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Research Article

Factors influencing self-regulated learning competence among first-year pre-service teachers in Vietnam's blended learning environments: A PLS-SEM investigation

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ABSTRACT

This study investigates the factors influencing self-regulated learning competence (SRLC) among first-year pre-service teachers in blended learning environments (BLEs) in Vietnam. Drawing on an integrated theoretical framework that combines social cognitive theory and self-determination theory, the study examines how environmental and personal factors jointly contribute to SRLC development. Seven hypotheses were formulated to test the direct and indirect effects of course objectives on SRLC, along with the direct effects of student factors, social interaction, the BLE and instructor factors on this competence. Survey data were collected from 700 first-year pre-service teachers enrolled at five teacher education institutions and analyzed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS 4.0. The results indicate that course objectives exert the strongest direct influence on SRLC while also enhancing student factors and social interaction, thereby producing both direct and indirect effects on learning competence. Student factors, BLE, and instructor factors also demonstrate significant positive effects on SRLC, whereas social interaction contributes a smaller but statistically significant effect. The proposed model explains 35.9% of the variance in SRLC and confirms that student factors and social interaction partially mediate the relationship between course objectives and SRLC. These findings highlight the pivotal role of well-designed course objectives in fostering SRLC among future teachers and provide practical implications for the design of blended learning programs and instructional practices in teacher education.

Keywords: self-regulated learning competence, blended learning, pre-service teachers, PLS-SEM, higher education, Vietnam

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INTRODUCTION

The rapid digital transformation of higher education, accelerated by the COVID-19 pandemic, has repositioned blended learning (BL) from a supplementary modality to a central pedagogical model. By systematically integrating face-to-face instruction with online components, BL offers greater flexibility, improved access to learning resources, and more learner-centered engagement (Ahmed & Al Marzouqi, 2015; Tong et al., 2022). However, the effectiveness of BL depends largely on students' capacity for self-regulated learning (SRL), which enables learners to plan, monitor, and regulate their cognitive, metacognitive, and motivational processes (Pintrich, 2000; Zimmerman, 2000).

For first-year pre-service teachers, this challenge is particularly important. These students experience a critical transition from the structured environment of secondary education to the autonomous and technology-supported context of university-level teacher training (Sriarunrasmee et al., 2015). Beyond adapting to new academic demands, they must also develop SRL skills that will support both their own learning and their future teaching practice. As future educators, they are expected not only to regulate their own learning effectively but also to foster SRL among their future students (Buzza & Allinotte, 2013; Martín-del-Pozo & Martín-Sánchez, 2022).

Despite a growing body of research on SRL in higher education and online learning, several important gaps remain. First, existing studies often examine SRL from either personal or environmental perspectives, with limited attention to how these factors interact within an integrated framework (Adinda & Mohib, 2020; Rasheed et al., 2020). Second, empirical evidence on first-year pre-service teachers in BL environments, particularly in non-Western contexts such as Vietnam, remains limited. Third, personal factor (e.g., self-efficacy and motivation) and environmental factors (e.g., instructor support, course design, and technological infrastructure) have rarely been examined together within a single model. Finally, the role of course objectives as an upstream factor influencing both student factors and social interaction has received limited empirical attention.

This study addresses these gaps by investigating the determinants of SRL competence among first-year pre-service teachers in a Vietnamese BL context. Grounded in an integrated theoretical framework of social cognitive theory (SCT) (Bandura, 1986) and self-determination theory (SDT) (Deci & Ryan, 2000), we employ partial least squares structural equation modeling (PLS-SEM) to estimate a structural model comprising six theoretically derived constructs. This study makes three main contributions. First, it proposes and validates an integrated model that incorporates both personal and environmental antecedents of SRL competence. Second, it extends the SRL literature by examining first-year pre-service teachers in a Vietnamese BL context. Third, it provides practical implications for designing BL programs that support the development of self-regulated learning competence (SRLC) in teacher education.

The remainder of this paper is structured as follows. We first review the theoretical foundations and relevant literature. We then develop the research hypotheses. Next, we describe the methodology. After that we present the results. We finally discuss the findings and conclude with implications, limitations, and future research directions.

THEORETICAL BACKGROUND AND LITERATURE REVIEW

Theoretical Framework: Integrating Social Cognitive Theory and Self-Determination Theory

This study draws on two complementary theories to explain SRL competence in BL environments. SCT (Bandura, 1986) emphasizes triadic reciprocal determinism, wherein personal factors (cognition and self-efficacy), behavioral factors (learning strategies and performance), and environmental factors (instructor support, peer interactions, course design) continuously interact to shape learning outcomes. Within BL, this triadic relationship is particularly salient: the digital environment mediates the interaction between students' self-beliefs and instructor scaffolding. Self-efficacy-a central SCT construct-has consistently been identified as a critical predictor of SRL engagement and academic achievement in blended and online contexts (Xu et al., 2022; Zimmerman, 2000).

SDT (Deci & Ryan, 2000) provides a complementary motivational lens, positing that intrinsic motivation and autonomous learning behavior emerge when three basic psychological needs are satisfied: autonomy (sense of volition), competence (perceived effectiveness), and relatedness (social connectedness). In BL environments, SDT predicts that students who perceive themselves as autonomous, competent, and connected to peers and instructors will exhibit greater intrinsic motivation and, consequently, more effective self-regulation (Damayanti et al., 2024; von Keyserlingk et al., 2025).

