IMPACT OF SYNCHRONOUS ONLINE LEARNING ENVIRONMENT ON STUDENTS' COGNITIVE ENGAGEMENT AND LEARNING OUTCOMES

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ABSTRACT

Although roles of teaching presence have often been neglected in online learning environments, recent research has acknowledged its burgeoning importance. Synchronous online learning mode in which the teaching and learning process occurs in concurrent real-time helps blur the physical boundary hindrance of online learning for students. However, being present in classes, even in brick-and-mortar classes or virtual classes, does not ensure students' learning occurrence. The purpose of this study was to investigate the effects of synchronous online learning environments (SOLE) on students' cognitive engagement, satisfaction, and academic achievement as well. Partial Least Square Structural Equation Modeling (PLS-SEM) was utilized to examine the issue under investigation. The results from a questionnaire survey from 186 participants indicated that pedagogical instructions had direct positive medium effects on both deep and shallow cognitive engagements; deep cognitive engagement had a direct positive impact on academic achievement while shallow cognitive engagement did not have any impact on academic achievement and satisfaction. Interestingly, technical support had a direct positive impact on both direct impacts on academic achievements and satisfaction. Implications for the teaching and learning in a synchronous online modality and limitations of the study were also discussed.

Keywords: Synchronous online learning, cognitive engagement, satisfaction, academic achievements, higher education, Vietnam.

INTRODUCTION

Although online learning has become universally widespread, especially in higher education (Andrew, Wallace, & Sambell, 2021), and was forecast to become mainstream by 2025 (Palvia et al, 2018), synchronous online learning is relatively new in this teaching and learning environment (Phelps & Vlachopoulos 2019). Online learning environments can be categorized into two types: asynchronous and synchronous (real-time) delivery (Chen, Ko, Kinshuk, & Lin, 2005). While a multitude of research on asynchronous learning modes has been conducted in higher education in the literature, synchronous interactions have been increasingly researched thanks to an upsurge in technology in the Fourth Industrial Revolution (Watts, 2016). The use of synchronous web-conferencing interactions was found to increase teaching and social presence (Clark, Strudler, & Grove 2015). This finding is especially crucial since it helps tackle the in-nature drawbacks of online learning mode, which are students' low level of engagement (Kim, Lee, Leite, & Huggins-Manley, 2020), feelings of isolation (Clark, Strudler, & Grove, 2015), or sense of belonging (Cunningham & Cunningham, 2014).

Learning environments had positive effects on students' learning satisfaction (Wu, Tennyson, & Hsia, 2010) in blended learning modality and online learning (Zou et al., 2021). Students admitted that the synchronous online learning section helped them to interact with instructors timely, having timely feedback, more interesting lessons thanks to instructors' use of various modern technology applications (Zou et al., 2021). Hubbard (2019) posited that learning environments with technology-assisted activities facilitate students' learning process in terms of knowledge access and/or skills retention, and so improvement of learning effectiveness.

Learning engagement also plays a crucial role in predicting students' academic achievement (Chase, Hilliard, John Geldhof, Warren , & Lerner, 2014; van Rooij, Jansen, & van de Grift, 2017). In particular, a study by Chase and his cohort (Chase, Hilliard, John Geldhof, Warren , & Lerner, 2014) confirmed a significant correlation between behavioral engagement and students' academic results, while research work by van Rooiji and his team (2017) identified a strong association between cognitive engagement and academic outcomes. Synchronous learning environments were also found to have varying impacts on students' cognitive engagement. Teaching presence or pedagogical affordance was found to have a direct positive impact on cognitive engagement (Lee & Koszalka, 2016; Shi, Tong, & Long, 2021; Zhang, Lin, Zhan, & Ren, 2016), while social and technological presence was proved not to have effects on students' cognitive engagement (Shi, Tong, & Long, 2021).

Previous studies have shown varying impacts on students' engagement in online learning modes, such as motivation (e.g., Shi, Tong, & Long, 2021; Xie, Heddy, & Greene, 2019; Zhou, Ntoumanis, & Thøgersen-Ntoumani, 2019), pedagogical affordance (Lee & Koszalka, 2016; Shi, Tong, & Long, 2021; Zhang, Lin, Zhan, & Ren, 2016), and instructors and students' technological & pedagogical skills (Zhang, Lin, Zhan, & Ren, 2016; Elshami et al., 2022). However, this correlation is still equivocal.

