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Self-Regulation, Teaching Presence, and Social Presence: Predictors of Students' Learning Engagement and Persistence in Blended Synchronous Learning

Qiuju Zhong [1], Ying Wang [2], Wu Lv [3], Jie Xu [1] and Yichun Zhang [1,*]

[1] School of Education Science, Nanjing Normal University, Nanjing 210097, China; 201822010130@mail.bnu.edu.cn (Q.Z.); 190601022@njnu.edu.cn (J.X.)
[2] Faculty of Education, The Chinese University of Hong Kong, Hong Kong 999077, China; 1155170298@link.cuhk.edu.hk
[3] School of Preschool Education, Jiangsu Second Normal University, Nanjing 210013, China; 201531010028@mail.bnu.edu.cn
[*] Correspondence: zyc@njnu.edu.cn; Tel.: +86-138-517-571-68

Abstract: Blended synchronous learning (BSL) is becoming increasingly widely implemented in many higher education institutions due to its accessibility and flexibility. However, little research has been conducted to explore students' engagement and persistence and their possible predictors in such a learning mode. The purpose of this study was to investigate how to facilitate students' engagement and persistence in BSL. In detail, this study used structural equation modeling to explore the relationships among specific predictors (self-regulation, teaching presence, and social presence), learning engagement, and learning persistence in BSL. We recruited 319 students who were enrolled in BSL at a Chinese university. The online survey was administered to gather data on the variables of this study. The results demonstrated that self-regulation, teaching presence, and social presence were positively associated with learning engagement. Self-regulation and learning engagement were positively associated with learning persistence. Moreover, learning engagement mediated the relationships between self-regulation, teaching presence, social presence, and learning persistence. This study suggests that self-regulation, teaching presence, and social presence are significant predictors for student learning engagement and persistence in BSL.

Keywords: blended synchronous learning; self-regulation; teaching presence; social presence; learning engagement; learning persistence

1. Introduction

In recent years, the rapid development of information technology has brought sweeping changes to the practice of teaching and learning. Currently, remote students can get access to classroom learning activities in real time through rich media synchronous technologies. This learning mode is described as *Blended Synchronous Learning* (BSL) [1], which is a particular type of blended learning [2,3]. BSL blurs the boundaries between on-campus learning and online learning at a remote site, integrating the two learning approaches simultaneously [4,5]. Compared to fully on-campus and fully online learning, BSL creates a more flexible, convenient, and engaging learning environment for students [5,6]. During the COVID-19 pandemic, BSL allows students who were unable to return to campus to participate in classes from home or remote sites, so that remote students attend classes in real time with classroom students [7]. Furthermore, when compared to asynchronous online learning, BSL reduces remote learners' feelings of isolation [3,5].

As BSL has become increasingly popular in higher education institutions [6,8–10], there have been growing studies focusing on it. Previous studied has focused on the design and implementation of BSL [9,11,12], teachers' and students' perceptions of BSL [7,13], and

evaluating the BSL mode [10,13–15]. A literature review suggested most of the existing studies on BSL were exploratory and qualitative, and more future research, especially empirical research, should investigate the effect on student learning outcomes [6]. In short, it can be summarized empirical studies investigating the use and effectiveness of BSL are needed.

Given this, we focused on learning engagement and persistence for effective BSL. Learning engagement is related to positive student academic outcomes [16] and high persistence rates [17]. For the BSL to be successful in higher education, it is necessary to understand how to engage students in the learning process. In terms of learning persistence, it is considered an essential contributor to effective learning [18]. Student persistence or dropout is highly correlated with learning achievement [19]. Therefore, this study considered learning engagement and learning persistence as two indicators of BSL learning outcomes.

Self-regulation, teaching presence and social presence have been found to be predictors of student engagement and persistence. Self-regulation is an important factor for learners' academic achievement in both synchronous and asynchronous online learning [20]. It is crucial to pay more attention to self-regulation in the online and blended learning environment [21]. Regarding teaching presence, it was found that teachers play a leading role in blended learning, from curriculum design to facilitating interactions and supporting students in the learning process [22,23]. Concerning social presence, it has an impact on student engagement, course and teacher satisfaction, final grade, and course completion rates in online learning [24,25]. In short, the effects of self-regulation, teaching presence and social presence have been heavily researched in learning settings, such as online learning. Moreover, prior studies have found that these factors separately predict students' learning outcomes [26–31]. However, it is not known whether these variables can be predictors of learning outcomes in BSL. To identify predictors that are related to learning engagement and persistence in BSL, we divided the independent variables into self-regulation, teaching presence, and social presence. What follows are research questions in the study:

1. Do self-regulation, teaching presence, and social presence affect learning engagement in BSL?
2. Do self-regulation, teaching presence, and social presence affect learning persistence in BSL?
3. Does learning engagement mediate the relationship between (1) self-regulation, teaching presence, and social presence and (2) learning persistence in BSL?

To answer the above questions, we tried to build a model to examine the relationship among predictors (i.e., self-regulation, teaching presence, and social presence), learning engagement, and learning persistence in BSL. The main contributions of this study include: (1) Theoretically, we identified an integrated model that provided insights for improving student engagement and persistence in BSL. We found that self-regulation, teaching presence, and social presence were significant predictors of student engagement and persistence. (2) Practically, from learners' self-regulation, pedagogical, and social perspectives, we provided effective practice guidelines for increasing student engagement and persistence in BSL.

