

Research Article

Exploring the mediating effect of academic self-efficacy and self-regulated learning in the relationship between teaching, social presences and cognitive presence

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This study investigates vocational students' blended learning from the perspective of the extended Community of Inquiry framework (incorporating learning presence as the fourth presence), and examine the mediating role of academic self-efficacy and self-regulated learning (two constructs that we label 'learning presence') in the effect of teaching, social presences on cognitive presence in a blended learning environment. The research model is based on environmental factor (teaching presence and social presence), personal factor (learning presence) and cognitive presence as an outcome. A cross-sectional survey was conducted on 538 students from 4 vocational colleges in Hebei province, China. Structural equation modelling results indicate that 1) teaching, social and learning presences are co-predictors of cognitive presence; 2) learning presence significantly mediates the effect of teaching, social presences on cognitive presence through self-regulated learning and academic self-efficacy; 3) academic self-efficacy positively influence self-regulated learning. The findings of this study revealed the critical role of learning presence in fostering cognitive development and positive interaction with the blended learning environments. Implications for interventions for blended teaching design are discussed with a focus on enhancing students' presences and academic self-efficacy to facilitate students' self-regulated learning and cognitive development.

Keywords: Academic self-efficacy; Blended learning; Cognitive presence; Self-regulated learning; Social presence; Teaching presence

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1. Introduction

In recent years, vocational education institutions have devoted great effort to the development of blended learning [BL] format, which integrates modern information & communication technology [ICT], rich online learning resources with traditional face-to-face classroom. BL is holding paramount importance in contemporary vocational education, significantly influence students' learning experiences (Bliuc et al., 2012; Rafiq et al., 2022; Wang & Han, 2020) and catering to diverse learning styles and preferences (Asarta & Schmidt, 2017; Wang et al., 2016). In an age marked by information explosion, students' cognitive development (e.g., critical and reflective

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thinking skills, the ability to identify, explore and solve real-world problems) is most often cited as the primary task of contemporary education (Garad et al., 2021).

In order to better understand students' blended learning process, Community of Inquiry [COI] framework with its three interrelated COI presences, namely teaching presence [TP], social presence [SP] and cognitive presence [CP] is considered a robust framework for probing into students' blended learning behaviours and experiences (Akyol & Garrison, 2012; Stenbom, 2018; Wertz, 2022). Specifically, TP plays a pivotal role in facilitating meaningful learning experiences in BL environments. It illustrates to what extent the teachers can provide high-quality course designing, instructional support and guidance for the students' learning (Garrison & Arbaugh, 2007). While SP refers to the capacity of students to communicate and collaborate with their peers and instructors via the medium of communication technologies in a social and emotional manner. Teacher-student meetings in BL always take place virtually, therefore, using telecommunication techniques to create a sensation of consciousness or being in a virtual classroom could be a representation of presence (Fan et al., 2022). On the contrary, lacking of informal or nonverbal contact might lead to a sense of isolation (Wut & Xu, 2021). More importantly, CP is defined as "the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry". Therefore, CP is regarded as an important indicator of BL quality since it consists of authentic process of students' cognitive development, namely triggering event, exploration, integration and problem resolution with the help of well-designed teaching activities and peers collaboration (Akyol & Garrison, 2008; Garrison et al., 1999). Put differently, students' knowledge acquisition and cognitive development can be potentially supported by these environmental facilitators (Casimiro, 2016; Garrison et al., 2010; Shea et al., 2006). The integration of COI framework within BL for vocational education presents a promising avenue for nurturing students' cognitive development, which is indispensable for navigating the multifaceted challenges in all walks of life (Okros, 2020).

However, according to Bandura's Social Cognitive theory [SCT], human's cognitive behaviours are dynamically constructed by both individual and environmental factors (Bandura, 1999; Wertz, 2022), especially in BL context where students' self-directive inquiry became a decisive factor for successful learning. Researchers has been argued that the COI model does not pay enough attention to the role of learners themselves, some researchers incorporated 'learning presence' as the forth presence to represent students' contribution to learning, including self-regulated learning [SLR] and academic self-efficacy [ASE] dimensions (ElSayad, 2023; Hayes et al., 2015; Honig & Salmon, 2021; Shea & Bidjerano, 2010). The term academic self-efficacy describes a student's confidence in their capacity to complete particular academic assignments. This kind of self-belief has an impact on how hard students work, their perseverance when they in the face of setbacks, and eventually the cognitive development (Bandura, 1999). While self-regulated learning refers to the process by which students actively manage their own learning by setting goals, monitoring their progress, and regulating their thoughts, behaviours, and emotions to achieve desired outcomes. It is a critical aspect of effective and autonomous learning, emphasizing the active role of the students themselves in the learning process (Zimmerman, 2008). It is enlightening that students with a high level of self-belief and self-discipline show more perseverance in face of setbacks, more willing to engage in course learning and peers collaboration, therefore, gaining deeper cognitive development and realize successful learning goals (Doo et al., 2023).