The integration of SCT and SDT is theoretically justified because the two theories explain complementary dimensions of SRL competence rather than competing perspectives. SCT focuses on how self-regulatory behavior develops through the interaction of personal, behavioral, and environmental factors, whereas SDT explains why learners are motivated to engage in self-regulation by emphasizing the fulfillment of autonomy, competence, and relatedness needs. Therefore, combining the two theories provides a more comprehensive explanation of SRL competence in BL environments by capturing both the regulatory processes and their underlying motivational mechanisms. This integrated perspective informs the selection of constructs and the hypothesized structural pathways in the present study.

Self-Regulated Learning in Blended Learning Environments

SRL refers to an active, constructive process whereby learners set goals, monitor progress, and adjust cognitive and motivational strategies in response to feedback (Pintrich, 2000; Zimmerman, 2000). In BL environments, SRL is particularly critical because the shift from instructor-directed to learner-centered activity demands that students take greater ownership of their learning trajectory without consistent face-to-face supervision. Prior research has identified self-efficacy as a robust predictor of SRL engagement in BL settings, with higher self-efficacy associated with greater goal-setting, self-monitoring, and help-seeking behaviors (Koyuncuoglu, 2023; Wei et al., 2021).

Motivation – both intrinsic and extrinsic – further moderates students' willingness to persevere through technological and pedagogical challenges inherent in BL (Elshareif & Mohamed, 2021; von Keyserlingk et al., 2025). However, the existing evidence remains limited in several respects. Most prior studies are cross-sectional, rely primarily on self-report measures, and focus on general higher education populations. As a result, the applicability of these findings to first-year pre-service teachers in blended learning environments (BLEs) remains uncertain (Ma et al., 2022; Rasheed et al., 2020).

Environmental and Personal Factors Influencing Self-Regulated Learning

Blended learning environment (MT)

The quality of the technological and pedagogical environment-including learning management system (LMS) reliability, resource richness, and interface usability-directly shapes students' ability to engage in SRL. Research shows that well-designed digital environments reduce cognitive load, facilitate resource access, and support self-monitoring (Damayanti et al., 2024; Mulenga & Shilongo, 2024). Information and communications technology self-efficacy and technology readiness are significant predictors of learner engagement with online components (Azeem, 2023; Geng et al., 2019).

Crucially, environmental quality also interacts with course design: a rich digital environment amplifies the effect of clear course objectives by making learning resources more accessible and navigation more intuitive (Yang et al., 2018; Zanjani, 2016). Nevertheless, previous studies have reported inconsistent findings regarding the strength of environmental influences on SRL. While some studies identify the BL environment as a direct determinant of SRL, others suggest that its effects are largely mediated through learner characteristics such as motivation and self-efficacy. These mixed findings highlight the importance of examining environmental and personal factors within an integrated framework.

Instructor factors (GV)

Instructor behavior is a pivotal determinant of student SRL in BL contexts. Instructors who provide timely and constructive feedback, design structured yet flexible learning activities, and offer technical guidance enable students to develop effective learning strategies and sustain motivation (Luo & Zhou, 2024; Prifti, 2020; Van Laer & Elen, 2016). Research demonstrates that systematic instructor training in online course design

significantly improves student self-regulation outcomes (Darmiany et al., 2024). Importantly, instructors in BL serve as cognitive scaffolds-gradually withdrawing support as students develop independent regulatory capacity-aligning with both SCT's emphasis on modeling and SDT's emphasis on autonomy support (Warren et al., 2020). Although instructor support is generally associated with better SRL outcomes, its effectiveness may vary depending on students' readiness for independent learning and the quality of course design. This suggests that instructor support alone may not be sufficient to promote SRL competence.

Student factors (SV)

Individual student characteristics-including self-efficacy, intrinsic goal orientation, time management skills, help-seeking behaviors, and internet self-efficacy-are critical predictors of SRL competence in BL (Kintu et al., 2017; Lynch & Dembo, 2004; Rasanty & Qudsyi, 2023). Academic self-efficacy directly influences metacognitive self-regulation by affecting the planning, monitoring, and regulating dimensions of the learning process (ElSayad, 2024; Yang et al., 2018). Among the Big Five personality traits, conscientiousness shows the strongest and most consistent correlation with academic performance in BL contexts (Trapmann et al., 2007), further highlighting the role of dispositional self-regulatory tendencies. However, previous studies have reported varying effect sizes (f^2) for individual learner characteristics, suggesting that personal factors alone cannot fully explain differences in SRL competence. Their influence is likely to depend on interactions with environmental conditions.

Course objectives (OJ)

Clear, well-structured course objectives function as cognitive anchors that enable students to organize their learning, allocate time effectively, and evaluate their progress against explicit standards. When objectives are professionally oriented and aligned with career competencies, they enhance student motivation and sense of purpose-key SDT autonomy and competence need-satisfaction (Buzza & Allinotte, 2013; Krauel-Nix et al., 2019). Furthermore, clearly articulated objectives signal to students what constitutes valued engagement, thereby shaping the nature and frequency of peer collaboration within the course. Despite the recognized importance of course design, relatively few studies have examined course objectives as an upstream factor influencing both individual and social aspects of SRL simultaneously. This gap provides further support for the proposed research model.

Social interaction (XH)

Peer interactions and social support represent key social-environmental determinants of SRL in BL. Collaborative learning activities-including problem-based learning, peer feedback, and online discussion groups-promote co-regulation, metacognitive awareness, and help-seeking behaviors (Banson, 2022; Er et al., 2020; So & Brush, 2008). Social presence enhances peer support, which in turn improves listening behaviors and learning performance in asynchronous discussions (Joksimović et al., 2015). However, existing evidence regarding the direct effect of social interaction on SRL is mixed, with some studies finding significant effects (Sharma et al., 2024) while others report contextual nullifications (ElSayad, 2024).