2. Theoretical Background and Research Hypotheses

In traditional and technology-based settings, student engagement and persistence have been identified as key variables for academic achievement. More research has been progressively performed to assess student engagement and persistence in learning.

2.1. Learning Engagement and Persistence in Blended Synchronous Learning

2.1.1. Learning Engagement

Learning engagement is a critical factor in academic success in higher education and has received widespread attention from educational researchers and practitioners [32]. When seen in the context of a course, learning engagement symbolizes the time and

effort students put into learning [33]. According to prior studies, student engagement was composed of three interrelated dimensions: behavioral, emotional, and cognitive dimensions [34]. In detail, behavioral engagement refers to their participation in activities, adherence to rules or standards, and paying attention to learning itself in BSL. Emotional engagement refers to students' positive emotions toward activities, peers, and the instructor in BSL. Cognitive engagement means to the cognitive effort to gain complicated knowledge and skills in the blended synchronous learning process.

BSL is popular because it allows remote students to study synchronously with their on-campus students. However, being in class does not mean that a student is fully engaged in learning, especially for remote students [13]. It is necessary to explore how to promote student engagement in the setting of BSL. Given this, learning engagement was selected as the outcome variable in this study.

2.1.2. Learning Persistence

Improving retention rates has long been an issue of great concern in higher education [19]. Learning persistence has gotten much attention since it's a multifaceted indication of a learner's emotions, cognition, and actions. To maintain continuity in learning, it is a matter of constantly fighting against possible temptations and difficulties [35]. Learning persistence has two meanings: the willingness to complete the current course and the willingness to pursue the other course at a later date [36]. In this study, we measured learning persistence with one's willingness to complete the BSL that they were presently enrolled in.

Studies have mainly focused on learning persistence in traditional learning environments [37,38], online learning [18,39], MOOC [34,40] and blended learning [41,42]. However, little research has focused on learning persistence in BSL settings. Indeed, BSL is a promising learning mode that provides flexible education for students [43]. It gives students the opportunity to attend courses at a remote site and reduces isolation for remote students. It makes sense to focus on how to enhance students' learning persistence in a BSL environment. Because of this, learning persistence was chosen as another outcome variable in this study.

2.1.3. Learning Engagement and Learning Persistence

Studies have shown that learning engagement was positively correlated with learning persistence. For example, in an e-learning environment, Adeshola and Agoyi [39] confirmed that learning engagement was a determinant of learning persistence. This is also true in a MOOC environment, Jung and Lee [34] used structural equation modeling to demonstrate that learning engagement had a direct effect on learning persistence. Similarly, Alamri [40] explored students' adoption of MOOCs and found that learning engagement positively affected learning persistence. To conclude, previous studies suggested that learning engagement had a positive impact on learning persistence in MOOC or e-learning environment. However, it is not known whether this relationship still holds in a BSL setting.

BSL is a network-dependent learning mode. A stable network makes it possible for remote students and face-to-face students to attend courses synchronously. Reliability is often utilized to evaluate network performance [44]. Therefore, we should pay attention to network reliability. The minimal cut set (MC, an edge set) can be used to evaluate network reliability [45].

2.2. Predictors of Learning Engagement and Persistence

In an attempt to make BSL effective, this study sought to explore the effects of predictors (i.e., self-regulation, teaching presence, and social presence) on student engagement and persistence.

2.2.1. Self-Regulation

Self-regulation, according to Zimmerman [46], is learners' self-generated ideas, attitudes, and behaviors that are systematically oriented toward achieving objectives. It has been proposed that self-regulated learning involves metacognition, motivation, and other psychological qualities [47]. Huang et al. [26] proposed that we cannot completely understand and analyze online learning without considering learners' self-regulation.

Self-regulation has been found to have a positive relationship with learning engagement [30,48] and learning persistence [49,50]. For example, Sun and Rueda [48] suggested that self-regulation was positively related to sub-dimensions of engagement (behavioral, emotional, and cognitive) in distance education, and similarly in large university classes [30]. In terms of the correlation between self-regulation and learning persistence, it was found students who persisted in their studies had higher levels of metacognitive self-regulation in online courses compared to those who dropped out [50]. Especially in difficult assignments, students higher in self-regulation were more likely to persist and put in more effort to achieve desired objectives [49]. These studies provide a perspective for discovering the links between self-regulation and learning engagement as well as self-regulation and learning persistence in different environments.

However, the role that self-regulation plays in blended learning settings is yet to be further explored. [21]. It may be that self-regulation in BSL is equally worthy of further exploration because BSL is a relatively new type of blended learning. Thus, it is essential to explore whether self-regulation was positively related to learning engagement and learning persistence in a BSL setting.

2.2.2. Teaching Presence

Teaching presence is described as teachers helping students achieve meaningful learning by design, facilitation, and direction [51]. It is composed of three subdimensions: design and organization, facilitation discourse, and direct instruction [52]. In the present study, design and organization means teachers establish learning activities, timelines, and other instructional components of the blended synchronous courses; facilitation discourse refers to teachers facilitating and guiding meaningful cooperation and dialogue in blended synchronous courses; direct instruction means teachers diagnose students' needs and provide timely instruction to ensure students achieve the desired learning outcomes [52]. Teaching presence is great for increasing learning satisfaction and fostering a sense of virtual community in online learning [53].