In the same vein, students' engagement was found to be an indicator of their academic achievements (Colling, Wollschläger, Keller, Preckel, & Fischbach, 2022; van Rooij, Jansen, & van de Grift, 2017; Elshami et al., 2022), and students' satisfaction (Gray & Diloreto, 2016; Murillo-Zamorano, Lopez Sanchez, & Godoy-Caballero, 2019).

Albeit an increase in synchronous online learning (Palvia et al., 2018; Bedenlier et al., 2021; Elshami et al., 2022; Ji, Park, & Shin, 2022; Meskill & Anthony, 2014; Torun, 2013; Suliman, Ta'an, Abdalrhim, Tawalbeh, & Aljezawi, 2022; Wolverton, 2018; Yang, Li, Liu, & Tan, 2021), there is a dearth of research investigating the effects of synchronous online learning environments on students' cognitive engagement, their satisfactions and academic achievements with empirical research method in higher education contexts. This study caters to this need. The research questions are formulated as follows:

RQ1: What are the relationships among synchronous online learning environments, students' cognitive engagement, satisfaction, and academic achievements?

RQ2: Do synchronous online learning environments have an influence on students' cognitive engagement?

RQ3: Do synchronous online learning environments have an influence on students' satisfaction and their academic achievements?

RQ4: Do students' cognitive engagement have an influence on students' satisfaction and their academic achievements?

LITERATURE REVIEW

Synchronous Online Learning Environments (SOLE) and Cognitive Engagement

Synchronous online learning environments are defined as a form of learning in which participants are allowed to interact with each other and instructors in real-time thanks to the use of synchronous online learning tools such as chat rooms or videoconferencing (Ji, Park, & Shin, 2022). This learning modality is believed to become "a learning paradigm shift in the post-corona era" (Ji, Park, & Shin, 2022, p.1). However, a favorable learning environment should feature pedagogical, social, and technical elements (Kirschner et al., 2004; Wang, 2008). In this paper, pedagogical elements refer to the use of sound teaching methods to boost the effectiveness of the teaching and learning process (Tang & Hew 2017) in synchronous online learning environments. It was measured by subscales of Teaching presence. Social affordance refers to the perceptions of how synchronous online learning environments can facilitate students' social presence which refers to students' sense of belonging and their ability to engage in social interactions (Kirschner et al., 2004). It was measured by subscales of social presence. Technological affordance refers to the features of synchronous online learning environments that can facilitate students in completing their tasks (Kirschner et al., 2004). However synchronous online learning tools can assist in removing physical distance barriers, they cannot replace in-class face-to-face interactions (Carbajal-Carrera, 2021; Andel et al., 2020). This can be presumably explained that being present in classes, even in brick-and-mortar classes or virtual classes, does not ensure students' learning occurrence.

Although student's engagement is a crucial indicator of student's learning outcomes in higher education, especially in online learning mode (Redmond, et al., 2018), there is a paucity of empirical evidence directly addressing the impact of pedagogical affordance on student engagement in online learning (Halverson, Graham, Spring, Drysdale, & Henrie, 2014; Yang, Li, Liu, & Tan, 2016). This is, theoretically, attributed to the elusiveness of the term "engagement" which is originated in students' different characteristics (Wolverton, Guidry Hollier, & Lanier 2020).

When studying online, students are expected to get involved in five categories of engagement, namely social, cognitive, behavioral, collaborative, and emotional engagement (Redmond, et al., 2018). It is beyond the scope of this study to examine the effects of synchronous online learning modality on these five dimensions of engagement, and so cognitive engagement was the focus of this research.

Cognitive engagement has numerous variances in its definition. It can be understood as the involvement of leaners in metacognition, active learning, critical thinking, and deep learning (Redmond, Abawi , Brown , Henderson, & Heffernan, 2018), or the students' effort in tackling with new materials, complicated ideas, and mastering new skills (Cooper, 2014; Fredricks, Blumenfeld, & Paris, 2004; Ji, Park, & Shin, 2022; Shi, Tong, & Long, 2021). As can be seen that it is dependent on what aspect of students' involvement in their learning process that the term is aimed to cover, but it entails cognitive process as a common feature. In this study, cognitive engagement comprises of two types: deep and surface cognitive engagement by (Greene, 2015; Xie, Heddy, & Greene, 2019). Surface or shallow cognitive engagement involves using memorization strategies such as memorizing, rehearsing, or rereading techniques (Xie, Heddy, & Greene, 2019); while deep cognitive engagement involves students' ability to utilize a high level of psychological investment, such as critical thinking, comparison, justification, and integration of ideas or information (Redmond, Abawi , Brown , Henderson, & Heffernan, 2018).