RESEARCH MODEL AND HYPOTHESES

Based on the theoretical integration of SCT and SDT and the literature reviewed above, we propose a structural model in which course objectives (OJ) serves as a key upstream antecedent shaping both student-level (SV) and social (XH) factors, all of which in turn influence SRLC (TH).

Figure 1 presents the proposed research model. Conceptual research model illustrating the seven hypothesized relationships (**H1**-**H7**) among the study constructs without estimated coefficients or model statistics.

Hypothesized Paths

Table 1 shows the research hypotheses.

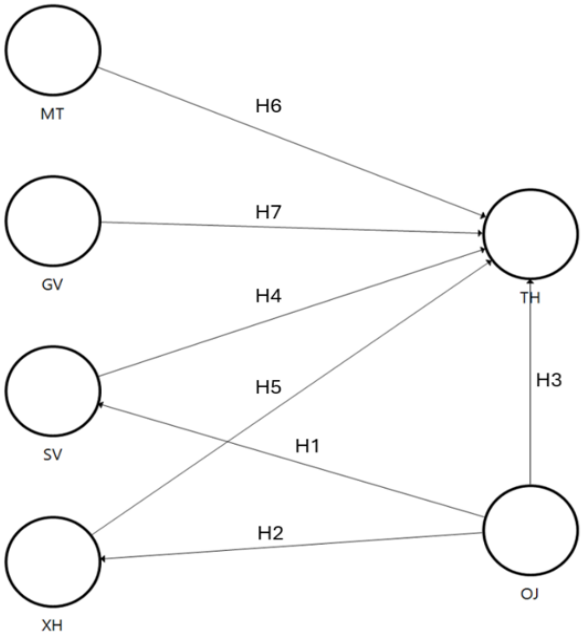


Figure 1. Proposed research model and hypothesized relationships (OJ: Course objectives; SV: Student factors; XH: Social interaction; MT: BLE; GV: Instructor factors; TH: SRLC; & **H1**-**H7** denote the proposed hypotheses) (created by the authors)

Table 1. Research hypotheses

H	Path	Theoretical rationale
H1	OJ → SV	Course objectives provide students with explicit learning goals enabling effective planning, time allocation, and self-monitoring—core SRL behaviors consistent with SCT goal-setting processes and SDT competence need-satisfaction.
H2	OJ → XH	Well-articulated objectives that emphasize collaborative tasks encourage peer discussion, group work, and community engagement, thereby stimulating social interaction within the BL environment.
H3	OJ → TH	Professionally oriented course objectives directly enhance students' self-regulated learning competence by aligning learning activities with career-relevant skills, increasing perceived relevance and intrinsic motivation (SDT autonomy).
H4	SV → TH	Students with stronger self-efficacy, intrinsic motivation, and self-regulatory skills demonstrate greater capacity for independent learning—the core behavioral manifestation of SRL competence (SCT; Bandura, 1986).
H5	XH → TH	Peer interactions, collaborative activities, and social support provide social modeling and co-regulation opportunities that reinforce SRL skills and metacognitive awareness (SCT observational learning).
H6	MT → TH	A high-quality blended learning environment reduces cognitive load, enhances resource accessibility, and enables more effective self-directed learning engagement (Damayanti et al., 2024).
H7	GV → TH	Instructor scaffolding—including timely feedback, structured activities, and technical support—fosters student self-efficacy and self-regulation skills in BL contexts (SDT competence support).

Note. H: Hypothesis

METHODOLOGY

Research Design

This study adopts a quantitative, cross-sectional survey design. PLS-SEM was selected over covariance-based SEM (CB-SEM) for three reasons:

(1) the study is exploratory and theory-building in an underexplored BL-SRL context;

(2) the structural model includes constructs with relatively small f^2 common in educational research; and

(3) PLS-SEM is well-suited for predictive modeling with complex, multi-construct frameworks (Hair et al., 2019; Sarstedt et al., 2021) and its application has become increasingly widespread in educational technology research over the past decade (Demir & Uşak, 2025).

SmartPLS version 4.0 was used for all analyses, with bootstrapping based on 5,000 subsamples.

Table 2. Demographic characteristics of participants (N = 700)

Characteristic	Category	Frequency (N)	Percentage (%)
Gender	Male	315	45.0
	Female	385	55.0
Major discipline	Educational sciences	175	25.0
	Social sciences	280	40.0
	Natural sciences	245	35.0
Institution	Hanoi National University of Education	200	28.6
	Thai Binh University	200	28.6
	Hanoi Metropolitan	100	14.3
	Hanoi Pedagogical University 2	100	14.3
	Thai Nguyen University of Education	100	14.3
Geographic distribution	Hanoi	300	42.9
	Thai Binh	200	28.6
	Vinh Phuc	100	14.3
	Thai Nguyen	100	14.3
Total		700	100

Note. Age information was not collected as part of the survey

Participants and Sampling

Participants were first-year pre-service teachers enrolled at five public teacher education universities in Vietnam, selected through purposive sampling. The participating universities were selected because they represent different geographic regions and implement the national teacher education curriculum issued by the Ministry of Education and Training. All institutions had adopted BL in first-year teacher education programs, providing comparable educational settings while allowing for contextual diversity. A total of 750 questionnaires were distributed; 700 valid responses were retained for analysis (response rate = 93.3%). The demographic characteristics of the participants are summarized in **Table 2**, including gender, major discipline, participating institution, and geographic region. The sample comprised 45% male and 55% female students. All data were collected in a structured, paper-based questionnaires administered during class sessions. A priori power analysis using the inverse square root method (Kock & Hadaya, 2016) indicated a minimum sample size of 138 for detecting medium f^2 (= 0.15) at α = .05 with 80% statistical power. Therefore, the final sample of 700 participants provided sufficient statistical power for the PLS-SEM analysis. Because the participating universities shared a common curriculum framework and comparable BL practices, the data were pooled to estimate a general structural model rather than compare institutional differences. Future research could employ MICOM or multigroup analysis to examine measurement invariance across institutions.