Teaching presence has been demonstrated positively predicted learning engagement and learning persistence. A study conducted in a blended synchronous course in China showed that pedagogical affordance (i.e., using sound teaching strategies to promote instruction and learning) was a strong predictor of students' deep cognitive engagement [28]. Another study conducted in China showed that the teaching presence encouraged students to boldly explore and constantly revise their original ideas, which in turn promoted learning engagement [54]. Furthermore, a survey among Korean learners showed teaching presence showed a statistically significant and positive influence on learning engagement [34]. Regarding learning persistence, it has been proposed to promote learner persistence by increasing teaching presence (e.g., providing more opportunities for students to ask questions) [29]. Furthermore, a Korean survey among MOOCs learners suggested that teaching presence showed a positive and direct relation to student persistence, as well as an indirect relation through learning engagement [34]. Therefore, we regarded teaching presence to be a valuable factor of students' learning engagement and persistence.

In blended synchronous learning and teaching, the instructor's performance is a good guide for students and, to some extent, determines whether the desired learning goals are achieved [55]. For BSL to run smoothly, teachers need to plan and design rigorous lessons and programs [11] and create interactive and inclusive learning environments [7]. It should be noted that, in BSL, the pedagogical effects of teaching presence are contextual and specific [55]. As a result, we argued it is worthwhile to investigate the influence of

teaching presence on student engagement and persistence in Chinese university classes where BSL was first adopted.

2.2.3. Social Presence

Social presence refers to the learners' competence in casting themselves socially and affectively through the medium of communication [51]. It is a multifaceted construct that includes effective expression, open communication, and group cohesion [52]. In this study, effective expression means that students in BSL share personal expressions and values. Open communication refers to students establishing mutual awareness and recognition in BSL. Group cohesion means that students develop and maintain a sense of group commitment in BSL [52]. Garrison et al. [56] explained that social presence fostered the development of a social identity via contact with others. Social presence enables students to express their thoughts and talents while also facilitating communication among students. In addition, social presence aids students in translating online activities into real-world peer interactions which could happen in the interpersonal communication process [57].

Social presence positively predicted learning engagement and learning persistence in MOOC or online settings. In terms of relation to learning engagement, social presence may be employed to promote MOOC students' community participation [58]. In a large university class adopting flipped learning, social presence not only directly predicted learning engagement, but also accounted for the relations between the factors (i.e., self-efficacy, self-regulation) and learning engagement [30]. Moreover, by exploring the development of social presence, it was discovered that social presence improved participants' feeling of authenticity in online learning, and that enhanced authenticity boosted their learning engagement consequently [31]. Concerning the relationship with learning persistence, social presence has been shown to impact student retention in online courses [25]. Also in the online setting, Liu et al. showed that social presence has a non-negligible role in students' persistence in the course, and in achieving good grades [24]. In conclusion, social presence can be considered a predictor of student engagement and persistence.

Given that BSL is built for remote students and on-campus students to attend classes together in real time [9], enriched social interactions are critical to facilitate students to achieve the desired learning outcomes [59]. Social presence showed favorable influence on learning via peer interaction in the blended learning setting [10]. Therefore, this study attempted to explore the influence of social presence on learning engagement and persistence in BSL.

2.3. Hypotheses

As discussed above, previous studies have explored the effect of specific predictors (self-regulation, teaching presence, and social presence) on students' learning engagement and persistence in traditional and technology-enhanced settings. However, in the BSL setting, few studies have focused on these predictors and their association with student learning outcomes [6]. BSL is promising for ensuring educational continuity during a catastrophic event [11] and deserves further study [5]. Given this, this study chose BSL as the research context to explore the structural relationship among student engagement, persistence, and related predictors (i.e., self-regulation, instructional presence, and social presence). The hypothesized model for this research is shown in Figure 1, and the research hypotheses are as follows:

Hypothesis 1a (H1a). *Self-regulation has a positive impact on learning engagement in BSL.*

Hypothesis 1b (H1b). *Teaching presence has a positive impact on learning engagement in BSL.*

Hypothesis 1c (H1c). *Social presence has a positive impact on learning engagement in BSL.*

Hypothesis 2a (H2a). *Self-regulation has a positive impact on learning persistence in BSL.*

Hypothesis 2b (H2b). *Teaching presence has a positive impact on learning persistence in BSL.*

Hypothesis 2c (H2c). *Social presence has a positive impact on learning persistence in BSL.*

Hypothesis 2d (H2d). *Learning engagement has a positive impact on learning persistence in BSL.*

Hypothesis 3 (H3). *Learning engagement mediates the relationships between (1) self-regulation, teaching presence, and social presence and (2) learning persistence in BSL.*
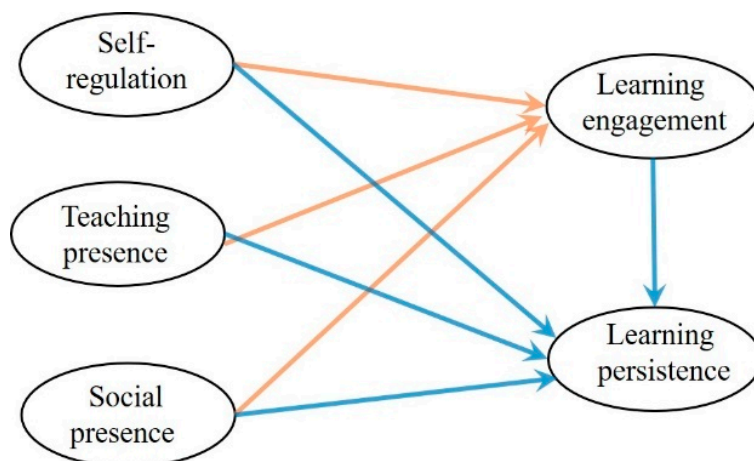

Figure 1. Hypothesized model.