Previous studies showed that pedagogical instructions had a direct positive impact on cognitive engagement (Shi, Tong, & Long, 2021; Zhong, et al., 2022; Wang and Stein, 2021) while social presence and technical support were found not to have any correlation with cognitive engagement BL synchronous learning environments (Shi, Tong, & Long, 2021). However, other studies revealed that social interactions played an important role in enhancing students' satisfaction and learning engagement in BL asynchronous and synchronous courses (Cheng & Chau, 2016; Zhong, Wang, Lv, Xu, & Zhang, 2022), students' outcomes and satisfaction (Richardson, Maeda, Lv, & Caskurlu, 2017; Andel et al., 2020). Wang's (2022) study found a significant positive correlation between technological support and students' cognitive engagement. In a similar vein, a very recent study by Ji and her cohorts inferred that technical support would greatly affect students' cognitive engagement and satisfaction in a synchronous online English language classes (Ji, Park & Shin, 2022).

Relationship among SOLE, Satisfaction, and Academic Achievements

Student satisfaction plays an important role in measuring students' learning performance or non-academic outcomes, and can be measured by self-report questionnaires (Bowyer & Chambers 2017). Identifying student satisfaction is essential since it helps educators to assist students with their learning progression (Anthonysamy, Koo, & Hew, 2020) and academic achievement (Gopal, Singh, & Aggarwal, 2021) and retention (Dhaqane & Afrah 2016).

A study by Ji and her teammates (2022) surveying 82 Korean undergraduates using least squares regression analysis indicated that the more students were involved in synchronous online learning environment, the higher levels of satisfaction they had. This result was congruent with studies indicating that social presence has a positive correlation with students' satisfaction in online learning environments (Andel et al., 2020; Zhong, Wang, Lv, Xu, & Zhang, 2022). Similarly, Watts (2016) found that synchronous learning facilitated students' social communication with peers and instructors, and avoided frustrations in online learning. In addition, social presence was closely correlated with students' academic achievements (Al-dheleai, Tasir, Al-Rahmi, Al-Sharafi, & Mydin, 2020). What is more, technological support was found correlated with student satisfaction in online learning (Almusharraf & Khahro, 2020; Aikina & Bolsunovskaya, 2020; Almusharraf & Khahro, 2020). Interestingly, studies also indicated that when students could see face-to-face online with their instructors, their satisfaction increased (Yoo & Jung 2022). Teaching presence was also found to have a positive impact on students' satisfaction (Turk, Heddy, & Danielson, 2022).

Review research on the impact of synchronous and asynchronous learning on students' grades remained inconclusive (Watts, 2016). A very recent study on the effects of synchronous online classes on students' outcomes found that undergraduate nursing students undertaking the program significantly increased their knowledge and abilities to make decisions, but students who received asynchronous online classes also achieved a similar result nonetheless (Suliman, Ta'an, Abdalrhim, Tawalbeh, & Aljezawi, 2022). This result was in line with previous studies on the subject of ethical and legal-decision making (e.g., Bijani, Tehranineshat, & Torabizadeh, 2019; Sari, Baysal, Celik, & Eser, 2018; Yeom, Ahn, & Kim, 2018).

Literature review also indicated a correlation between learning environments and students' academic achievements. A learning environment in which students were overloaded with workload or the use of multiple choices for testing would advocate students to employ surface approach which was testified to yield low academic achievements (Feeley & Biggerstaff, 2015; Ohrstedt & Lindfors, 2019; Takase & Yoshida, 2021; Toraman, Ozdemir, Aytug Kosan, & Orakci, 2020).

Cognitive Engagement, Students' Satisfaction, and Academic Achievements

There is growing evidence showing that student engagement has a positive correlation with satisfaction (Chan, Lin, Chau, Takemura, & Fung, 2021; Croxton, 2014; Ji, Park, & Shin, 2022; Martin & Bolliger, 2018; Meyer, 2014). What is more, students' satisfaction can be boosted by enhancing their engagement (Wolverton, Guidry Hollier, & Lanier, 2020). However, this finding was still equivocal since students were found to be dissatisfied with online collaborative activities due to technological-related skills (Elshami et al., 2022; Garratt-Reed, Roberts, & Heritage, 2016).

