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Understanding the Relationship between Support Provided to Students and Their Engagement in an Online Learning Environment: A Moderated Mediation Model

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Abstract: This study aims to develop a moderated mediation model to explore the mediating role of online learning satisfaction and the moderating role of interaction between online course support and students' online engagement. According to self-determination theory, technology acceptance model and Fogg's Behaviour Model, we conducted a survey with students to develop the moderated mediation model, multiple regressions were employed to examine moderated mediation effect. Online learning satisfaction plays a significant mediating role between online course support and students' online engagement. The mediating effect was partially moderated by online learning interaction. The results revealed that when students had a higher level of online learning interaction, the predictive effect of online course support on their online engagement via online learning satisfaction was stronger. The moderated mediation model provides a deeper understanding of the online learning and offers potential strategies to improve students' engagement with online courses.

1. Introduction

The advent of COVID-19 and its subsequent spread across the globe resulted in several courses transitioning to online format in an unprecedented manner. It is the most significant, swift, and worldwide transformation that higher education has ever experienced. Online learning has got several well-known benefits, it eliminates any physical barriers to learning making education more accessible and inclusive. However, it is important to acknowledge that online learning environment is different from learning in physical environments. For instance, several challenges are experienced when courses are delivered online such as the potential disparities in internet access, technical difficulties and the need for self-discipline in managing one's study schedule. One of the major problems discussed in extant literature is the problem of lack of student engagement in online courses. This raises the important question about how to optimize students' engagement with

learning activities in an online environment. Several research studies explored some of the factors influencing students' online engagement. However, few studies focus on exploring how and when the online course support promotes students' online engagement. The literature review indicates a lack of research that specifically investigates the dynamic nature of the link between online course support and students' engagement in online learning. As a result, we sought to examine the relationship, with the view to identifying the underlying mechanism and the fundamental characteristics of the relationship. The study findings help to provide a deeper understanding of how to promote students' engagement in an online learning environment.

2. Theoretical Background and Hypotheses

2.1. Online Course Support and Students' Online Engagement

The definition of engagement focuses on "the behaviour intensity and emotional quality of a person's active involvement during a task", and the three dimensions including emotional engagement, cognitive engagement and behavioural engagement [1], we sought to develop a deeper understanding and to discuss the students' engagement in online courses. Many factors influence students' online learning engagement, such as learning technology, online APP quality, perceived teacher support, students' ICT self-efficacy, and teacher emotional support. In the same vein, it is also argued that in distance education, teachers' strategies are important for student engagement. The technology acceptance model (TAM) suggests that the technical support is important for developing appropriate online learning behaviour. Among the different influential factors, teacher support is one of the most important factors [2]. As highlighted above, very little attention has been paid to investigate the relationship between online course support and students' engagement in online learning, as well as to examine the underlying mechanisms influencing this relationship. Given the above, we formulated the following hypothesis:

H1: Online course support has positive effect on students' online engagement.

2.2. Mediating Role of Online Learning Satisfaction

Basic psychological needs such as satisfaction is the mediator between teacher autonomy, support and student engagement [3]. The study proposes that online learning satisfaction plays an important mediating role in the process of providing online course support, thereby influencing students' online engagement. The support provided to students is an important aspect of student satisfaction. Teachers' emotional support has an impact on students' online learning satisfaction. Institutional support could increase satisfaction. The self-determination theory (SDT) points out that psychological needs (autonomy, competence and relatedness) affect student engagement. According to the technology acceptance model (TAM), when students are presented with digital technology in an online class, the perceived usefulness and perceived ease-of-use of the online course platform will influence their decision about how and when they will engage with the online course. Technical problems reduce student online learning satisfaction. When given the technical support, students can use the online course materials more conveniently and this benefits their satisfaction with the online course. Therefore, we consider that online course support has a positive influence on online learning satisfaction. We, therefore, posit the following hypothesis:

H2: Online course support has a positive effect on online learning satisfaction.

On the other hand, teacher support was shown to have a positive correlation with online learning engagement. Therefore, we consider that online course satisfaction has positive influence on students' online engagement. We propose the following hypothesis:

H3: Online learning satisfaction has positive effect on students' online engagement.