3. Methods

3.1. Research Context and Participants

3.1.1. Research Context

The research was conducted in the compulsory course "Modern Educational Technology" in the fall semester of 2021 at a Chinese university. This course was designed for normal students from different majors in the university. It aimed to teach students to develop computer literacy and use technology in their studies. The course was initially delivered in a face-to-face manner. However, it was often a challenge for the non-returning and internship students to attend physically due to COVID-19. Then, the course was moved fully online in an attempt to increase attendance rates. However, the students who could easily attend in classrooms complained that they missed out on the social interaction of in-person classes; the teachers also missed out on the opportunity to meet at least some students face-to-face. Finally, the course was decided to be conducted in BSL mode, which was utilized for the first time in the course.

In the BSL mode, teachers taught in the physical classroom, students were allowed to choose attendance mode flexibly: attended class physically or just attended synchronous online classes through Tencent Meeting (a popular video conference tool in China https://meeting.tencent.com/, accessed on 30 March 2022). All teaching activities could be attended by both remote and face-to-face students. The interactive process between remote and face-to-face students, and between remote students and the instructor, was mediated visually and verbally through Tencent Meeting. In such cases, remote students and face-to-face students received the same instruction and engage in the same learning activities synchronously. The blended synchronous course ran once a week from 7 p.m. to 9:30 p.m. To improve the effectiveness of BSL, teachers designed different instructional activities such as tool sharing activities, interactive groups and team discussions, and classroom-based tasks.

3.1.2. Participants

The study included 319 (valid response rate: 93.3%) participants who enrolled in the blended synchronous course "Modern Educational Technology". Students who signed the consent form completed the questionnaire anonymously. All participants were informed of the study background, questions, and purpose. Questionnaires were completed in class, rather than a take-home task, which ensured that students had enough time to understand and answer the questions seriously. In order for students to answer the questionnaire honestly, ex-ante approaches were adopted in the survey. First, the introductory information was used to ensure the anonymity and confidentiality of the students' responses. Second, before data collection, students were told that the answers were not right or wrong and were not related to their grades. Thus, students can fill in their honest thoughts. Each respondent received 5 RMB in return for completing the questionnaire.

Reversed items were used in this study to filter potentially invalid respondents. The respondents who rated both positive and reversed items essentially the same were filtered out. For example, the respondents to be excluded were the ones who rated "strongly agree" on the positive items (e.g., Completing the blended synchronous learning is important to me) while rating the reversed items (e.g., I am not likely to continue my studies in the blended synchronous learning) as "strongly agree" or "agree". Based on the inconsistency between the positive items and reversed items, we eliminated 23 invalid questionnaires. Thus, survey data from 319 respondents were involved in further analysis.

The participants' age ranged from 17 to 24 (M = 20.24; SD = 1.71), including 77 freshmen (24.1%), 55 sophomores (17.2%), 100 juniors (31.3%) and 87 seniors (27.3%). There were 184 female (57.7%) and 136 men (42.3%). The participants represented a wide variety of disciplines such as art, literature, history, law, and education.

3.2. Measurement Instrument

The self-report questionnaire covered all five variables in the study: self-regulation, teaching presence, social presence, learning engagement, and learning persistence (see Appendix A). A few minor modifications were made to the questionnaire to meet the BSL environment. On a seven-point Likert scale, the students assessed the questionnaire items from 1 (strongly disagree) to 7 (strongly agree). The reliability of the variables was measured by Cronbach's Alpha and composite reliability (CR). As indicated in Table 1, Cronbach's Alpha and CR of all variables in this study reached the acceptable level of 0.70 [60] and 0.60 [61], respectively.

Table 1. List of measurement instruments.

Variables		# Of Items	Source	Scales	Cronbach's Alpha	Composite Reliability
self-regulation	——	9	Pintrich and De Groot (1990) [62]	7-point Likert scale	0.872	0.874
teaching presence	Design and organization Facilitation discourse Direct instruction	13	Arbaugh et al. (2008) [63]	7-point Likert scale	0.943	0.943
social presence	Affective expression Open communication Group cohesion	9	Arbaugh et al. (2008) [63]	7-point Likert scale	0.879	0.880
learning engagement	Behavioral engagement Emotional engagement Cognitive engagement	12	Sun and Rueda (2012) [48]	7-point Likert scale	0.898	0.900
learning persistence	——	6	Shin (2003) [64]	7-point Likert scale	0.874	0.877

Note. N = 319.

3.3. Data Analysis

The data were analyzed using the statistical software SPSS v.24 and Amos v.24. First, we conducted the descriptive statistical analysis and correlation analysis as a preliminary analysis. Second, the goodness-of-fit metrics ($\chi2/df$, CFI, TLI, RMSEA, and SRMR) were computed to ensure the hypothesized model was suitable for further analysis. Then, structural equation modeling (SEM) was conducted to explore the relationships among self-regulation, teaching presence, social presence, learning engagement, and learning persistence in BSL. Finally, bootstrapping with 5000 resamples was performed to test the mediation effects of learning engagement in the relationship between predictors (i.e., self-regulation, teaching presence, social presence) and learning persistence.