With the pivotal role of learning presence has been highlighted recent years, increasing number of researchers attempt to explore how this extended COI framework (incorporated with learning presence) can facilitate students' cognitive development and gain a deeper understanding of BL process. At the same time, new requirements and issues arise as a result of the daily advancements in technology (Rasheed et al., 2020). The person-environment interactions in BL context are presumably ubiquitous but intricate due to the diversity of both environment and learners' internalization mechanism (Capone, 2022; Han & Ellis, 2020; Sunnemark et al., 2023; Zhang, 2020). However, seldom studies have delved in students' learning presence to examined its internal

mechanism on a sub-dimension level as well as their interactions with external environmental factors, especially for the BL scenarios in vocational colleges. In view of this, this study concerns learning presence from the mental (academic self-efficacy) and behavioural (self-regulated learning) dimensions, endeavours to examine how students' teaching, social and learning presences (academic self-efficacy and self-regulated learning) impact on cognitive presence under BL context. Besides, this study pays special attention on learning presence's mediating effect between environmental factors (teaching, social presences) and cognitive presence.

2. Literature Review and Research Hypothesis

2.1. Learning Presence towards Academic Self-efficacy and Self-regulated learning

In BL, students' subjective initiative is especially crucial to learning efficiency, since students are not passive recipients of knowledge, but the main administer of learning behaviours, the degree to which students can take responsibility for their own learning is a critical factor of successful learning (Shea & Bidjerano, 2010). In view of this, learning presence [LP] was firstly introduced as the fourth presence to COI framework by Shea and Bidjerano (2010) to highlight the students' role in BL (Shea & Bidjerano, 2010). Specifically, LP is widely defined by academic self-efficacy [ASE] and self-regulated learning [SRL] as mental and behavioural dimensions, which are driven by students' perceptions with the course learning, willingness to participate and adaptability to the learning environment (Schunk & Zimmerman, 2011; Shea & Bidjerano, 2010). Prior studies have proved that students with higher academic self-efficacy (confidence, expectation) and self-regulation (goal setting, self-discipline, strategy use, self-assessment and self-monitoring) are more likely to perform better in cognitive development (Broadbent et al., 2021; Broadbent & Poon, 2015; Honicke & Broadbent, 2016; ElSayad, 2023; Zheng et al., 2023) and promising learning outcomes (Barnard et al., 2009; Pintrich & De Groot, 1990; Shea & Bidjerano, 2010; Wertz, 2022; Zimmerman, 2008).

More specifically, Wertz (2022) defined SRL from three aspects: motivation, behaviour, and development. 'Motivation' represents students' learning impetus sourced from curiosity, positive affect and perceived usefulness. The 'behaviour' dimension reflects students' self-disciplinary behaviours, while the 'development' component describes students' willingness to meet challenges and gain personal development. Students with higher levels of self-regulation prone to persevere and employ effective tactics to accomplish goals, particularly when faced with challenging assignments. These offer a particular viewpoint for figuring out how self-regulated learning and cognitive development relate to one another in contemporary BL context.

Of particular interest, it has been found that the degree of self-regulated learning not only depend on various contexts and individuals but also within the same person over time since it is both socially and contextually (Credé & Phillips, 2011). Put differently, apart from the ever-changing external environment, the personal determinant also has a predictive effect on students' self-regulative behaviour. In education field, a person's belief of their own ability to successfully perform in academic tasks is known as academic self-efficacy (another potential aspect of LP), and it influences their decision making and persistence in particular circumstances. Students with higher academic self-efficacy are more likely to possess higher determination, confidence in tasks accomplishment and social interactions (Schunk & Zimmerman, 2011). In view of this, academic self-efficacy can acts as an forethought and impetus to stimulating learning behaviours (Zimmerman & Campilo, 2003); consequently exert diverse effects on human's behavioural mode (such as self-regulation and persistence) in the face of challenges.

Increasing evidences have indicated that the extended COI framework with four presences reached a more comprehensive model to understand and design online or blended learning environment (Cho et al., 2017; ElSayad, 2023; Hu et al., 2023; Zhong et al., 2022). However, as an emerging construct, the internal structure of LP and its interaction with other COI presences require further investigation in contemporary BL contexts. Hence, the present study explores

learning presence's role in COI framework from the perspective of academic self-efficacy and self-regulated learning in a BL environment.