2.3. Moderating Role of Online Learning Interaction

In order to reveal the conditions and mechanisms that explain the role of online course support and students' online engagement, based on the mediating role of online learning satisfaction, this study uses online learning interaction as the moderating variable. Many studies show the elements of Fogg's Behaviour Model (FBM): motivation, ability and trigger indicating that these can change behaviour. Signal is one kind of the trigger elements. Interaction is the signal of online learning because students are easy to be distracted, however, proper interaction can draw them back to course content. Interaction is one of the key successful factors in online learning [4]. We designed a moderated mediating model to analyse "when" a student will execute online learning engagement after getting the online course support. Students' satisfaction is positively related to teacher-student interaction. Different forms of interaction (student-student formal, student-student informal and student-instructor) contribute to student satisfaction. While interactions among students and self-regulated learning did not contribute to student satisfaction [5].

In this study, online learning interaction refers to interactions between student and the online course teacher. Online learning interaction is closely related to online learning satisfaction. That is online learning interaction can promote online learning satisfaction. Therefore, we anticipate that, when students interact with the teacher in the online course, and if students have a high level of interaction, this will promote students to get a high level of online course support. As a result, this strengthens the positive correlation between online course support and online learning satisfaction. In general, the students' satisfaction level will be higher. On the contrary, if students' online learning interaction is low, this will weaken the positive association between online course support and satisfaction. That is, online learning interaction may moderate the positive effect between online course support and satisfaction. We, therefore, hypothesize that:

H4: Online learning interaction positively moderates the link between online course support and online learning satisfaction. The link between online course support and online learning satisfaction will be stronger with higher (vs. lower) level of Interaction.

As highlighted above, we also hypothesize that:

H5: Online learning interaction positively moderates the link between online course support and students' online engagement. With the improvement of interaction, the predictive effect of online course support on students' online engagement will increase. Thus, we form the conceptual model of our study (Fig. 1).

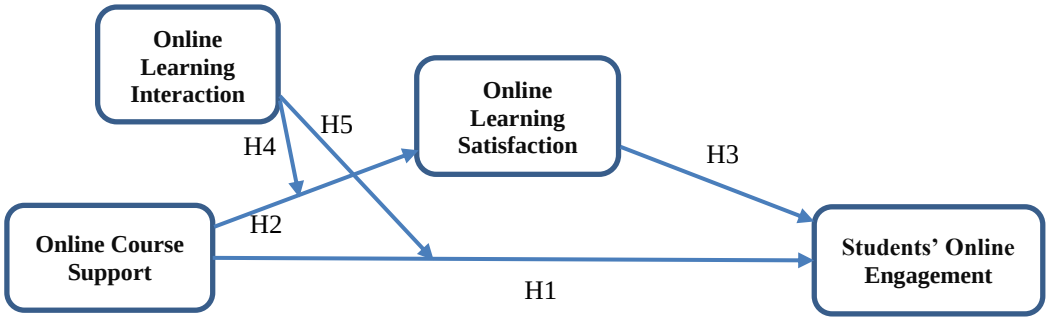

Figure 1: Conceptual Model

3. Methods

3.1. Participants and Procedures

We recruited undergraduate and graduate students from a university in Zhejiang province in

China as volunteers to take part in the study. 225 questionnaires were sent to the participants; after eliminating the invalid questionnaires we got 212 valid cases. Female students made up 55.7% (n=118) of the sample, male students were 93 (43.9%) and 1 the other (0.4%). Among them, for undergraduate 116 (54.7%) were first year students, 28 (13.2%) were second year students, 29 (13.7%) were third year students, 25(11.8%) were fourth year students, and14(6.6%) were postgraduate students.

3.2. Measures

Students' Online Engagement

The measurement of students' online engagement (SOENG) consists of 12 items [1], including 3 dimensions: behavioural engagement (e.g., "I always listen carefully when I am in the online course"), cognitive engagement (e.g., "I set my own study plan for the online course"), emotional engagement (e.g., "I like the knowledge I gain from the online course"). The items were rated on a 5 points scale, with 1 indicating "strongly disagree" and 5 indicating "strongly agree". The 12 items were averaged, with higher scores indicating higher level of SOENG (M= 3.68, SD= 0. 79, Cronbach's α= 0.95).