Measurement Instrument

All constructs were measured using reflective, 5-item Likert-type scales (1 = strongly disagree, 5 = strongly agree). Scale items were adapted from validated instruments in the SRL, BL, and educational technology literatures (Pintrich, 2000; Zimmerman, 2000), and subsequently translated into Vietnamese using a standard back-translation procedure (Brislin, 1970). The instrument underwent three stages of validation:

(1) expert content validity review by a panel of five specialists in educational psychology and instructional technology, achieving a content validity index ≥ 0.80 for all items;

(2) linguistic validation by two bilingual education researchers; and

(3) a pilot test with 50 first-year pre-service teachers (not included in the main sample) to assess item comprehension and initial psychometric properties.

Table 3 presents the construct operationalizations and sample measurement items. The full instrument is provided in **Appendix A**.

Common Method Bias Assessment

Given the single-source, self-report nature of the data, potential common method bias (CMB) was assessed using multiple procedures. At the procedural level, anonymity of responses was assured, items were clearly worded, and the questionnaire was formatted to minimize response fatigue. At the statistical level, three

Table 3. Construct operationalizations, sources, and sample measurement items

Construct (code)	Operational definition	Primary source(s)	Sample item
BLE (MT)	Quality and accessibility of digital learning tools, including LMS reliability, online resource richness, and interface usability.	(Geng et al., 2019; Zanjani, 2016)	The LMS used in my courses is reliable and easy to navigate.
Instructor factors (GV)	Support, feedback quality, and instructional design capability of instructors in the BL environment.	(Prifti, 2020; Van Laer & Elen, 2016)	My instructor provides timely and constructive feedback on my work.
Student factors (SV)	Students' self-efficacy, proactive learning attitude, and capacity to manage and adjust their learning process.	(Kintu et al., 2017; Lynch & Dembo, 2004)	I take responsibility for organizing and managing my own study schedule.
Course objectives (OJ)	Clarity and professional alignment of course learning goals with career-relevant competency requirements.	(Buzza & Allinotte, 2013; Krauel-Nix et al., 2019)	The course objectives are clearly stated and aligned with my professional development goals.
SRLC (TH)	Students' demonstrated ability and confidence to engage in independent, self-directed learning using self-regulatory strategies.	(Pintrich, 2000; Zimmerman, 2000)	I can independently plan, monitor, and evaluate my own learning progress.
Social interaction (XH)	Quality and frequency of peer, instructor, and community interactions supporting a positive learning environment.	(Er et al., 2020; So & Brush, 2008)	Interacting with my classmates helps me better understand course content.

Note. All constructs measured using 5-item reflective Likert scales (1 = strongly disagree, 5 = strongly agree) & full instrument provided in **Appendix A**

complementary tests were applied. First, Harman's single common factor test was conducted: the first unrotated factor accounted for 22.05% of total variance, well below the 50% threshold, suggesting CMB is not a substantial concern(Podsakoff et al., 2003). Second, the full collinearity VIF approach (Kock, 2015) was applied; all outer VIF values ranged from 1.644 to 2.125 and all inner VIF values ranged from 1.107 to 1.212, well below the critical threshold of 3.3. Third, the HTMT ratios (reported in Section 5.2.2) were all below 0.52, indicating that discriminant validity holds, which is inconsistent with severe CMB (Henseler et al., 2015). Collectively, these results suggest that CMB does not pose a substantial threat to the validity of the findings.

Analytical Procedure

Analysis proceeded in two stages following the PLS-SEM two-step approach (Hair et al., 2019). In stage 1, the measurement model was assessed for indicator reliability (outer loadings ≥ 0.70), internal consistency (Cronbach's alpha, composite reliability (CR), and rho_A ≥ 0.70), convergent validity (average variance extracted [AVE] ≥ 0.50), and discriminant validity (HTMT ≤ 0.85). In stage 2, the structural model was evaluated using path coefficients (β), explained variance (R^2), f^2, and predictive relevance (Q^2 via blindfolding, D = 7). All significance tests were conducted via bias-corrected bootstrapping (N = 5,000 subsamples, two-tailed, α = .05). Model fit was assessed using SRMR and NFI indices.

Ethical Considerations

Permission to conduct this study was granted by Hanoi National University of Education (approval No. 74/GCN-ĐHSPHN, dated 19 March 2025). The study was conducted in accordance with the University's research regulations and relevant national ethical principles for research involving human participants. Written informed consent was obtained from all participants prior to data collection. Participation was voluntary, and anonymity and confidentiality were maintained throughout the study.

RESULTS

Descriptive Statistics

Table 4 presents descriptive statistics for the six constructs. Mean scores range from 3.552 (course objectives) to 3.741 (instructor factors), indicating moderately positive perceptions across all constructs. Standard deviations are consistent (0.564-0.601), reflecting comparable response variability. Skewness values (-0.139 to 0.052) and kurtosis values (-0.424 to -0.087) are within acceptable ranges (|skewness| < 2, |kurtosis| < 7; Hair et al., 2019), supporting the assumption of approximate normality for PLS-SEM analysis.