It can be seen that students' satisfaction with online learning can be influenced by internal factors (i.e., students' active involvement in the learning process, or knowledge of technical skills), and external factors, such as learning environment or technological affordance.

Previous studies also revealed inconsistent effects of deep learning on students' academic achievements. For example, recent evidence has shown a positive impact of deep learning strategies and students' academic performance (e.g., Bolliger& Halupa, 2018; Liu S., Liu, S., Liu, Z., Peng, & Yang, 2022); meanwhile other studies did not find such a relationship (Campbell & Cabrera, 2014; Ohrstedt & Lindfors, 2019). However, Gomez-Rey, Barbera, and Fernandez-Navarro (2016) suggested more metacognitive practices should be done in higher education institutions for students to improve the acquired knowledge, and hence an increase in their satisfaction.

Research Model and Hypotheses

Prior studies revealed significant relationships among synchronous online learning environments and students. The purpose of this study was to investigate the relationships among a BSLE (Pedagogical, social, and technical affordance), learning motivation, and cognitive engagement. The research model and hypotheses are illustrated in Figure 1.

H1: Pedagogical instructions have positive effects on students' cognitive engagement, satisfaction, and academic achievements in synchronous online environments.

H2: Social interactions have positive effects on students' cognitive engagement, satisfaction, and academic achievements in synchronous online environments.

H3: Technological support has positive effects on students' cognitive engagement, satisfaction, and academic achievements in synchronous online environments.

H4: Students' cognitive engagements have positive effects on their satisfaction and academic achievements in synchronous online environments.

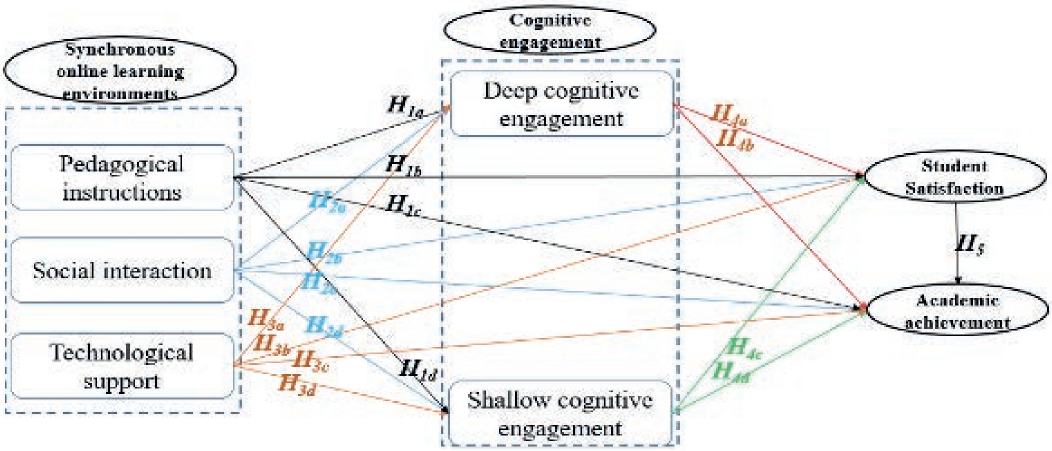

Figure 1. The proposed research model

METHOD

Participants

The current study aimed to obtain the confidence level of 95% and the margin of error with 5%. The participants of the study were 224, recruited from a university in Mekong Delta from March 26 to April 18, 2022. The participants, first-year students, aging from 18-20, were those who have studied in synchronous online EFL classes in a span of Covid-19 as required by the university. A link to the Questionnaires and a Consent Form were sent to these participants.

Of 244 responses were obtained, 183 were qualified for data analysis. According to Kock and Hadaya (2018), the minimum sample size (n_{min}) with a significance level of 5% and a minimum path coefficient (p_{min}) of 0.2 within the minimum magnitude in the PLS-SEM math model is calculated by the following equation: n_{min}>((2.846/p_{min})^2) → n_{min}>((2/486/0.2)^2) = 154.505, so the minimum sample size is 155. Hence, further adata analysis of the study is ensured. Table 1 below provides detailed demographics of participants.