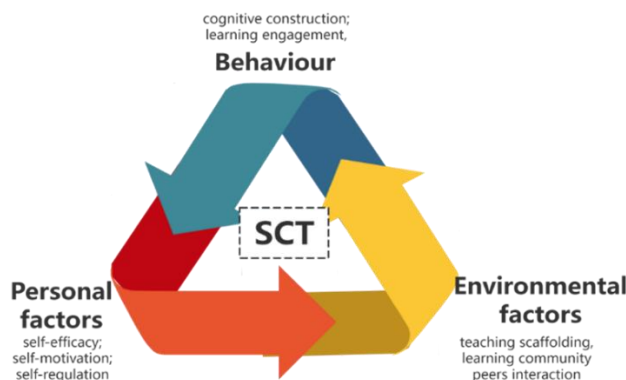
2.2. Cognitive Development as an Outcome of Environmental and Personal Factors

Drawing upon Social Cognitive Theory and COI framework, students' cognitive development is conceptualized as an outcome of the synergistic mechanism of teaching environment and personal factors, as illustrated in Figure 1. Environmental factors describe the teaching scaffolding (activities or strategies designed by teachers) and social interactions (communication, collaboration and group cohesion with peers) in the shared learning community, which can be represented by TP and CP in the COI framework. While personal factors such as self-beliefs (academic self-efficacy) and the ability to regulate learning (self-regulated learning), are expected to play a connecting role between the external environment and the knowledge internalization caused by cognitive behaviour (Geng et al., 2019; Honig & Salmon, 2021; Hu et al., 2023). Students may be particularly benefit from an appropriate "person-environment fit" when their personal characteristics are matched with the environmental conditions (Rocconi et al., 2020). It is believed that this match promotes effective learning outcomes and cognitive growth.

Acknowledging different ways that self- and environmental influence on human's cognition, this study primarily focuses on how environmental factors (teaching, social presences) affect personal factors (learning presence: academic self-efficacy and self-regulated learning), and further contribute to facilitate students' cognitive presence, particularly paying attention to the mediating role of learning presence between environmental factors and cognitive presence.

Figure 1

Social Cognitive Theory from Bandura (1999)



2.3. Hypothesis Development

According to the above analysis, this study takes teaching, social presences from COI framework as two important environmental factors (independent variables); learning presence as the personal determinant including academic self-efficacy and self-regulated learning dimensions (mediators); and cognitive presence serves as an outcome of the environment-person interaction (dependent variable).

Based on the above settings, this study hypothesizes that teaching, social presences can positively impact on learning presence (academic self-efficacy and self-regulated learning), and further exert influence on cognitive presence. Additionally, academic self-efficacy and self-regulated learning are assumed to be the mediators between teaching, social presences and cognitive presence. The corresponding research hypothesis are developed as below, and the conceptual framework involves five key variables in this study is presented in Figure 2.

H1 (a, b, c): TP has a positive impact on (academic self-efficacy, self-regulated learning, cognitive presence) of vocational students.

H2(a, b, c): SP has a positive impact on (academic self-efficacy, self-regulated learning, cognitive presence) of vocational students.

H3: Academic self-efficacy has a positive impact on self-regulated learning of vocational students.

H4: Academic self-efficacy has a positive impact on cognitive presence of vocational students.

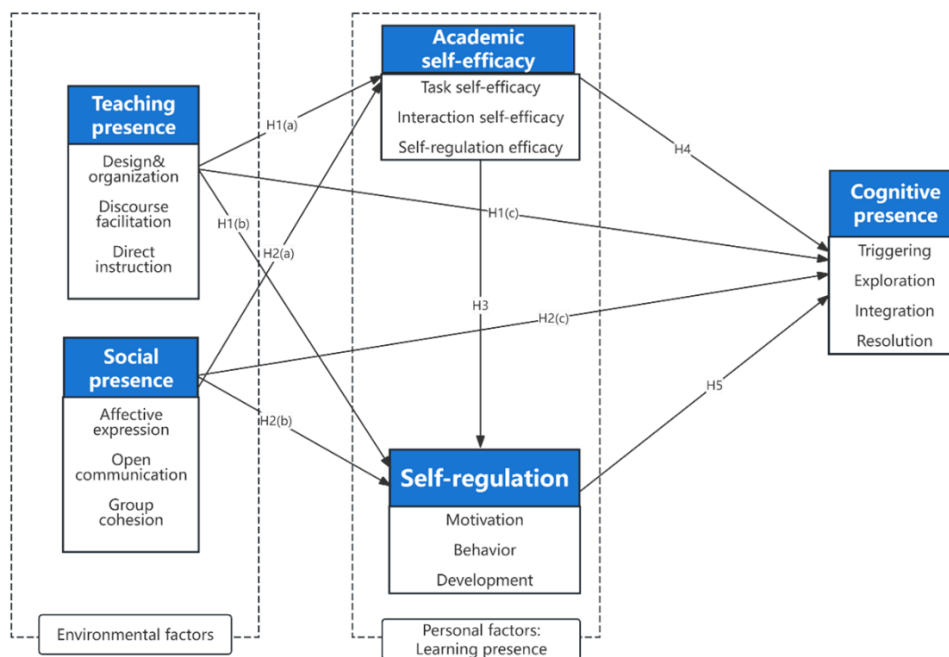
H5: Self-regulated learning has a positive impact on cognitive presence of vocational students.