Table 4. Descriptive statistics of the six constructs (N = 700)

Construct	N	Mean	Standard deviation	Minimum	Maximum	Skewness	Kurtosis
BLE (MT)	5	3.617	0.564	2.00	5.00	-0.030	-0.387
Instructor factors (GV)	5	3.741	0.588	1.80	5.00	-0.139	-0.087
Student factors (SV)	5	3.569	0.584	2.00	5.00	-0.060	-0.349
Course objectives (OJ)	5	3.552	0.580	2.00	5.00	0.020	-0.196
SRLC (TH)	5	3.683	0.588	2.00	5.00	-0.122	-0.110
Social interaction (XH)	5	3.626	0.601	2.00	5.00	0.052	-0.424

Note. N: Number of items per construct & Construct scores computed as the mean of the five corresponding indicators

Table 5. Reliability and convergent validity of the measurement model

Construct	n	Cronbach's alpha	ρ_A	CR (ρ_c)	AVE	Outer loading range
BLE (MT)	5	0.842	0.851	0.887	0.612	0.745-0.806
Instructor factors (GV)	5	0.860	0.861	0.899	0.640	0.777-0.828
Student factors (SV)	5	0.844	0.845	0.889	0.616	0.764-0.807
Course objectives (OJ)	5	0.853	0.855	0.895	0.630	0.781-0.809
SRLC (TH)	5	0.862	0.863	0.901	0.645	0.779-0.819
Social interaction (XH)	5	0.864	0.874	0.901	0.646	0.768-0.822

Note. CR (Dijkstra-Henseler's ρ_c); ρ_A: Dijkstra-Henseler's rho_A; AVE = Average Variance Extracted. Acceptable thresholds: α ≥ .70, CR ≥ .70, AVE ≥ .50 (Fornell & Larcker, 1981; Hair et al., 2022)

Table 6. Outer loadings of all 30 measurement indicators

Indicator	MT	GV	OJ	SV	TH	XH
Item 1	0.802	0.777	0.783	0.799	0.816	0.814
Item 2	0.745	0.802	0.794	0.775	0.800	0.768
Item 3	0.765	0.791	0.802	0.778	0.779	0.808
Item 4	0.806	0.802	0.781	0.764	0.800	0.822
Item 5	0.791	0.828	0.809	0.807	0.819	0.807

Note. All loadings significant at p < .001 (bootstrapping N = 5,000); MT: BLE; GV: Instructor factors; OJ: Course objectives; SV: Student factors; TH: SRLC; XH: Social interaction; & item codes correspond to the full instrument in **Appendix A**

Table 7. Discriminant validity assessed by the HTMT ratio

Construct	GV	MT	OJ	SV	TH	XH
Instructor factors (GV)	-					
BLE (MT)	0.078	-				
Course objectives (OJ)	0.187	0.184	-			
Student factors (SV)	0.379	0.285	0.203	-		
SRLC (TH)	0.346	0.350	0.520	0.450	-	
Social interaction (XH)	0.042	0.086	0.364	0.037	0.206	-

Note. Values below .85 indicate acceptable discriminant validity (Henseler et al., 2015). - indicates diagonal; upper triangle suppressed

Measurement Model Assessment

Indicator reliability and internal consistency

Table 5 summarizes the reliability and convergent validity results. All constructs satisfy the recommended thresholds for internal consistency and convergent validity, with Cronbach's alpha, CR, and rho_A values exceeding 0.70, AVE values above 0.50, and outer loadings ranging from 0.745 to 0.828 (Hair et al., 2019, 2022; Fornell & Larcker, 1981). The complete outer loading matrix is presented in **Table 6**.

Discriminant validity

Discriminant validity was assessed using the Heterotrait-Monotrait (HTMT) ratio (Henseler et al., 2015), which is considered a more conservative and accurate criterion than the Fornell-Larcker criterion.

As shown in **Table 7**, all HTMT values range from 0.037 to 0.520, well below the stringent threshold of 0.85 (and the conservative threshold of 0.90), confirming that all constructs are empirically distinct from one another. The Fornell-Larcker criterion was also satisfied: the square root of each construct's AVE (diagonal values in **Table 8**) exceeds all inter-construct correlations in the corresponding row and column.

Table 8. Fornell-Larcker criterion: Inter-construct correlations and square root of AVE (diagonal, **bold**)

Construct	GV	MT	OJ	SV	TH	XH
GV	**0.800**					
MT	-0.021	**0.782**				
OJ	0.160	0.158	**0.794**			
SV	0.324	0.243	0.174	**0.785**		
TH	0.300	0.302	0.447	0.384	**0.803**	
XH	0.023	-0.048	0.320	0.013	0.184	**0.804**

Note. Diagonal values (**bold**): Square root of AVE & off-diagonal values: Pearson inter-construct correlations

Table 9. Structural model path coefficients and hypothesis testing results (bootstrapping N = 5,000)

H	Path	β	Mean	SE	t	p	95% CI	Decision
H1	OJ → SV	0.174	0.176	0.037	4.740	< .001	[0.103, 0.247]	Supported
H2	OJ → XH	0.320	0.323	0.033	9.834	< .001	[0.257, 0.386]	Supported
H3	OJ → TH	0.321	0.320	0.033	9.733	< .001	[0.256, 0.384]	Supported
H4	SV → TH	0.219	0.219	0.031	7.168	< .001	[0.157, 0.279]	Supported
H5	XH → TH	0.084	0.085	0.033	2.549	.011	[0.021, 0.150]	Supported
H6	MT → TH	0.207	0.208	0.033	6.232	< .001	[0.142, 0.272]	Supported
H7	GV → TH	0.180	0.182	0.034	5.290	< .001	[0.117, 0.248]	Supported