Online Course Support

In accordance with the TAM model, online course support (OCSUP) was measured with 14 items [6], including 3 dimensions: technical support (e.g., "It is fast to get response of technical help from teachers/ classmates"), emotional support (e.g., "My teacher encourages me and supports me to overcome online study difficulties"), learning strategy support (e.g., "Teachers tell me some learning strategies for online course learning"). The items were rated on a 5 points scale, with 1 indicating "strongly disagree" and 5 indicating "strongly agree". The 14 items were averaged, with higher scores indicating higher level of OCSUP (M= 4.01, SD= 0.71, Cronbach's α= 0.96).

Online Learning Satisfaction

We measured online learning satisfaction (OLSAT) with 3 items [7], on a 5 points Likert's scale (1= "strongly disagree", 5 = "strongly agree"): (1) "For your own study, what's your level of satisfaction about the online course learning", (2) "For teacher's teaching, what's your level of satisfaction about the online course learning", and (3) "Overall, what's your level of satisfaction about the online course learning". The 3 items were averaged, with higher scores indicating higher level of OLSAT (M= 3.77, SD= 0.81, Cronbach's α= 0.88).

Online Learning Interaction

In order to measure the students' attitude to the online learning interaction frequency (OLIFQ), we used one item "How many interactive activities do you think is enough in 45 minutes of the online course". The item was rated on a 4 points scale, with 1 indicating "1-2 times", 2 indicating "3-5 times", 3 indicating "6-8 times" and 4 indicating "9 and more". The item was with higher scores indicating higher level of OLIFQ (M= 1.6, SD= 0.63).

Control variables

Gender, personality and satisfaction are closely related in an online course. One way ANOVA on students' personal characteristics variables showed that gender had a significant effect only on the QLIFQ variable (F (2, 209) = 4.11, p=0.018). Discipline, Major and Political party membership, these three variables' effect using ANOVA were non-significant.

Hardware, we measured online learning hardware with 2 items on a 5 points Likert scale (1= "strongly disagree", 5 = "strongly agree"): e.g., "When I have my online course, I have access to good Wi-Fi / Broadband services".

Information Literacy (InfLitcy), In line with TAM and changed from Doyle's [8] 42-item PILS of six constructs, we measured InfLitcy for online learning with 6 items on a 5 points Likert's scale

(1= “strongly disagree”, 5 = “strongly agree”): e.g., “I know where to find the solutions, when I study online facing difficulties”.

4. Results

4.1. Preliminary Analysis

Table 1 shows a correlational relationship among the variables. OCSUP was significantly positively correlated with SOENG and OLSAT, but no significant correlation with OLIFQ. Both OLSAT and OLIFQ were significantly positively correlated with students’ online engagement. Among the control variables, hardware and information literacy were positively correlated with SOENG, while gender was negatively correlated with online learning interaction.

Table 1: Correlations between the variables

	SOENG	OCSUP	OLSAT	OLIFQ	Gender	Hardware	InfLitcy
SOENG	1						
OCSUP	0.574***	1					
OLSAT	0.726***	0.491***	1				
OLIFQ	0.146*	0.059	0.019	1			
Gender	-0.123	0.023	-0.021	-0.195**	1		
Hardware	0.382***	0.399***	0.380***	-0.061	0.052	1	
InfLitcy	0.609***	0.605***	0.523***	0.017	-0.004	0.512***	1

***p<0.001; **p<0.01; *p<0.05.

4.2. Mediating Role of Online Learning Satisfaction

The mediation analysis results are shown in Table 2, to test the mediating role of online learning satisfaction between online course support and students’ online engagement. Gender, hardware and InfLitcy were entered as covariates.

Table 2: Mediating role of online learning satisfaction

	Model 1		Model 2		Model 3
Predictors	SOENG		OLSAT		SOENG
	B (SE)		B (SE)		B (SE)
OCSUP	0.319***		0.258***		0.186**
	(0.065)		(0.072)		(0.055)
OLSAT					0.514***
					(0.052)
R^2	0.458		0.332		0.634
F	43.700***		25.749***		71.511***

***p<0.001; **p<0.01; *p<0.05.

Supporting H1, a positive association was found between online course support and students’ online engagement (B=0.319, SE=0.065, P<0.001). Consistent with H2 and H3, online course support has positive relations with online learning satisfaction (B= 0.258, SE=0.072, P<0.001), and online learning satisfaction was positively correlated with students’ online engagement (B=0.514, SE=0.052, P< 0.001). In addition, the bootstrap analysis presents that indirect effect of online course support and students’ online engagement via online learning satisfaction was significant (effect size= 0.127, SE= 0.045, CI= [0.043, 0.224]). Thus, the path of online course support →

online learning satisfaction → students' online engagement was supported.