Table 1. Participant demographics

		N	Percentage (%)
Gender	Male	85	46.5
	Female	98	53.5
Age	18-20	103	28.9
Majors	Business	43	23.4
	IT	80	43.7
	English	60	32.8

Research Instruments

The 46-item modified questionnaires were adapted from previous studies. In particular, the items related to pedagogical affordance and social presence were adapted from Arbaugh, et al. (2008) technological support items were adapted from Davis (1989); those relevant to students' cognitive engagement were adapted from Miller and his cohorts (1996)performance goals, obtaining future consequences, pleasing the teacher, and pleasing the family; students' satisfaction and academic achievement were adapted from Ejubovic and Puska (2019). Five-point Likert scale was used, starting from Strongly disagree to Strongly agree, to investigate the participants' perspectives on the issue under investigation.

Data Collection and Analysis

Google Forms was employed to collect data from the participants. Prior to the actual data collection phase, the questionnaire was administered to forty-eight students of the researcher's class for the purpose of piloting phase. The Cronbach's Alpha of the variables were ranged from 0.85 – 0.95, indicating that the instrument was reliable for further data collection and analysis.

Smart-PLS 3.0 was utilized to measure the reliability of the questionnaire in the actual data collection phase, the correlation between observation variables and latent variables through a reflective measurement mode. The use of the Partial least squares-based structural equation modelling (PLS-SEM) is in the field of information systems, and has been proved to be helpful in many other fields where multivariate statistical methods are employed. Furthermore, if the research purpose is to explain the relationships between exogenous and endogenous constructs, and the sample size is small (n<100), PLS-SEM would be definitely appropriate (Hair et al., 2021).

ANALYSIS AND RESULTS

Instrument Reliability and Validity

Table 2. Measurement Model Parameter Estimation

Dimensions	Items	Factor loadings	**Cronbach's Alpha**	**CR**	**AVE**
Pedagogical instructions	PI1	0.807	0.942	0.95	0.656
	PI2	0.8			
	PI3	0.792			
	PI5	0.818			
	PI6	0.843			
	PI8	0.836			
	PI9	0.791			
	PI10	0.88			
	PI11	0.803			
	PI12	0.721			
Social interactions	SI4	0.848	0.934	0.948	0.752
	SI5	0.916			
	SI6	0.909			
	SI7	0.858			
	SI8	0.802			
	SI9	0.866			
Technological support	TS1	0.844	0.949	0.96	0.799
	TS2	0.85			
	TS3	0.915			
	TS4	0.935			
	TS5	0.913			
	TS6	0.901			

Shallow cognitive engagement	SCE1	0.895	0.769	0.897	0.812
	SCE2	0.908			
Deep cognitive engagement	DCE1	0.728	0.877	0.911	0.672
	DCE4	0.826			
	DCE5	0.877			
	DCE6	0.849			
	DCE7	0.812			
Student Satisfaction	SS1	0.911	0.904	0.94	0.839
	SS2	0.92			
	SS3	0.917			
Academic Achievement	AA1	0.832	0.878	0.916	0.733
	AA2	0.865			
	AA3	0.899			
	AA4	0.827			

Table 2 indicated the indicator reliability (> 0.7), internal consistency reliability (Cronbach's Alpha > 0.7, and CR > 0.7) and the convergent validity (AVE > 0.5) of each construct (Hair Jr, et al., 2021). HTMT ratio intimation is also used to examine discriminant validity of scale. Each item's HTMT should be under 0.9 (Henseler, Ringle, and Sarstedt 2015), thus the constructs' discriminant validity in ensured (Table 3).

Table 3. Heterotrait–Monotrait Ratio of Correlations

Dimension	AA	DCE	PI	SCE	SI	SS	TS
Academic Achievement (AA)							
Deep Cognitive Engagement (DCE)	0.694						
Pedagogical Instructions (PI)	0.547	0.721					
Shallow Cognitive Engagement (SCE)	0.706	0.858	0.769				
Social Interaction (SI)	0.61	0.609	0.774	0.636			
Student's Satisfaction (SS)	0.815	0.635	0.597	0.643	0.614		
Technological Support (TS)	0.777	0.574	0.63	0.579	0.739	0.815	

Collinearity analysis: The variance inflation factor (VIF) should be lower 3 to avoid collinearity issues (Hair Jr, et al., 2021). Table 4 indicated that the bivariate correlation between TS and AA is larger than 3; however "if all VIFs resulting from a full collinearity test are equal to or lower than 3.3, the model can be considered free of common method bias" (Kock, 2015, p. 7). The full collinearity test results are illustrated in Table 4; all constructs' VIFs smaller than 3 indicate no collinearity issues. It could be concluded that the collinearity of the formative indicators in this study did not occur.