Note. H: Hypothesis; β: Standardized path coefficient (original sample); Mean: Bootstrap mean; SE: Bootstrap standard deviation; t = |β/SE|; & 95% CI = percentile bootstrap confidence interval

Table 10. R^2, adjusted R^2, and f^2

Endogenous construct	R^2	Adjusted R^2	Predictor (f^2)	f^2 value	Interpretation
Student factors (SV)	0.030	0.029	OJ → SV	0.031	Small
Social interaction (XH)	0.103	0.101	OJ → XH	0.114	Small-to-medium
SRLC (TH)	0.359	0.354	OJ → TH	0.134	Small-to-medium
			SV → TH	0.062	Small
			MT → TH	0.060	Small
			GV → TH	0.044	Small
			XH → TH	0.010	Small

Note. R^2 benchmarks: ≥ .25 = moderate, ≥ .75 = substantial (Hair et al., 2022) & f^2 benchmarks: .02 = small, .15 = medium, .35 = large (Cohen, 1988)

Structural Model Assessment

Hypothesis testing

Table 9 summarizes the structural model results obtained from bootstrapping (5,000 subsamples). All seven hypothesized relationships were statistically supported ($p < .05$). Course objectives (OJ) exhibited the strongest direct effect on SRLC (TH), followed by student factors (SV), BLE (MT), and instructor factors (GV), social interaction (XH) also showed a positive but comparatively weaker effect on TH. Detailed path coefficients, confidence intervals, and hypothesis decisions are reported in **Table 9**.

Explained variance and effect sizes

Table 10 presents the R^2 and the f^2. The model explains approximately 35.9% of variance in SRLC (TH), whereas student factors (SV) and social interaction (XH) exhibit relatively lower R^2. f^2 ranged from 0.010 to 0.134, indicating predominantly small effects across the structural model (Hair et al., 2019; Scherer et al., 2019).

Model fit

The saturated model yielded SRMR = 0.043 (below the recommended threshold of 0.08; Hu & Bentler, 1999), and the estimated model yielded SRMR = 0.072. The estimated model also achieved an NFI of 0.901, indicating acceptable model fit.

Mediation analysis

Table 11 presents the mediation analysis results. Both indirect effects were statistically significant because their confidence intervals excluded zero. Student factor (SV) accounted for 9.8% of the total effect, whereas

Table 11. Indirect effects and mediation analysis results (bias-corrected bootstrap, N = 5,000)

Indirect path	Indirect β	SE	p	95% CI	VAF (%)	Mediation type
OJ → SV → TH	0.038	0.012	.002	[0.017, 0.062]	9.8	Partial
OJ → XH → TH	0.027	0.012	.023	[0.006, 0.051]	7.0	Partial
Total indirect (OJ → TH)	0.065	0.017	.001	[0.034, 0.099]	16.8	-
Total effect (OJ → TH)	0.386	0.032	< .001	[0.323, 0.450]	-	-

Note. Indirect effects estimated via bias-corrected percentile bootstrap CI (N = 5,000; two-tailed); Significance indicated when 95% CI excludes zero; VAF: Variance accounted for = indirect effect/total effect × 100; & Partial mediation confirmed when VAF < 20%

social interaction (XH) accounted for 7.0% indicating partial mediation. Detailed indirect effects, confidence intervals, and VAF values are reported in **Table 11** (Hair et al., 2022).

DISCUSSION

The Central Role of Course Objectives

The findings indicate that course objectives (OJ) play a central role in promoting SRLC (TH) by directly supporting students' learning and indirectly strengthening both student factors (SV) and social interaction (XH). Rather than serving only as a guide for course content, clearly designed learning objectives appear to encourage students to regulate their own learning while promoting meaningful collaboration with peers. The significant indirect effects further suggest that part of the influence of course objectives operates through students' personal characteristics and social learning experiences.

These findings are theoretically consistent with integrated SCT and SDT framework. From an SCT perspective, clearly articulated objectives provide students with clear goals that guide planning, monitoring, and self-evaluation throughout the learning process (Zimmerman, 2000). From an SDT perspective, professionally relevant learning objectives strengthen students' sense of competence by making learning activities more meaningful and connected to future professional practice, thereby enhancing intrinsic motivation and autonomous engagement (Buzza & Allinotte, 2013). In addition, course objectives may encourage greater social interaction, supporting the development of SRL through peer co-regulation (Er et al., 2020; Zhan & Mei, 2013).

Environmental and Instructor Influences

Both the BLE (MT) and instructor factors (GV) made meaningful contributions to students' SRLC. This finding is consistent with previous studies highlighting the importance of technology quality and instructor support in BLEs (Bergin, 2023; Luo & Zhou, 2024). A high-quality digital environment reduces cognitive load and facilitates resource access, enabling students to devote more cognitive resources to self-regulatory processes rather than technical problem-solving (Nikolopoulou & Zacharis, 2023). Instructor support—particularly timely feedback and adaptive scaffolding—fosters students' self-efficacy and competence perceptions, both of which are established predictors of SRL engagement (Panadero et al., 2017). The comparable f^2 of MT and GV on TH suggest that neither the technological nor the human dimension of BL can be neglected in instructional design.

Student Self-Efficacy and Social Interaction

Student factors emerged as one of the strongest contributors to SRLC, supporting previous research emphasizing the importance of self-efficacy, intrinsic motivation, and self-regulatory disposition in successful learning (Panadero et al., 2017; Zimmerman, 2000). The findings also suggest that clearly defined course objectives may strengthen these personal characteristics, providing an important pathway through which course design supports students' SRL.