4. Results

4.1. Descriptive Statistics and Correlations

We performed descriptive statistics and correlation analysis to obtain a complete picture of the collected data. Descriptive statistics and correlations of the measured variables are presented in Table 2. The mean and standard deviations ranged from 5.33 to 5.69 and from 0.68 to 0.86, respectively. At the alpha level of 0.05., all of the correlations between the variables were significant.

Table 2. Descriptive statistics and correlations of study variables.

Variables	1	2	3	4	5
1. SR	1				
2. TP	0.59 **	1			
3. SP	0.66 **	0.61 **	1		
4. LE	0.67 **	0.72 **	0.68 **	1	
5. LP	0.69 **	0.55 **	0.60 **	0.67 **	1
Mean	5.63	5.69	5.33	5.53	5.61
SD	0.68	0.86	0.81	0.70	0.85
Skewness	−0.86	−0.58	−0.57	−0.31	−0.34
Kurtosis	0.40	0.09	−0.11	−0.64	−0.61

Note. N = 319, ** $p < 0.01$. SR = Self-regulation, TP = Teaching presence, SP = social presence, LE = Learning engagement, LP = Learning persistence.

4.2. Testing the Hypothesized Model

This study used SEM analysis to measure the structural relationships among variables. Before the analysis of the hypothesized model, we calculated the goodness-of-fit metrics of the model. The model fit is good when $\chi2/df < 3.0$, CFI > 0.90, TLI > 0.90 [65], RMSEA $\leq$ 0.05, and SRMR < 0.08 [66]. However, some of the model fit metrics were not within the acceptable range due to the expanded chi-square values caused by the non-multivariate normality [67,68]. For this reason, we used the Bollen-Stine bootstrap method to correct the model fit metrics [68]. By using the Bollen-Stine bootstrap and 2000 corrections, we found that the model fit metrics ($\chi2$ = 1367.956; df = 1117; $\chi2$ /df = 1.225; CFI = 0.972; TLI = 0.970; RMSEA = 0.027; SRMR = 0.053) were all acceptable. These indices suggested that hypothesized model analysis can be performed.

The hypothesized model with standardized coefficients is presented in Figure 2. The findings of the direct effects between the variables in this research are given in Table 3. First, teaching presence held the highest correlation with learning engagement (β = 0.389, $p < 0.001$), followed by social presence (β = 0.297, $p < 0.001$), and self-regulation (β = 0.277, $p < 0.001$) in BSL, thereby supporting H1a, H1b, and H1c. Second, self-regulation (β = 0.489, $p < 0.001$) and learning engagement (β = 0.377, $p < 0.001$) was positively related to learning persistence in BSL, supporting H2a and H2d. However, teaching presence (β = −0.031,

p = 0.654) and social presence (β = 0.049, *p* = 0.550) had no significant impact on learning persistence in BSL, suggesting that H2b and H2c was not supported. In brief, except for the effects of (1) social presence on learning persistence and (2) teaching presence on learning persistence, the rest of the direct effects were significant.
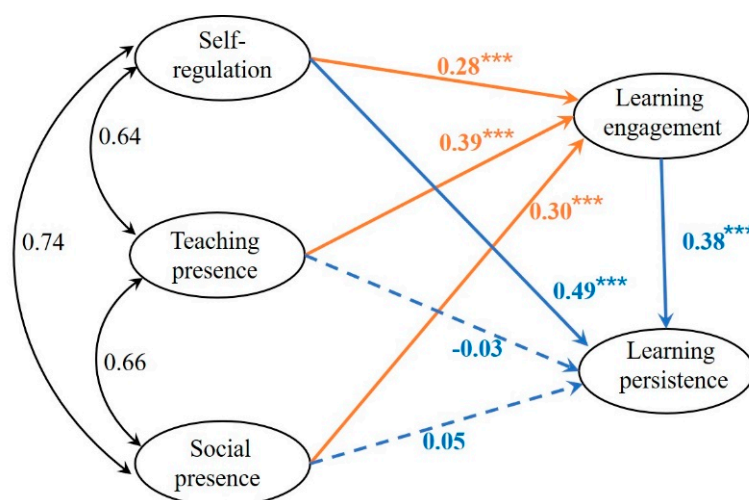

Figure 2. Hypothesized model with standardized path coefficients. Note: N = 319, *** *p* < 0.001.

Table 3. Path coefficients of the hypothesized model.

Latent Variable	Observed Variable	Estimates (B)	Standardized Estimates (β)	S.E.	C.R.	Supported
Learning engagement	Self-regulation	0.315	0.277 ***	0.081	3.901	Yes
	Teaching presence	0.301	0.389 ***	0.048	6.265	Yes
	Social presence	0.289	0.297 ***	0.071	4.068	Yes
Learning persistence	Self-regulation	0.576	0.489 ***	0.104	5.529	Yes
	Teaching presence	−0.025	−0.031	0.056	−0.448	No
	Social presence	0.049	0.049	0.082	0.598	No
	Learning engagement	0.389	0.377 ***	0.100	3.885	Yes

Note. N = 319, *** *p* < 0.001.

4.3. Mediation Analysis

Bootstrapping analyses were conducted to assess the mediation effects. In the present study, we assumed that learning engagement mediated the relationship between each predictor (i.e., self-regulation, teaching presence, social presence) and learning persistence. To exam the indirect effects of the predictors through learning engagement, we conducted bias-corrected percentile bootstrapping and percentile bootstrapping at a 95% confidence interval with 5000 bootstrap samples [69].