Table 4. Evaluating Collinearity of Scale and Model Fit

	AA	DCE	PI	SCE	SI	SS	TS
Academic Achievement (AA)							
Deep Cognitive Engagement (DCE)	2.446					2.378	
Pedagogical Instructions (PI)	2.911	2.23		2.23		2.909	
Shallow Cognitive Engagement (SCE)	2.342					2.306	
Social Interaction (SI)	2.768	2.756		2.756		2.764	
Student's Satisfaction (SS)	2.637						
Technological Support (TS)	3.112	2.008		2.008		2.073	

Table 5. A Full Collinearity Test

	Random
Academic Achievement (AA)	2.033
Deep Cognitive Engagement (DCE)	2.234
Pedagogical Instructions (PI)	1.258
Shallow Cognitive Engagement (SCE)	
Social Interaction (SI)	2.24
Student's Satisfaction (SS)	1.319
Technological Support (TS)	2.306
Deep Cognitive Engagement (DCE)	1.094

Structural Equation Modelling Analysis

According to (Hair, et al., 2019)yet concise, overview of the considerations and metrics required for partial least squares structural equation modeling (PLS-SEM, the coefficient of determination (R2, which should be 0.25 < R2 < 0.9) and the path coefficients should be considered for assessing the structural model.

As can be shown in Table 6, the R2 values of DCE, SCE, SS, and AA were 0.463, 0.446, 0.621, and 0.646 respectively. The R2 values of 0.44 – 0.64 for the endogenous variables in the proposed structural model indicated fairly strong explanatory relationships among the study constructs, namely pedagogical instructions, social interactions, technological support, cognitive engagement, satisfaction, and academic achievements.

Table 6. R2 Values

Dimensions	R2	R2 Adjusted
Deep Cognitive Engagement (DCE)	0.463	0.454
Shallow Cognitive Engagement (SCE)	0.446	0.437
Student's Satisfaction (SS)	0.621	0.61
Academic Achievement (AA)	0.646	0.634

Hypotheses Testing

Table 7 and Figure 2 below indicate the path coefficients and p-values for each hypothesis. The results from Table 6 reveal that pedagogical instructions had direct positive medium effects on both deep and shallow cognitive engagements; deep cognitive engagement had a direct positive impact on academic achievement while shallow cognitive engagement did not have any impact on academic achievement and satisfaction. Interestingly, technical support had a direct positive impact on both academic achievements and satisfaction. Satisfaction was confirmed to have an effect on academic achievement. Among these correlations, the effect of technological support (TS) on satisfaction (SS) was strongest, followed by the impacts of pedagogical affordances on cognitive engagements, then TS on academic (AA), SS on AA. The effect of deep cognitive engagement on AA was the smallest. Social support did not have any correlations with students' satisfaction ($p = 0.638 > 0.05$), deep cognitive engagement ($p = 0.648 > 0.05$), or shallow cognitive engagement ($p = 0.074 > 0.05$) in a synchronous online learning modality.

Table 7. Hypotheses Testing Results

Hypothesis	**Paths**	**Path Coefficients**	**p-value**	**Results**
H1a	PI -> DCE	0.513	0.000	Supported
H1b	PI -> SS	0.025	0.789	Rejected
H1c	PI -> AA	-0.161	0.142	Rejected
H1d	PI -> SCE	0.530	0.000	Supported
H2a	SI -> DCE	0.055	0.592	Rejected
H2b	SI -> SS	-0.04	0.638	Rejected
H2c	SI -> AA	0.042	0.547	Rejected
H2d	SI -> SCE	0.061	0.648	Rejected
H3a	TS -> DCE	0.178	0.074	Rejected
H3b	TS -> SS	0.628	0.000	Supported
H3c	TS -> AA	0.333	0.017	Supported
H3d	TS -> SCE	0.133	0.251	Rejected
H4a	DCE -> SS	0.161	0.126	Rejected
H4b	DCE -> AA	0.201	0.029	Supported
H4c	SCE -> SS	0.116	0.187	Rejected
H4d	SCE -> AA	0.180	0.051	Rejected
H5	SS -> AA	0.331	0.001	Supported