H6 (a, b): Academic self-efficacy mediates the relationship between (TP and CP, SP and CP) of vocational students.

H7 (a, b): Self-regulated learning mediates the relationship between (TP and CP, SP and CP) of vocational students.

Figure 2

Conceptual framework of this study



3. Methodology

Quantitative survey research design was employed to testify the hypothesis. Structural equation modelling [SEM] approach was used in this study to test the influencing paths among multiple variables simultaneously, as well as the extent to which academic self-efficacy and self-regulative learning mediate the influence of teaching, social presences toward cognitive presence respectively in BL environment.

3.1. Participants and Context

This study was a cross-sectional design and data were collected from vocational colleges in Hebei province, China. Hebei is a key province with a large educational population and actively develops the combination of vocational education and information technology, especially in wake of the COVID-19 pandemic in recent years.

A stratified random sampling was used to select participants. Firstly, considering the influence of informatization construction level and blended teaching mode of school, four vocational colleges in Hebei were selected. Secondly, third-year students who took blended courses in Semester 2 of 2023-2024 were invited to participate in this study. We chose third-year students due to the fact that the fifth semester is a pivotal semester that focus on the core professional courses. Next step, Krejcie and Morgan' table was used to determine the sample size of each college

according to the total third-year enrolment (Krejcie & Morgan, 1970). A total of 545 participants were finally included in the data analysis.

In order to better take advantages of online resources and physical classroom teaching, these colleges adopt blended teaching (online and offline) mode where the teachers provide learning materials in forms of video and audio on the platform to be facility in online learning. Besides, teachers also interpret the goals and schedule of the curriculum, and provide the task list before each class. During the limited face-to-face classroom time, teachers can focus on action demonstration, students' presentations and exercises, and spot evaluation by the teachers against the practice of the students. After class, teachers assign individual homework and group tasks for students to consolidate the knowledge. Besides, with the utilization of the discussion board in Chaoxing learning platform and WeChat APP, students can collaborate together to solve problems in a shared learning environment.

All participants were informed with the study aim and consent forms by the researchers; they understood that participation was entirely voluntary and their answers would be kept completely secret. Online questionnaires were generated by Wenjuanxing platform and distributed as a QR code via email to every participant. In view of the outliers who didn't response carefully, the response with reaction times shorter than 60 seconds were eliminated. As a result, a total of 538 eligible responses were obtained. Among the 538 participants from four vocational colleges, 226 (42%) were male and 312 (58%) were female.

3.2 Instruments

The survey instruments for teaching, social, cognitive presences were the 34-item measurement scale developed by Arbaugh et al. (2008), which is a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). To measure participants' academic self-efficacy in accordance with the context of this study, the author selected items from scales developed by Jia et al. (2023), emphasizing that students not only engage in independent inquiry but also in social interaction and cooperative learning behaviors in BL environment. With respect to self-regulated learning, the instrument was synthesized based on questionnaires developed by Wertz (2022), Shea and Bidjerano (2010) and Zheng et al. (2023), taking the motivation (3 items), behavioral control (8 items) and self-development (3 items) aspects into consideration. The details of the scales are displayed in Table 1.

In the process of determine the measurement scales, it is important to emphasize the real situation of the BL format, where students' self-inquiry, interactions (interactions between student-student, student-content, and student-teacher) and collaboration are all playing crucial role in students' cognitive development during the whole BL process, the questionnaire items should represent these characteristics as a result. Besides, since the questionnaires were first developed in English and none of our participants is native English speakers in this study, the questionnaires were translated into Chinese by forward and backward translation procedures with a view to avoid misunderstanding.

3.3. Data Analysis

The data analyses were carried out in sequence including measurement model analysis, structural model analysis, and mediation analysis using SPSS 28.0 and Amos 23.0 software. The survey included 59 items from the five latent variables, item parcelling technique was conducted for statistical purposes since this study pays more attention to exploring the causal relationship among variables rather than the specific internal component factors. After verifying each latent variables' measurement construct (reliability and validity), the first-order (lower-order) models were converted into second-order (higher-order) model according to their sub-dimensions as showed in Table 3.