4.3. Moderated Mediation Effect

Gender, hardware and information literacy were controlled in the study. All predictive variables were standardized before data processing, and gender, hardware and InfLitcy variables were controlled. Three regression equations were established as following:

$$OLSAT = a_0 + a_1\,OCSUP + a_2\,OLIFQ + a_3\,OCSUP \times OLIFQ + \varepsilon_1 \quad (1)$$

$$SOENG = c_0 + c_1\,OCSUP + c_2\,OLIFQ + c_3\,OCSUP \times OLIFQ + \varepsilon_2 \quad (2)$$

$$SOENG = c'_0 + c'_1\,OCSUP + c'_2\,OLIFQ + b_1\,OLSAT + c'_3\,OCSUP \times OLIFQ + \varepsilon_3 \quad (3)$$

These regression equations were to test whether the mediating effect of OCSUP on SOENG through OLSAT was moderated by OLIFQ. The results are shown in Table 3. In regression Eq.1, the effect of OCSUP on OLSAT was significant (B= 0.251, SE= 0.072, P<0.01), and the interaction of OCSUP and OLIFQ had significant effect on OLSAT (B= 0.134, SE = 0.055, P<0.05). The result of Eq.2 showed that OCSUP had significant effect on SOENG (B= 0.314, SE= 0.064, P<0.001), and the interaction between OCSUP and OLIFQ had no significant effect on SOENG (Table 3).

Table 3: Moderated mediating effect of OCSUP on SOENG

Regression Equation		Fit Index			Significance of Regression Coefficient		
Outcome Variables	Predictive variables	R	R^2	F	B	SE	95% *CIs*
OLSAT	OCSUP	0.592	0.351	18.480***	0.251**	0.072	0.109, 0.392
	OLIFQ				0.003	0.058	-0.111, 0.116
	OCSUP×OLIFQ				0.134*	0.055	0.025, 0.242
SOENG	OCSUP	0.692	0.479	31.416***	0.314***	0.064	0.187, 0.441
	OLIFQ				0.123*	0.051	0.023, 0.223
	OCSUP×OLIFQ				0.085	0.049	-0.010, 0.181
SOENG	OCSUP	0.804	0.646	53.216***	0.176**	0.055	0.069, 0.284
	OLIFQ				0.102*	0.043	0.018, 0.186
	OLSAT				0.505***	0.052	0.403, 0.607
	OCSUP×OLIFQ				0.041	0.041	-0.040, 0.123

***p<0.001; **p<0.01; *p<0.05.

From regression Eq.3, the effect of OCSUP on SOENG was significant (B= 0.176, SE= 0.055, P<0.01), the effect of OLSAT on SOENG was significant (B= 0.505, SE= 0.052, P<0.001), and the interaction of OCSUP and OLIFQ had no significant effect on SOENG. Table 3 indicates that OLSAT has significant mediating effect on the relationship between OCSUP and SOENG, the mediating effect value is 0.127, and the mediating effect accounts 41.91% of the total effect, and the mediating effect of OCSUP and SOENG through OLSAT is moderated by OLIFQ in the first half path, but not significant in the direct path.

For more detailed explanation of the moderating effect of OLIFQ through a simple slope test (see in Fig2). OLIFQ was divided into high and low group according to the mean plus or minus one standard deviation.

