significant difference between learning experience and learning effect ($z=0.991$, $P=0.322 > 0.05$), indicating that learning experience has no influence on learning effect. In this study, the three teaching strategies: curriculum design strategy, explorative strategy and interactive strategy have significant influence on learning experience and learning effect respectively, however, the curriculum design teaching strategy has significant negative influence on learning experience.(see Table 6)

TABLE VI. Influence path analysis in structural equation

X	- >	Y	Unstandardized path coefficient	SE	z	p	Normalized path coefficient	Hypot hesis
Curriculum Design Strategy	- >	Learning effect	0.531	0.0 22	23. 889	0.00 0**	0.498	H1a
Explorative strategy	- >	Learning effect	0.201	0.0 32	6.2 85	0.00 0**	0.195	H2a
Interactive strategy	- >	Learning effect	0.253	0.0 30	8.4 53	0.00 0**	0.262	H3a
Curriculum Design Strategy	- >	Learning experience	-0.110	0.0 38	-2.9 33	0.00 3**	-0.089	H1b
Explorative	-	Learning	0.206	0.0	3.8	0.00	0.173	H2b

strategy	>	experience		54	20	0**		
Interactive	-	Learning	0.681	0.0	14.	0.00	0.611	H3b
strategy	>	experience		46	681	0**		
Learning	-	Learning	0.018	0.0	0.9	0.32	0.020	H4
experience	>	effect		18	91	2		

Note: ->Represents path influence relationship, ** is significant at 0.01 level

6.6 Online Teaching Strategy Interaction

As can be seen from Table 8, when curriculum design strategy has an impact on learning effect, the standardized path coefficient is $0.434 > 0.05$, and the path presents significance at 0.01 level ($z=3.653$, $P=0.000 < 0.01$), indicating that curriculum design strategy has a significant positive influence on learning effect; The same is true for interactive strategy on learning, and curriculum design strategy * explorative strategy on learning effect. Curriculum design strategy, explorative strategy and interactive strategy all have significant positive influence on learning experience. However, when curriculum design strategy * interactive strategy has an impact on learning experience, the standardized path coefficient is -1.267 , and the path is significant at the level of 0.05 ($z=-2.429$, $P=0.015 < 0.05$), which indicates that curriculum design strategy * interactive strategy has a significant negative impact on learning experience;

There is no significant difference in the effect of explorative strategy on learning effect ($z=-1.617$, $P=0.106 > 0.05$), indicating that explorative strategy has no influence on learning effect. The same is true for curriculum design strategy on learning experience, interactive strategy on learning experience, curriculum design strategy * interactive strategy on learning effect, curriculum design strategy * explorative strategy * interactive strategy on learning effects, and curriculum design strategy * explorative strategy on the learning experience. Explorative strategy * interactive strategy has no impact on the learning experience.

TABLE VII. Interactive situation table of three online teaching strategies

X	-	Y	Unstandardized path coefficient	SE	z	p	Normalized path coefficient	Hypot hesis
Curriculum Design	-	Learning effect	-0.106	0.054	-1.955	0.051	-0.695	H6a
Strategy*Interactive strategy	>							
Curriculum Design	-	Learning effect	0.130	0.046	2.850	0.004**	0.842	H5a
Strategy*Exp	>							

lorative strategy								
Explorative strategy	- >	Learning effect	0.002	0.0 50	0.0 44	0.96 5	0.015	H7a
*Interactive strategy								
Curriculum Design	- >	Learning effect	-0.002	0.0 12	-0.1 53	0.87 8	-0.065	H8
Strategy* Explorative strategy								
*Interactive strategy								
Curriculum Design	- >	Learning experience	-0.224	0.0 92	-2.4 29	0.01 5**	-0.967	H6b
Strategy*Inte ractive strategy								
Curriculum Design	- >	Learning experience	-0.083	0.0 78	-1.0 70	0.28 5	-0.465	H5b
Strategy* Explorative strategy								
Explorative strategy *	- >	Learning experience	-0.087	0.0 84	-1.0 30	0.30 3	-0.510	H7b
Interactive strategy								
Curriculum Design	- >	Learning experience	0.042	0.0 20	2.1 34	0.03 3**	0.953	H9
Strategy*Exp lorative strategy *								
Interactive strategy								

6.7 Gender Moderation

Table 8 and Figure2 show that the moderating effect is divided into three models. Model 1 includes independent variable (learning experience). A moderating variable (gender) is added in Model 2 on the basis of Model 1. An interaction term (product term of independent variable and moderating variable) is added in Model 3 on the basis of Model 2. Model 1 aims to study the influence of the independent

variable (learning experience) on the dependent variable (learning effect) without considering the interference of the moderating variable (gender). As shown in the table above, the independent variable (learning experience) presents a significance ($t=21.167$, $P=0.000 < 0.05$), which means that learning experience has a significant impact on learning effect. The moderating effect can be examined in two ways, the first of which is to examine the significance of the change in F value from Model 2 to Model 3, while the second is to look at the significance of interaction terms in model 3. In this study, the moderating effect was analyzed in the second way. Gender was treated as a dummy variable in this study, and the moderating effect could be analyzed based on the significance of interaction terms in Model 3. The same method was applied to grade and learning platforms, and no moderating effect was found.