Table 1

List of measurement scales

<i>Variables / Subdimensions</i>	<i>Items</i>	<i>Source</i>	<i>Cronbach's α</i>
Teaching presence		Arbaugh et al., (2008)	0.928
Design and organization	4		
Discourse facilitation	4		
Direct instruction	5		
Cognitive presence			0.928
Triggering events	3		
Exploration	3		
Integration	3		
Resolution	3		
Social presence			0.882
Affective expression	3		
Open communication	3		
Group cohesion	3		
Self-efficacy		Jia et al. (2023)	0.915
Task self-efficacy	3		
Interaction	4		
Self-regulation efficacy	3		
Self-Regulative learning		Wertz (2022); Shea & Bidjerano (2010); Zheng et al. (2023)	0.860
Motivation	3		
Behavior	8		
Development	3		

According to Hair's recommended criterion, the reliability of the measurement model is achieved if Cronbach's α coefficient is higher than .70 and composite reliability [CR] exceeds cut-off level of .70 (Hair et al., 2014). Convergent and discriminant validity of measurement models were examined by confirmatory factor analysis [CFA]. The average communality for each latent factor in a reflective model is revealed by the average variance extracted [AVE] value, which we computed to evaluate the convergent validity (should be higher than the recommended cut-off level 0.50) (Fornell & Larcker, 1981). Since each variable's square root of AVE value was greater than its correlation coefficient with other constructs in this model, discriminant validity was deemed to have been attained. The structural equation model was created following the validation of the measurement models' reliability and validity. The goodness-of-fit indexes for SEM (χ^2/df , CFI, GFI, and RMSEA) were calculated by using bootstrapping method to make sure the model was suitable for further examination (Barrett, 2007; Byrne, 2001).

4. Results

4.1 Descriptive Statistics and Correlations among the Variables

The means of TP, SP, ASE, SRL, and SP were calculated to indicate the general status of BL and the means of them were 3.35, 3.37, 3.10, 2.95, 3.47, respectively (see Table 2), which indicated a medium level among vocational students in Hebei province. The skewness and kurtosis were all fell within the normal distribution (between -1.96 and +1.96). The correlation coefficients among them ranged from .294 to .504 at a significant level of $p < .01$, indicating that significant associations existed among these five variables. Besides, the Cronbach's α values were all above the recommended threshold 0.7, indicating the reliability of our instruments.

Table 2
Results of descriptive analysis

	TP	SP	ASE	SRL	CP
TP		.504**	.345**	.321**	.389**
SP			.383**	.332**	.392**
ASE				.303**	.353**
SRL					.294**
Mean	3.35	3.37	3.10	2.95	3.47
Std.Deviations	.82	.87	.91	.85	.88
Skewness	-.231	-.427	-.224	.076	-.646
Kurtosis	-.795	-.771	-1.186	-1.035	-.715
Cronbach's α	.920	.883	.882	.908	.922

Note. N=538; TP: teaching presence; SP: social presence; ASE: academic self-efficacy; SRL: self-regulated learning; CP: cognitive presence; ** $p < .01$

4.2 Measurement Model

Firstly, CFA was conducted on the five latent variables' subscales using AMOS software, each measurement model's Cronbach's α coefficient, AVE, CR, factor loadings and correlation coefficient between sub-dimensions were checked for model's reliability and validity (discriminant and convergent validity). According to Table 3, each construct's CR value ranged from 0.75 to 0.82 (above the suggested threshold of 0.70), and the AVE value was higher than the suggested limit of 0.50, indicating the reliability and convergent validity of our measurement model.

Table 3
Results of CFA for hypothesized model

Constructs and Sub-dimensions	Factor loading	AVE	CR
TP		0.51	0.75
DO	0.72		
DI	0.75		
DF	0.65		
SP		0.52	0.77
AE	0.75		
OC	0.71		
GC	0.71		
ASE		0.55	0.79
TSE	0.81		
ISE	0.72		
SRE	0.69		
SRL		0.53	0.77
MO	0.72		
BE	0.81		
DE	0.65		
CP		0.54	0.82
TE	0.72		
Exp	0.72		
Int	0.72		
Res	0.76		

Note. N=538, TP: teaching presence; SP: social presence; ASE: academic self-efficacy; SRL: self-regulated learning; CP: cognitive presence; DO: design and organization; DI: direct instruction; DF: discourse facilitation; AE: affective expression; OC: open communication; GC: group cohesion; TSE: task self-efficacy; ISE: interaction self-efficacy; SRE: self-regulated efficacy; MO: motivation; BE: behavior; DE: development; TE: triggering event; EX: exploration; IN: integration; RE: resolution.