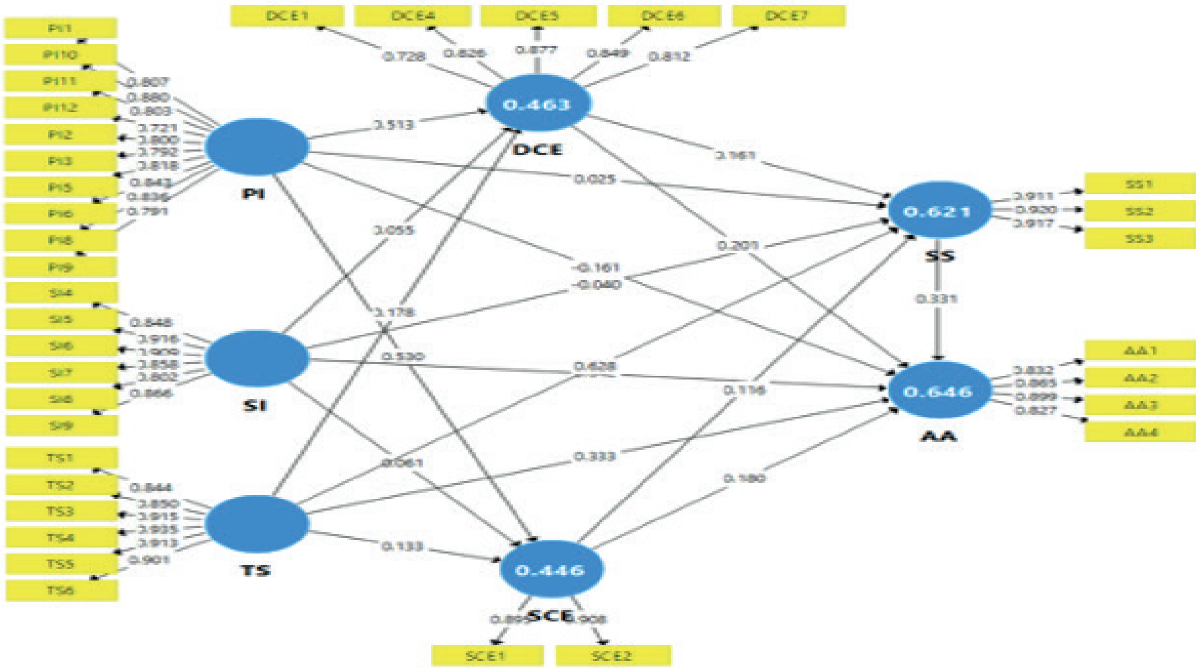

Figure 2: The results of path coefficients

DISCUSSIONS

The initial goal of the present study is to identify the impact of the synchronous online learning environment on students' cognitive engagement, satisfaction, and academic achievements. For this objective, the results of the study confirmed the roles of pedagogy play in students' cognitive engagement, which was supported by other studies (Lee and Koszalka 2016) Shi, Tong and Long, 2021; Zhong, et al., 2022; Wang and Stein, 2021; Zhang, et al., 2016), yet it ran counter to a study revealing that pedagogical affordance did not have effects on students' shallow cognitive engagement (Shi et al. 2021). It has been suggested that if the instructors encouraged students to take notes as a reminder for their later use in tackling future quizzes, this can contribute to their memorization of prior knowledge, and so it may enhance their involvement in the lessons. However, pedagogical affordance did not contribute to students' satisfaction and academic achievements in this study. This result contradicted the findings from (Almusharraf & Khahro 2020; Turk, Heddy & Danielson, 2022). A plausible explanation to this dichotomy can be that in this study, most of the participants studying in the Google Meet platform were required to set their cameras on during the online classes. The real-time interaction and ability to see face-to-face online may have contributed to their negative feelings about the synchronous learning online environment due to the feeling of freedom sacrifice. This should be unearthed in a further study to confirm the author's presumption. The study did not find any correlations between teaching presence and students' perceived academic achievements although previous studies indicated that teacher-students' interaction implied an enhancement on students' academic outcomes (Martin & Bolliger 2018; Richardson et al., 2016). One possible explanation is that the roles of teaching and testing may be taken into account (Dinh & Nguyen, 2022).