The results of the bootstrapping analysis are reported in Table 4. First, self-regulation had both direct effect (β = 0.489, *p* < 0.05) and indirect effect (β = 0.104, *p* < 0.05) on learning persistence, which indicated that learning engagement partly mediated the relationships between self-regulation and learning persistence. Second, the indirect effect of teaching presence on learning persistence was significant (β = 0.147, *p* < 0.05), but it did not have a significant direct effect, indicating that learning engagement completely mediated the association between teaching presence and learning persistence. Third, the indirect effect of social presence on learning persistence was significant (β = 0.112, *p* < 0.05), but the direct effect was not, which indicating that learning engagement played a completely mediating role in the link between social presence and learning persistence. Thus, H3 was supported.

Table 4. Total effects, indirect effects, and direct effects of the model.

	Point Estimate	Product of Coefficients		Bias-Corrected Percentile 95% CI			Percentile 95% CI		
		S.E.	Z	Lower	Upper	Two-Tailed Significance	Lower	Upper	Two-Tailed Significance
Total effect									
SR→LP	0.593	0.129	4.597	0.468	0.981	0.000 ***	0.46	0.967	0.000
TP→LP	0.116	0.058	2	−0.027	0.199	0.132	−0.022	0.203	0.107
SP→LP	0.161	0.094	1.713	−0.027	0.347	0.088	−0.026	0.348	0.086
Indirect effect									
SR→LE→LP	0.104	0.056	1.857	0.038	0.253	0.003 **	0.039	0.256	0.002
TP→LE→LP	0.147	0.043	3.419	0.045	0.217	0.001 **	0.042	0.209	0.002
SP→LE→LP	0.112	0.056	2	0.03	0.245	0.002 **	0.03	0.248	0.002
Direct effect									
SR→LP	0.489	0.137	3.569	0.323	0.866	0.000 ***	0.302	0.847	0.000
TP→LP	−0.031	0.066	−0.47	−0.17	0.094	0.655	−0.161	0.101	0.739
SP→LP	0.049	0.108	0.454	−0.171	0.252	0.637	−0.177	0.245	0.684

** $p < 0.01$; *** $p < 0.001$. Mediators: Learning Engagement (LE).

5. Discussions

The study aimed to explore the predictors for students' learning engagement and persistence in BSL. To respond this, empirical research was conducted. The main findings and implications are concluded below.

5.1. The Predictors of Learning Engagement

Firstly, we found self-regulation was positively related to learning engagement, which is the same as the previous findings in distance education [48] and the flipped learning of college students [30]. This finding indicates that self-regulation can effectively improve learning engagement in a BSL environment. Students with a high level of self-regulation are good at managing time, controlling learning and process, and adjusting learning strategies timely [70]. In this way, students could keep their focus on the course, whether in an online context or an on-campus context. In this study, even if the students attended an online course at home, they were able to monitor their learning process without distraction. When students were better able to engage in blended synchronous courses, their participation in turn led to learning engagement [71]. Therefore, in BSL, teachers should pay more attention to students with low levels of self-regulation and adopt some strategies to help them. Metacognitive strategies are emphasized in blended learning environments to promote self-regulation [21], teachers in the BSL course can guide students to make plans, estimate the time needed to complete tasks, and choose appropriate learning methods.

Secondly, teaching presence held a significant positive correlation with learning engagement. Compared with the other two predictors (i.e., self-regulation, social presence), teaching presence had the strongest correlation with learning engagement. This is supported by Szeto [55], who revealed that teaching presence was an essential factor in facilitating the effectiveness of BSL. One possible explanation is that the instructor-constructed designs and facilitations were effective in increasing student engagement. In BSL, teaching presence takes a prominent role in achieving the desired learning goals [55]. As for the courses involved in this study, the instructor of the BSL gave detailed activity instructions and task guidance to both face-to-face and remote students, which facilitated student participation in the activities. As stated by Wang and Stein [54], direct instruction of the teachers is beneficial in enhancing students' emotional engagement. In this study, instructors prompted students to engage in productive dialogue, guided the class towards the

blended synchronous course topics, and provided timely feedback. Direct instructions from the instructors prompted students to feel excited and interested in the content. To some extent, students' learning engagement is enhanced. Furthermore, in BSL, teacher's assessment of student performance increases students' behavioral engagement. This is because evaluation may assist students to recognise learning issues and direct them to further research [72]. For remote students, in particular, teacher evaluations could make them feel noticed and more engaged in the activities. Therefore, to improve students' learning engagement in BSL, some designed instructional strategies, such as designing well-structured blended synchronous courses, and providing adequate opportunities for students to participate in activities, should be seriously considered.

Thirdly, social presence was positively linked to learning engagement, which is in line with the findings of MOOCs [58] and a large university class [30]. Learning is a social process [73,74]. For students, interaction with peers or teachers is an integral part of learning. Thus, social presence, meaning open communication and emotional expression of the learners, is crucial in the learning process. In this study, social presence positively influenced students' learning engagement through instructional activities that involved remote students and on-campus students synchronously. In the process of the activity, the instructor asked students to evaluate each other to develop a sense of interaction. Gradually, students' social identities were developed and their perceived social presence was enhanced. Social presence enhances students' sense of authenticity during interpersonal interactions [57] and facilitates group cohesion and group efficacy [75]. As a result, students were more inclined to complete course tasks with a community of peers, increasing learning engagement in BSL. To promote student engagement in BSL, there should be a focus on interaction to enhance the students' perceived social presence. For example, both instructors and face-to-face students put more effort into the integration of remote students [2].