The discriminating validity of measurement models were approved since the square root of the AVE value for each construct was higher than its correlation coefficient with any other construct in this model (see in Table 4).

Table 4

Discriminant validity for the measurement model

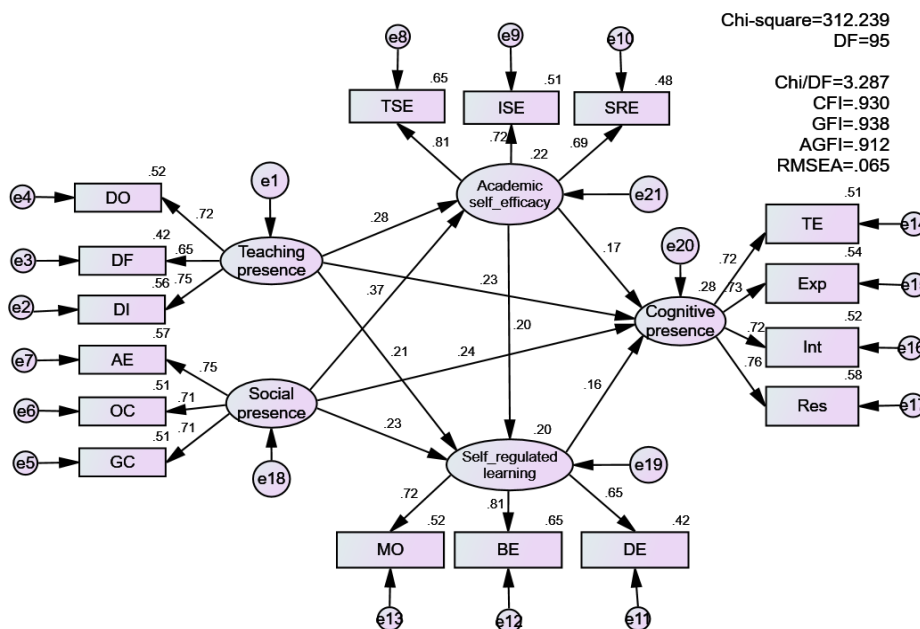
	TP	SP	ASE	SRL	CP	Square root of AVE
TP	-	0.67	.46	.42	.49	.71
SP		-	.49	.43	.50	.72
ASE			-	.40	.43	.74
SRL				-	.40	.73
CP					-	.73

4.3. Structural Model

According to Collier (2020), for the acceptable model fit, the value of χ^2/df should be between 2 to 5. At the same time, both of the value of GFI and CFI should above 0.9, and RMSEA should not greater than 0.08. After the verification, the final structural model's results show $\chi^2/df = 3.287$, GFI = 0.938, AGFI = 0.912, CFI = 0.930 and RMSEA = 0.065, indicating a good model fit (see in Figure 3). In total, the model explained 28% of the variance in cognitive presence ($R^2=.28$). Besides, the R^2 value was 0.22 and 0.20 for academic self-efficacy and self-regulated learning respectively, indicating that 22% variance in academic self-efficacy can be explained by the impact of teaching presence and social presence, whereas 20% change in self-regulated learning by teaching, social presences and academic self-efficacy.

Figure 3

The structural model



In view of that our participants consist of 58% female ($n=312$) and 42% male ($n=226$) students, multi-group SEM was used to examine if significant differences exist between two gender groups. Results are shown in Table 5. First of all, a baseline model is established, and the fitting index of the baseline model is $\chi^2/df = 2.217$; CFI = 0.931, TLI = 0.912, RMSEA = 0.046, indicating that the baseline model fits well with the sample data, which can provide a reference for the cross-group effect verification of the model. The pairwise comparison difference of fitting indexes between the

two models shows that ΔCFI is < 0.05 and the p -value is $> .05$, which indicates that the model has the same measurement construct and structural weights among vocational students of different genders. Thus, gender is not a significant moderator within the COI mechanism.

Table 5

Results of multi-group analysis

<i>Model</i>	χ^2/df	<i>p</i>	<i>CFI</i>	<i>IFI</i>	<i>RMSEA</i>
Measurement weights	2.040	.887	0.932	0.933	0.044
Structural weights	1.882	.977	0.935	0.936	0.041
Measurement residuals	1.768	.996	0.938	0.936	0.038

4.4. Hypothesis Testing

All hypothesized influencing paths in the model were significant at a 95% confidence level. According to Cohen (1988), the Standardized Estimate (β) can represent the size of the influence of independent variables on dependent variables in a SEM or regression analysis. The cut-off values for β were 0.10 for small, 0.30 for moderate, and 0.50 for large effect, respectively. For this study's results, apart from H2(a) had a moderate effect, the other hypothesis had a small but significant effect, so H1 to H5 are all accepted in this study. The outcome of the structural equation modelling with detailed information are shown in Table 6.