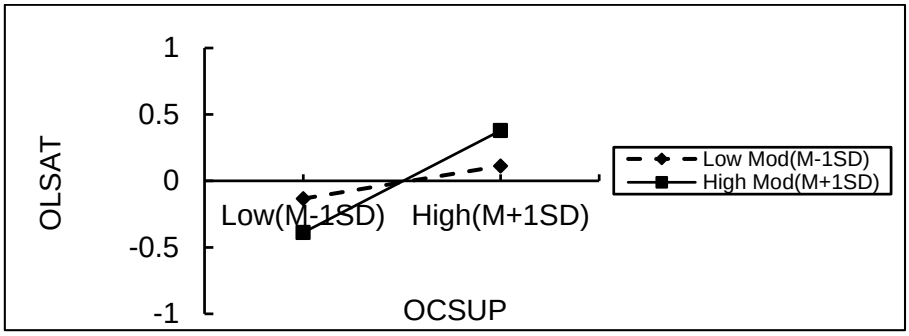

Figure 2: Moderating role of OLIFQ in the relationship between OCSUP and OLSAT

Figure 2 demonstrates that OLIFQ has a positive effect of OCSUP on OLSAT. That is with the increase of OLIFQ, the predictive effect of OCSUP on OLSAT gradually increased. It reveals that OLSAT is greater when OLIFQ is higher. However, the steeper gradient seen for high OLIFQ shows that OCSUP has a stronger effect on OLSAT than for those with low levels. Moreover, OLIFQ moderated the indirect effect of OCSUP on OLSAT via OLSAT: the indirect effect was significant in conditions where the level of OLIFQ was high, whereas the indirect effect was not significant in conditions where the level of OLIFQ was low. The different level of OLIFQ influenced different moderating effect between OCSUP and OLSAT (Table 4).

Table 4: Mediating effect of OLSAT in different OLIFQ levels

Online learning interaction level	Mediating effect value	95% *CIs*
M-SD	0.062	-0.052, 0.187
M	0.127	0.043, 0.224
M+SD	0.194	0.108, 0.295

Based on the above statistical results the final model is shown as Figure 3.

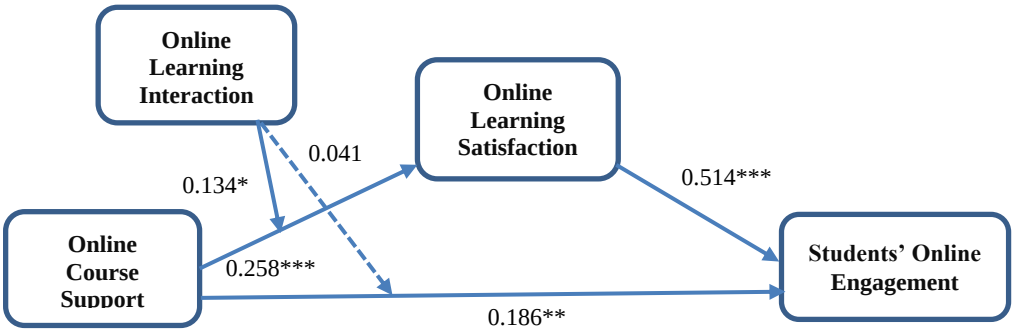

Figure 3: Final model based on statistical results. ***p<0.001; **p<0.01; *p<0.05.

5. Conclusions

Online learning has the remarkable capability to bring students from different geographic locations and backgrounds together to study the same course. However, it brings many challenges to students' engagement in online courses. Based on the theoretical and empirical findings, we developed a moderated mediation model to test the interrelations between OCSUP, SOENG, OLSAT and OLIFQ. The survey shows online learning satisfaction plays a significant mediating role between online course support and students' online engagement. We found that mediating effect was partially moderated by online learning interaction. Online course support significantly

positively promotes students' online engagement via online learning satisfaction when the level of OLIFQ was high, but was not significant when the level of OLIFQ was low. These results deepened our understanding of how and when online course support promotes students' online engagement, which enriches the Fogg's Behaviour Model.

This study findings have some practical implications. First, increasing online course support can be achieved by providing technical assistance to reduce students' anxiety and unfamiliarity with the online learning environment. Utilizing emerging technologies, such as big data, in supporting online resources can be particularly beneficial. Moreover, offering detailed guidance on using course APPs, platforms, and databases, and ensuring faster internet speed and accessible devices can enhance the learning experience. Second, focusing on emotional support is vital. By creating more opportunities for interaction with students, a positive online learning environment can be fostered, allowing a better understanding of their learning progress and circumstances. When students feel supported and cared for, their satisfaction and engagement are likely to increase. Third, giving effective learning strategy support. Encouraging active learning strategies can lead to greater student involvement in the learning process. Equipping students with problem-solving skills enhances their confidence and motivation to learn, resulting in increased online learning engagement.

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