Social Interaction (XH: β = 0.084, p = .011) showed a small but statistically significant effect on TH, contrasting with prior studies reporting larger social influence effects on SRL (Bai et al., 2020). Several contextual factors may explain this relatively modest effect. First, the study was conducted among first-year students who may not yet have developed effective peer collaboration skills within the BL platform. Second, in the Vietnamese educational context, hierarchical teacher-student relationships characteristic of Confucian-heritage cultures may attenuate peer-driven SRL, with students relying more on instructor guidance than on

peer co-regulation (Hofstede, 2001). Third, asynchronous online components of BL—which characterize many Vietnamese university BL programs—may limit the spontaneity and depth of social exchanges that drive co-regulation. Future research should investigate how the design of structured social learning activities (e.g., peer review protocols and collaborative problem-solving tasks) can strengthen the social pathway to SRL competence.

Practical Implications

The findings carry several actionable implications for teacher education institutions. First, curriculum designers should develop the course objectives that clearly specify learning outcomes, expected SRL behaviors, and assessment criteria. Each learning activity should be explicitly linked to these objectives so that students understand how individual tasks contribute to professional competence. Second, teacher education institutions should provide regular professional development workshops on blended course design, formative feedback strategies, and the effective use of LMS. Third, instructors should integrate structured peer-learning activities such as peer review, collaborative lesson planning, small-group discussions, and reflective learning journals into blended courses, particularly during the first year of teacher education. Finally, orientation programs for first-year students should include practical guidance on goal setting, learning planning, time management, self-monitoring, and reflective learning strategies to strengthen students' SRL from the beginning of their university studies.

Practical Significance

Beyond statistical significance, the findings have important practical implications for teacher education. The strong influence of course objectives suggests that clearly articulated learning outcomes aligned with professional competencies can effectively promote students' SRLC. The positive effects of instructor support and the BLE indicate that universities should invest in faculty development and digital learning infrastructure to strengthen students' independent learning capacity.

Limitations and Future Research Directions

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference and the examination of how SRL competence evolves over time. Longitudinal studies tracking first-year pre-service teachers across a full academic year would provide stronger causal evidence and reveal developmental trajectories. Second, all data are self-reported, and despite CMB diagnostics suggesting acceptable levels of common method variance, objective behavioral measures of SRL (e.g., LMS log data and learning analytics) would strengthen validity. Third, the sample is limited to five institutions in Vietnam; generalizability to other cultural and institutional contexts requires caution and cross-cultural replication. Although the participating universities shared a common curriculum framework and similar blended practices, measurement invariance across institutions was not formally assessed using MICOM or multigroup analysis. Therefore, future studies should examine whether the proposed structural relationships remain stable across different institutional contexts. Fourth, the low R^2 values for SV (0.030) and XH (0.103) indicate that substantial variance in these constructs remains unexplained, suggesting that additional antecedents—such as institutional policies, peer group composition, or family support—should be incorporated in future models. Fifth, this study did not examine potential moderating effects (e.g., whether the MT → TH relationship is stronger for students with higher initial self-efficacy). Future research using multi-group analysis or interaction terms in PLS-SEM could yield important boundary condition insights.

CONCLUSION

This study investigated the determinants of SRLC among first-year pre-service teachers in BLEs using an integrated structural model grounded in SCT and SDT. The findings support the proposed relationships among course objective, student factors, social interaction, the BLE, instructor factors, and SRL competence. Course objectives emerged as the most influential factor, exerting both direct and indirect effects on students' SRLC. Overall, the proposed model demonstrated satisfactory explanatory power and supports the integrated theoretical framework.

This study makes three main contributions to the SRL and BL literature. Theoretically, it provides an empirically validated model integrating environmental, interpersonal, and personal factors within a single framework, addressing the need for more comprehensive explanations of SRL in BL contexts (Adinda & Mohib, 2020; Rasheed et al., 2020). Methodologically, it demonstrates the usefulness of PLS-SEM with bias-corrected bootstrapping and mediation analysis for examining both direct and indirect relationships among educational variables. Practically, the findings highlight the importance of clearly defined course objectives, supportive instructors, well-designed BLEs, and meaningful social interaction in fostering SRL among pre-service teachers.

As BL continues to expand in higher education, particularly in teacher education programs, designing learning environments that strengthen students' SRL has become increasingly important. The findings provide practical guidance for curriculum designers, teacher educators, and higher education institutions seeking to develop independent, motivated, and lifelong learners. Future studies should further validate the proposed model across different educational and cultural contexts.

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Ethics declaration: This study was approved by the Institutional Review Board at Hanoi National University of Education on 19 March 2025 with approval number 74/GCN-ĐHSPHN. It was conducted in accordance with relevant institutional and national research ethics guidelines. All ethical standards for research involving human participants were strictly followed. Participants were informed about the nature and purpose of the study. Informed consent was obtained from all participants prior to data collection. Participation was voluntary, and anonymity and confidentiality were strictly ensured.

AI statement: AI-assisted language editing tools were used only to improve grammar, clarity, and readability. All conceptualization, data analysis, interpretation of results, and conclusions were developed solely by the authors.