Table 6

Paths coefficient for hypothesis 1-5

	<i>Paths</i>	<i>Standardized Estimate (β)</i>	<i>SE</i>	<i>t-value</i>	<i>p</i>	<i>Accepted or not</i>
H1(a)	TP $\rightarrow$ ASE	.284	.074	4.538	***	Yes
H1(b)	TP $\rightarrow$ SRL	.215	.062	3.242	.001	Yes
H1(c)	TP $\rightarrow$ CP	.232	.062	3.658	***	Yes
H2(a)	SP $\rightarrow$ ASE	.372	.072	5.805	***	Yes
H2(b)	SP $\rightarrow$ SRL	.235	.061	3.431	***	Yes
H2(c)	SP $\rightarrow$ CP	.245	.064	3.533	***	Yes
H3	ASE $\rightarrow$ SRL	.204	.049	3.268	.001	Yes
H4	ASE $\rightarrow$ CP	.168	.048	2.800	.005	Yes
H5	SRL $\rightarrow$ CP	.155	.062	2.614	.009	Yes

Note: *** $p < .001$ (two-tailed); $n = 538$.

This study adopted bias-corrected percentile method at a 95% confidence interval with 2,000 bootstrap samples (Taylor et al., 2008) to verify the mediating effects of academic self-efficacy and self-regulated learning in relationships between SP and CP, TP and CP. The mediating effect and its significance can be assessed by examining the direct, indirect, and total effects in the output results. After examining the model, TP was found to had both significant direct ($\beta = 0.232$, $p < .001$) and indirect effects on CP through academic self-efficacy as well as self-regulated learning, with indirect effect of 0.048 and 0.033 respectively. Similarly, SP had a significant direct ($\beta = 0.245$, $p < .001$) and indirect relationship with CP through academic self-efficacy as well as self-regulated learning, with indirect effect of 0.062 and 0.036 respectively. So H6 (a, b) and H7 (a, b) are all accepted in this study. Besides, there were also chain mediating effects through TP (SP) $\rightarrow$ ASE $\rightarrow$ SRL $\rightarrow$ CP at a significant level. The details of the four mediating hypotheses are shown in Table 7.

Table 7
The test of research hypotheses 6 to 7

	Bias-Corrected 95% CI			<i>p</i>	Results
	Estimates	Lower	Upper		
Standardized Total Effects					
TP → CP	.322	0.366	0.604	.004	
SP → CP	.355	0.211	0.445	.011	
Standardized Direct Effects					
TP → CP	.232	.091	.360	***	
SP → CP	.245	.097	.373	***	
Standardized Indirect Effects:					
TP → CP	.090	.046	.150	***	
H6(a): TP → ASE → CP	.048	.010	.089	.008	Supported
H7(a): TP → SRL → CP	.033	.002	.083	.030	Supported
TP → ASE → SRL → CP	.009	.077	.167	.026	
SP → CP	.111	.060	.176	***	
H6(b): SP → ASE → CP	.062	.018	.128	.004	Supported
H7(b): SP → SRL → CP	.036	.004	.089	.020	Supported
SP → ASE → SRL → CP	.013	.069	.128	.021	

Note: ****p* < .001

5. Discussion

Prior literature advocates a holistic approach on the multi-stage nature of student cognitive development. This study extends the understanding of students' cognitive presence in vocational education under blended learning context. The novelty of this study is attributed to the integration of Community of Inquiry model and Social Cognitive Theory in the formation of students' cognitive presence through the nature of blended learning as a coping strategy to contemporary ICT-based education and information explosion era.

The results showed that both teaching and social presence are positive predictors of cognitive presence. Additionally, mediator analysis testified academic self-efficacy's mediating role in the relationship between teaching presence and cognitive presence, as well as between social presence and cognitive presence. These findings are both insightful and aligned with theoretical expectations in the COI framework and Self-efficacy Theory, further underscores the pivotal role of academic self-efficacy in BL. Our conclusions consist with the point of view of Garrison et al. (2010), Shea and Bidjerano (2010), which highlighted teaching presence's positive effect on academic self-efficacy by providing teachers' support in BL and online contexts. This implication make sense in BL that well-executed teaching activities directly enhances students' confidence, motivation, and preparedness to tackle complex learning tasks. This study advances this understanding by showing that academic self-efficacy acts as a bridge between teachers' activities to students' cognitive presence, confirming that the motivational impact of teaching presence is a precursor to deep learning.