TABLE VIII. Moderating effects of gender on learning experience and learning effect

	Model 1				Model 2				Model 3			
	β	SD	t	p	β	SD	t	p	β	SD	t	p
Constant	3.57	0.02	171.0	0.000	3.57	0.02	171.	0.000	3.56	0.02	169.8	0.000
	7	1	85	**	7	1	1	**	9	1	23	**
Learning	0.44	0.02	21.16	0.000	0.44	0.02	21.1	0.000	0.44	0.02	20.91	0.000
Experience	3	1	7	**	6	1	5	**	2	1	4	**
Gender					0.02	0.02	1.28	0.2	0.03	0.02	1.672	0.095
					7	1	3		6	1		
Learning experience*Gender									-0.054	0.02	-2.707	0.007**
R ²		0.292				0.293				0.297		
Adjust R ²		0.291				0.291				0.296		
F		F				F				F (3,1086)=153.302		p=0.000
		(1,1088)=448.047		p=0.000		(2,1087)=224.980		p=0.000				
						0						
ΔR^2		0.292				0.001				0.005		
ΔF		F				F (1,1087)=1.647		p=0.200		F (1,1086)=7.328		p=0.007
		(1,1088)=448.047		p=0.000								
Independence: Learning effect												

Notes:* $p < 0.05$ ** $p < 0.01$

VII. DISCUSSIONS

Among curriculum design, explorative and interactive teaching strategies, online curriculum design strategy has a positive and significant impact on college students' learning experience, which means that H1a is not valid, for the reason that curriculum design strategy will increase the complexity of online

learning, thus college students cannot obtain a good learning experience. As can be seen from Table 6, H1b, H2a, H2b, H3a and H3b are all valid. However, the common belief that online learning experience of college students has a positive and significant promoting effect on learning has not been supported, which means that H4 is not valid. In fact, there is no direct correlation between the online learning experience of college students and the learning effect, which may be related to the subjective initiative of college students. In other words, college students can overcome the bad learning experience of online teaching and still obtain good learning effect.

In terms of interaction effect, curriculum design strategy * explorative strategy has a significant impact on learning effect, thus H5a is valid. Curriculum design strategy * Interactive strategy has a negative significant effect on learning experience, thus H6b is not valid. Course design strategy * explorative strategy * interactive strategy has a significant positive impact on learning experience, thus H9 is supported. H6a, H7a, H8, H5b and H7b have positive and negative effects, but they are not significant, thus the hypotheses are not verified in this study. The interaction between curriculum design strategy and interactive strategy has a negative significant influence on learning experience, indicating that adding interactive teaching design to curriculum design strategy can reduce the online learning experience of college students, which is also the aspect that should be paid attention to in terms of the combination of online teaching strategy. However, the combination of the three teaching strategies only have a positive impact on learning experience, but not necessarily a significant impact on learning effect, which may even lead to negative effect. Therefore, in the design of teaching strategies, it is necessary to carefully select appropriate teaching strategy combination, or directly use one of the three online teaching strategies: curriculum design, explorative and interactive teaching strategies.

Gender has a moderating effect on learning experience and learning effect. In low-level learning experience, girls' learning effect is better than that of boy, whereas in high-level learning experience, boys' learning effect is better than that of girls. Therefore, the improvement of learning experience is conducive to the improvement of both boys' and girls' learning effect. However, the choice of grade and platform has no moderating effect on the improvement of learning experience and learning effect.

VIII. RESEARCH AND APPLICATION

The values that online teaching pursues are high-quality teaching resources and low-cost teaching operation. The social acceptance of online teaching is still controversial, and there are different opinions about various problems in the process of online teaching. However, there is a general consensus that a good online teaching strategy can make up for the problems in online teaching. Therefore, the design and combination of online teaching strategies can effectively solve the problems of college students' online learning experience and learning effect. Positive teaching experience throughout the study does not necessarily have significant influence on college students' online learning effect. Teachers do not always

need to do simple and straightforward teaching, they can appropriately increase the design of the teaching difficulty, present the explorative teaching process, and improve the interactivity of the online curriculum, which are all helpful to improve students' study effect. However, the curriculum design strategy may reduce some teaching experience in the process of combination, which also indicates that teachers' skills of online teaching design need to be improved. The mixed application of a variety of teaching strategies can improve the complexity of teaching process design and can effectively improve students' learning experience, while the learning effect may not be significantly improved, or may even cause reverse effects. It is beneficial to develop the learning experience and effect of online teaching to keep the diversity and dominance of it. Moreover, online teaching should give play to students' subjective initiative and passion. Neither grade nor online teaching platform has a moderating effect, while the gender of students has a moderating effect, which indicates that online teaching has different learning effects for students of different genders at various levels of learning experience, and is conducive to the common enhancement of learning effects in mixed gender groups of men and women.

IX. LIMITATIONS AND FUTURE RESEARCH

This study adopted panel data, and the change of the teaching effect is a long-term process, which is one of the limitations of this study for a more in-depth research. In addition, this study only focuses on the teachers' teaching strategies, students' learning experience and the teaching effect, however, there are more factors influencing students' online learning experience, such as some technical issues and teaching effect is also related to students' concentration and initiative, which have not been included in the scope of this study. Furthermore, there are many teaching strategies of teachers, which have different understandings from multiple perspectives. This study only discusses curriculum teaching strategy, explorative teaching strategy and interactive teaching strategy, and other teaching strategies are not investigated, which will be explored in depth in the future.

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