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APPENDIX A

Table A1. Full measurement instrument (English and Vietnamese) (all items rated on a 5-point Likert scale: 1 = strongly disagree/hoàn toàn không đồng ý; 5 = strongly agree/hoàn toàn đồng ý)

Code	English item	Vietnamese item
BLE (MT)		
MT1	The online learning platform used in my courses is reliable and functions without technical problems.	Nền tảng học tập trực tuyến được sử dụng trong các khóa học đáng tin cậy và hoạt động tốt.
MT2	The LMS interface is easy to navigate and use for accessing course materials.	Giao diện LMS dễ dàng để truy cập tài liệu học tập.
MT3	The digital resources provided in my blended courses are diverse and support my learning effectively.	Các tài nguyên kỹ thuật số trong khóa học hỗ trợ việc học của tôi hiệu quả.
MT4	The blended learning environment helps me easily access learning resources anytime and anywhere.	Môi trường học hỗn hợp giúp tôi truy cập tài nguyên học tập mọi lúc mọi nơi.
MT5	The technological tools in my blended courses support interaction and engagement with learning activities.	Các công cụ công nghệ trong khóa học hỗ trợ sự tương tác và tham gia các hoạt động học tập.
Instructor factors (GV)		
GV1	My instructor provides timely and constructive feedback on my assignments.	Giảng viên của tôi cung cấp phản hồi kịp thời và mang tính xây dựng về bài tập.
GV2	My instructor designs clear and well-structured learning activities for both online and face-to-face components.	Giảng viên thiết kế các hoạt động học tập rõ ràng cho cả phần trực tuyến và trực tiếp.
GV3	My instructor is available and responsive when I need academic or technical support.	Giảng viên sẵn sàng hỗ trợ tôi khi cần về học thuật hoặc kỹ thuật.
GV4	My instructor uses strategies that encourage me to take ownership of my own learning.	Giảng viên sử dụng các chiến lược khến tôi chủ động hơn trong việc học.
GV5	My instructor's instructional design in blended courses helps me develop effective learning strategies.	Thiết kế dạy học của giảng viên giúp tôi phát triển các chiến lược học tập hiệu quả.
Student factors (SV)		
SV1	I take responsibility for organizing and managing my own study schedule.	Tôi chủ động tổ chức và quản lý lịch học của mình.
SV2	I believe I am capable of successfully completing challenging tasks in my courses.	Tôi tin rằng mình có khả năng hoàn thành các nhiệm vụ khó trong khóa học.
SV3	I actively seek additional learning resources beyond what is provided in class.	Tôi chủ động tìm kiếm tài nguyên học tập bổ sung ngoài những gì được cung cấp.
SV4	When I encounter difficulties in learning, I adjust my strategies to overcome them.	Khi gặp khó khăn trong học tập, tôi điều chỉnh chiến lược để vượt qua.
SV5	I am intrinsically motivated to learn and improve my knowledge and skills as a future teacher.	Tôi có động lực nội tại để học và nâng cao kiến thức và kỹ năng của mình.
Course objectives (OJ)		
OJ1	The learning objectives of my courses are clearly stated and easy to understand.	Mục tiêu học tập của các khóa học được phát biểu rõ ràng và dễ hiểu.
OJ2	The course objectives are well aligned with my professional development needs as a future teacher.	Mục tiêu khóa học phù hợp với nhu cầu phát triển nghề nghiệp của tôi.
OJ3	The course objectives help me understand what is expected of me and guide my learning efforts.	Mục tiêu khóa học giúp tôi hiểu những gì được kỳ vọng và định hướng nỗ lực học tập.
OJ4	The course objectives are relevant and meaningful to my career goals as a teacher.	Mục tiêu khóa học có ý nghĩa và liên quan đến mục tiêu nghề nghiệp của tôi.
OJ5	The course objectives motivate me to engage actively in both online and face-to-face learning activities.	Mục tiêu khóa học thúc đẩy tôi tham gia tích cực vào các hoạt động học tập.
SRLC (TH)		
TH1	I can independently set specific learning goals and plan how to achieve them.	Tôi có thể tự đặt mục tiêu học tập cụ thể và lập kế hoạch đạt được chúng.
TH2	I regularly monitor my own learning progress and adjust my strategies when needed.	Tôi thường xuyên theo dõi tiến độ học tập và điều chỉnh chiến lược khi cần.
TH3	I can evaluate my own learning performance and identify areas for improvement.	Tôi có thể đánh giá kết quả học tập của mình và xác định các lĩnh vực cần cải thiện.
TH4	I am confident in my ability to learn new content independently using available resources.	Tôi tự tin vào khả năng tự học nội dung mới bằng cách sử dụng các tài nguyên sẵn có.
TH5	I take initiative in seeking out learning opportunities beyond formal coursework.	Tôi chủ động tìm kiếm các cơ hội học tập ngoài chương trình chính khóa.

Table A1 (Continued).

Code	English item	Vietnamese item
Social interaction (XH)		
XH1	Interacting with my classmates helps me better understand course content.	Tương tác với bạn cùng lớp giúp tôi hiểu nội dung khóa học tốt hơn.
XH2	I feel comfortable asking my peers for help when I encounter difficulties in my studies.	Tôi thoải mái nhờ bạn bè giúp đỡ khi gặp khó khăn trong học tập.
XH3	Participating in group discussions and collaborative activities enhances my learning outcomes.	Tham gia thảo luận nhóm và các hoạt động hợp tác nâng cao kết quả học tập của tôi.
XH4	The learning community in my blended courses provides a supportive environment for my development.	Cộng đồng học tập trong khóa học tạo ra môi trường hỗ trợ sự phát triển của tôi.
XH5	Sharing knowledge and experiences with peers in both online and face-to-face settings enriches my learning.	Chia sẻ kiến thức và kinh nghiệm với bạn cùng lớp làm phong phú việc học của tôi.