5.2. The Predictors of Learning Persistence

Firstly, self-regulation held a significant positive correlation with learning persistence. This suggests that learners' self-regulation not only in online learning environments [49,50], but also in BSL situations, has a beneficial effect on learning persistence. Given the important role that self-regulation plays in helping students persist in BSL, learners should be aware of the need to continuously improve students' self-regulation. Furthermore, teachers should focus on scaffolding, interaction, and other attributes that are supportive of learners' self-regulation [76]. These attributes would promote learners to have a better level of self-regulation and increased their desire to complete the BSL.

Second, the results indicated that teaching presence was not significantly associated with learning persistence. However, it did have a positive relationship with learning engagement. These results are somewhat unexpected and contradict previous findings of a significant relation between teaching presence and learning persistence in MOOCs and e-learning environments [29,34]. One reason for this may be that BSL environments are different from MOOC and e-learning environments. BSL environments are more complex due to the inclusion of both online and offline scenarios. In the BSL setting of this study, teachers had to focus on both remote students and on-campus students when conducting instructional operations. This somewhat affected the effectiveness of teachers' instruction and, in turn, the students' learning in BSL. Although the teaching presence did not directly affect learning persistence, it did indirectly affect learning persistence through learning engagement. This suggests that if teachers help students engage behaviorally, emotionally, and cognitively in BSL, students will persist in learning. Therefore, we recommend increasing students' learning engagement in a BSL setting. Specifically, instructors should establish a trusting relationship with students at the beginning of the semester and clearly explain how the BSL course will unfold and the corresponding expectations [77].

Third, social presence was not found to be significantly related to learning persistence. However, social presence did positively predict learning engagement. These results are also

unexpected and inconsistent with Liu et al. [59], who discovered that social presence was a significant predictor of persistence rates in an online course. This may be related to the fact that BSL faces difficulties in curriculum design, student interaction and technology and is therefore more challenging than online learning [3]. In terms of the technical challenges of BSL, as highlighted by existing research [1,5], remote students often do not receive the same audio quality as face-to-face students. In this study, remote students sometimes could not communicate smoothly with classroom students due to inconsistent audio quality, which affected their learning to a certain extent. Although social presence did not show a positive impact on learning persistence, it could indirectly affect learning persistence through learning engagement. This result suggests that in BSL, enhancing students' engagement from a social perspective helps students persist in their learning. Therefore, measures based on a social perspective should be taken to increase students' engagement in learning, such as encouraging students to express their ideas boldly, increasing open communication among students, and enhancing class cohesion.

Fourthly, learning engagement was positively associated with learning persistence. In addition, learning engagement served as a mediator between self-regulation, teaching presence, social presence, and learning persistence. This study is in accordance with prior research findings regarding the significant link between learning engagement and learning persistence [39,40]. This finding shows that the role of learning engagement in BSL should be fully emphasized. When students are actively engaged in BSL, they are physically and energetically focused on what they are learning. As a result, they are likely to achieve the expected learning outcomes. Achieving expected outcomes gives students motivation to better overcome the temptations and obstacles in the learning process, and ultimately motivates them to persist in their learning over time.

6. Limitations, Future Research, and Conclusions

The present study has a few limitations that should be pointed up. First, it should be cautious to generalize the findings to other BSL settings. The main reason is that non-random sampling may have led to sample bias. Although the participants in this study were students from different majors and grades, they may not be representative of the entire college student population. This is because the participants were recruited from a selected course at one university. More populations that met the study criteria (e.g., BSL learners in different educational settings) were not included in the survey population. This threatens the external validity of the conclusions. Moreover, the limited sample size reduces the generalization of the study findings to some extent. Second, this study relied heavily on student self-reports, rather than actual log data or completion rates as evidence of BSL results. Third, the specific role of the dimensions of the variables has not been explored in depth. For example, teaching presence is a multifaceted variable. This study only gives a general understanding of teaching presence.

The future studies can be improved in the following ways. First, random sampling methods should be used to ensure the study objective is randomly identified from all BSL participants. A greater number of students and schools from various levels should be involved. By doing so, the research can provide stronger evidence and lead to more generalizable conclusions. Second, data collection methods should be expanded to increase the diversity of data. Log data can be used as an objective measure to analyze variables, since most information about the BSL process is stored as log data. As the use of learning analytics grows, future studies may gather large amounts of BSL learning data (e.g., BSL completion rate) and apply data science techniques to these data. In addition, qualitative methods, including in-depth interviews and observations, can be used to reveal the hidden aspects involved in the results. Third, the detailed analysis of these variables is required. Future research should explore the relationship among the sub-dimensions of teaching presence, learning engagement, and learning persistence in a BSL setting.

BSL is becoming increasingly popular in higher education institutions because of its accessibility and flexibility. In the event of a disaster (such as the COVID-19 pandemic),

the BSL approach can be considered to ensure educational continuity. However, few studies have examined student engagement and persistence in BSL and the predictors that influence them. The current study explored predictors of student engagement and persistence in BSL from learner self-regulation, pedagogical, and social perspectives at a Chinese university. The results indicated that (1) self-regulation, teaching presence, and social presence were positively related to learning engagement. (2) Self-regulation and learning engagement were positively related to learning persistence. (3) Learning engagement had indirect effects on the relationships between the predictors (self-regulation, teaching presence, social presence) and learning persistence. These findings have theoretical and practical implications for improving student engagement and persistence in BSL. Theoretically, this comprehensive model builds a bridge among learning engagement, learning persistence, and the variables that might predict them, providing insights for improving student engagement and persistence in BSL. Practically, this research provides scientific practical instructions to improve students' learning engagement and persistence in BSL from learners' self-regulation, pedagogical, and social perspectives.