Similarly, as the other critical aspect involved in BL environment, social presence also has been proved to have a facilitating role in students' academic self-efficacy and further impact on students' meaningful learning and knowledge acquisition (Doo et al., 2023; Shea & Bidjerano, 2010; Zhou, 2022). It is enlightening to find the mediating role played by academic self-efficacy between social presence and cognitive presence, which provides valuable insights into how social interaction and peers' collaboration foster deeper cognitive engagement through motivational factors. The findings pointed to the possibility that interventions to the social presence may be particularly useful for students' cognitive development, such as setting up Wechat groups, promoting peer collaboration, group discussions, and interactive forums. Furthermore, adopting the method of improving students' academic self-efficacy at the same time is more conducive to the effectiveness of this intervention, such as role modelling through high-performing peers,

promoting active engagement through role-playing and simulations are all effective ways in professional course learning. Enhanced academic self-efficacy motivates students to engage deeply in the learning process, promoting higher-order thinking and problem-solving skills (Honick & Broadbent, 2016; Walker et al., 2006).

Additionally, the direct hypotheses H5 and the indirect hypotheses H7 (a, b) were supported in this study, confirming that self-regulated learning was another key determinant of students' cognitive presence in BL context (Anthonysamy et al., 2020; Cho et al., 2017; Men et al., 2023; Zhao & Cao, 2023; Zimmerman, 2008). Consistent with previous studies (Shea et al., 2012; Shea & Bidjerano, 2010), this study demonstrated that self-regulated learning not only has a positive effect on cognitive presence, but also has a significant mediation effect in the association between environmental factors (teaching, social presences) and cognitive presence, emphasizing the foundational role of teaching, social presences (Shea & Bidjerano, 2010) and the collaborative benefits of self-regulated learning in promoting students' cognition formation.

Besides, this study further unveils academic self-efficacy's positive effect on self-regulated learning, highlighting how self-belief factors shape students' motivation and behaviours for self-directed learning. Thus, combining the above research findings, both the environmental (teaching, social presences) and personal factor (academic self-efficacy) can exert influence on students' self-regulated learning behaviours, and in turn facilitate their cognitive presence. This chain effect extends the existing literature by identifying self-regulated learning as a pivotal mediator within the COI framework, bridging external instructional and social factors with internal motivation and cognitive engagement.

6. Conclusion

This study endeavours to understand how teaching and social presences (two main presences within COI framework) impact on cognitive presence in blended learning context among vocational students, and how learning presence (academic self-efficacy and self-regulated learning) mediated the relationship between teaching, social presences and cognitive presence. Prior studies have testified that teaching, social presences can effectively facilitate students' blended learning and cognitive development, now we have further revealed how learning presence interact with the environmental factors and exert positive effect on students' cognitive presence during blended learning process. Furthermore, by investigating learning presence from sub-dimension level, the dual mediating roles of academic self-efficacy and self-regulated learning provide a nuanced understanding of how personal factors bridge the gap between environmental presences and cognitive development.

By advancing the understanding of the extended COI framework and its applications, this study paves the way for more effective, inclusive, and student-centric blended learning practices in vocational education and beyond. When designing teaching strategies with various information and communication technologies (ICT), teaching and social presence can foster a supportive and interactive learning climate, which, in turn, enhances students' academic self-efficacy and self-regulation skills. Besides, in order to bolster cognitive development and engagement, educators could integrate SRL-focused activities (e.g., reflective journals, self-assessment tools, time-management training) and motivational strategies (e.g., success modelling, positive feedback) to foster a harmonious social community (peer collaboration, group discussions).

However, there also several limitations must be acknowledged. First, this study employed cross-sectional survey design and self-reported data, which may lead to bias in students' assessments. Therefore, incorporating observational data or objective measures could potentially strengthen the findings' validity. Besides, longitudinal designs are expected to explore how COI presences evolve over time and how these dynamics influence long-term cognitive development in blended learning environments. Second, this study focuses on academic self-efficacy and self-regulated learning as personal factors influencing cognitive presence. Other individual differences, such as prior learning experience, personality traits, and ICT skills, were not considered. These factors may

shape students' experiences within blended learning environments and their ability to regulate their own learning. Future studies could incorporate these variables to gain a more comprehensive understanding of how personal characteristics interact with the COI framework in blended learning settings. Last but not least, this study focuses on vocational students from Hebei province, China, which may not be fully generalizable to other regions, cultural settings, or types of institutions. In view of this, future research should extend this investigation to diverse educational settings, including universities, international students, and different vocational training systems, to examine the cross-cultural applicability of the findings.

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Data availability: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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