The study also unearthed the critical importance of technological support in promoting students' satisfaction (f value = 0.501), as well as its impact, albeit small, on students' academic achievements. This result was consistent with studies by Almusharraf and Khahro (2020) and (Aikina and Bolsunovskaya (2020). In addition, the study also lent support to previous research revealing that technological support did not have an impact on students' cognitive engagement (Shi et al. 2021), and was not reinforced by other studies (Wang, 2022; Ji, Park & Shin, 2022). In Wang's (2022) study, students in online courses valued the contribution of technological support to their cognitive engagement owing to their instructors' using various means of asynchronous teaching tools and media to tackle students' technical problems in learning. However, the participants showed a negative correlation between direct instruction and cognitive engagement. One explanation for these inconsistent findings with the current ones is that technological support would be appropriate for asynchronous online learning environments and that the participants of the current study did not encounter technical problems during their synchronous online learning. In the meantime, differences in pedagogical affordance could have led to students' differences in their perceived cognitive engagement. While the instructors in Wang's study mainly provided explicit explantions or solutions, the instructors in the current study primarily provided assistance or encouragement for students to get involved in the learning process.

Although social presence was supposed to be an essential factor in online learning (Tiedt, Owens, & Boysen, 2021) to promote students' engagement, it did not have any correlation with cognitive engagement in the current study, which was also confirmed by (Shi et al. 2021). This finding, however, was not aligned with previous studies which have signposted a positive correlation between social presence and satisfaction (Andel et al., 2020; Cheng & Chau, 2016; Richardson, et al., 2017), academic achievements (Al-dheleai et al., 2020) and learning engagement (Wang, 2022; Zhong, et al., 2022). This dichotomy can be elucidated that in a synchronous online environment with a camera on, students do not appreciate the interactions or collaboration with their peers. This provides academicians with pedagogical implications for their synchronous online-based teaching in designing activities or other supporting teaching tools that employ teacher-student interactions as well as peer interactions, which can foster students' academic achievements.

This study did not find any correlations between cognitive engagement and satisfaction which was reported by other studies (Chan et al. 2021; Ji, Park & Shin, 2022; Martin &s Bolliger, 2018; Meyer, 2014), yet it is aligned with prior studies pinpointing the close correlations between student engagement and academic outcomes (Bolliger & Halupa, 2018; Liu, et al., 2022). Although this result was not reinforced by some other research (Ohrstedt & Lindfors, 2019; Campbell & Cabrera, 2014), the finding adds subtle nuances of the role of deep cognitive engagement to students' perceived academic achievements in a synchronous online learning environment. Moreover, the role of technological affordance was found beneficial to students' emotional and behavioral engagement in other studies (e.g., Wang, 2022; Ji et al., 2022), which was not observed in the present research.

The study once again acknowledged the impact of satisfaction on academic achievement, even in a synchronous online learning environment where most of the students were participating online classes with their laptop camera on. This result was in line with previous studies (Dhaqane and Afrah, 2016; Gopal, Singh and Aggarwal, 2021; Dinh & Nguyen, 2022).

CONCLUSION AND LIMITATIONS

To the best knowledge of the author, this study is the first one examining the combined effects of online learning environments, especially the synchronous one, students' cognitive engagement on students' satisfaction and academic performances, utilizing the PLS-SEM technique. The results confirm the impact of pedagogical instructions in the synchronous online learning, technological support, and deep learning engagement on students' satisfaction and academic achievement. The study put forward the critical role of pedagogy even in online learning on students' cognitive engagement which is recognized as having an impact on students' academic outcomes. In addition, technological support is perceived to be crucial to online students' satisfaction and academic achievement although its correlation with students' cognitive engagement was not confirmed.

From the aforementioned findings, the current study, in terms of theoretical contribution, confirms the importance of teaching presence to students' learning process which has been well documented in Community of Inquiry (CoI) devised by Garrison et al. (2000), but now in a synchronous online learning where students' cameras are on. Regarding practical contribution, this study provides pedagogical implications for universities, educators, and instructors to consider online teaching activities and technological support in implementing synchronous online courses.

The current study acknowledges its limitations in terms of population scarcity, self-reported survey questionnaires, and a single design method. However, the study ensures the reliability and validity of the data quality through multi-progression analysis. The study also calls for further investigation of this issue in a larger population as well as in the context of public universities where students' different backgrounds and motivations could be predictors for their cognitive engagement and satisfaction in a synchronous online environment. Furthermore, qualitative data collection such as on-site classes and/or interviews could help triangulate the findings. Finally, yet importantly, further studies should investigate instructors' specific synchronous online teaching activities in relation to other aspects of students' learning engagement such as social, emotional, and behavioral engagement.

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