Appendix A. Measurement Scales Used in This Study

Table A1. Self-regulation scale.

NO.	Items	M	SD
1	I ask myself questions to make sure I know the material I have been studying.	5.63	0.928
2	When work is hard I either give up or study only the easy parts. (*R)	5.70	0.923
3	I work on practice exercises and answer end of chapter questions even when I do not have to.	5.70	0.988
4	Even when study materials are dull and uninteresting, I keep working until I finish.	5.87	0.931
5	Before I begin studying I think about the things I will need to do to learn.	5.49	1.087
6	I often find that I have been reading for class but do not know what it is all about. (*R)	5.61	0.918
7	I find that when the teacher is talking I think of other things and do not really listen to what is being said. (*R)	5.38	0.993
8	When I'm reading I stop once in a while and go over what I have read.	5.73	0.908
9	I work hard to get a good grade even when I do not like the blended synchronous course.	5.50	0.968

*R, reverse worded item.

Table A2. Teaching presence scale.

NO.	Items	M	SD
1	The instructor clearly communicated important blended synchronous learning topics.	5.86	1.008
2	The instructor clearly communicated important blended synchronous learning goals.	5.85	0.979
3	The instructor provided clear instructions on how to participate in blended synchronous course learning activities.	5.75	0.997
4	The instructor clearly communicated important due dates/time frames for blended synchronous learning activities.	5.97	1.014
5	The instructor was helpful in identifying areas of agreement and disagreement on blended synchronous learning topics that helped me to learn.	5.48	1.151
6	The instructor was helpful in guiding the class towards understanding blended synchronous learning topics in a way that helped me clarify my thinking.	5.56	1.209
7	The instructor helped to keep blended synchronous learning participants engaged and participating in productive dialogue.	5.60	1.161
8	The instructor helped keep the blended synchronous learning participants on task in a way that helped me to learn.	5.69	1.052
9	The instructor encouraged blended synchronous learning participants to explore new concepts in this course.	5.65	1.199
10	Instructor actions reinforced the development of a sense of community among blended synchronous learning participants.	5.77	1.091
11	The instructor helped to focus discussion on relevant blended synchronous learning issues in a way that helped me to learn.	5.78	1.109
12	The instructor provided feedback that helped me understand my strengths and weaknesses relative to the blended synchronous learning's goals and objectives.	5.40	1.209
13	In the blended synchronous learning environment, the instructor provided feedback in a timely fashion.	5.57	1.254

Table A3. Social presence scale.

NO.	Items	M	SD
1	Getting to know blended synchronous learning participants gave me a sense of belonging in the course.	5.29	1.212
2	I was able to form distinct impressions of some blended synchronous learning participants.	5.18	1.199
3	A blended synchronous learning environment is an excellent medium for social interaction.	5.17	1.165
4	I felt comfortable conversing through the blended synchronous learning medium.	5.53	1.101
5	I felt comfortable participating in the blended synchronous learning discussions.	5.39	1.122
6	I felt comfortable interacting with blended synchronous learning participants.	5.29	1.130
7	I felt comfortable disagreeing with other blended synchronous learning participants while still maintaining a sense of trust.	5.24	1.114
8	I felt that my point of view was acknowledged by blended synchronous learning participants.	5.33	1.056
9	The discussions in the blended synchronous course help me to develop a sense of collaboration.	5.51	1.121

Table A4. Learning engagement scale.

NO.	Items	M	SD
1	I follow the rules of the blended synchronous courses.	5.60	1.017

Table A4. *Cont.*

NO.	Items	M	SD
2	I participate in activities in the blended synchronous courses (e.g., interactive poll, quiz).	5.67	0.971
3	I am able to consistently pay attention when I am taking the blended synchronous courses.	5.52	0.967
4	I like taking the blended synchronous learning.	5.33	1.077
5	I feel excited by my work in the blended synchronous course.	5.54	1.036
6	The blended synchronous classroom is a fun place to be.	5.75	0.991
7	I feel happy when taking blended synchronous courses.	5.72	0.928
8	When I read the blended synchronous learning materials, I ask myself questions to make sure I understand what it is about.	5.45	0.966
9	If I do not know about a concept when I am learning in the blended synchronous course, I do something to figure it out.	5.68	0.950
10	I try to look for some course-related information on other resources such as journal papers, web pages, etc.	5.47	1.109
11	If I do not understand what I learned in blended synchronous course, I go back to teacher's instructions and learn again.	5.08	1.148
12	I read extra materials to learn more about things we do in the blended synchronous course.	5.53	1.024

Table A5. Learning persistence scale.

NO.	Items	M	SD
1	Completing the blended synchronous learning is important to me.	5.82	0.985
2	I am confident that I can overcome obstacles encountered in the blended synchronous learning.	5.71	1.044
3	I will finish my studies in the blended synchronous learning no matter how difficult it may be.	5.66	1.106
4	I will certainly finish the blended synchronous learning of this semester.	5.25	1.192
5	I am not likely to continue my studies in the blended synchronous learning. (*R)	5.74	1.078
6	I would like to quit my studies in the blended synchronous learning. (*R)	5.50	1.121

*R, reverse worded item.

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