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Factors affecting learner engagement in HyFlex learning environments

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ABSTRACT

Higher education institutions are increasingly implementing hybrid flexible (HyFlex) learning mode due to its accessibility and flexibility. However, little is known about students' engagement and potential predictors in this learning approach. This study's objective was to look into strategies for enhancing learner engagement in HyFlex learning environments. In this study, the relationships between specific predictors (learner control, self-efficacy, and learning motivation), learners' perceived community of inquiry (CoI) presences, and learner engagement in HyFlex learning environments were investigated using partial least squares structural equation modeling (PLS-SEM). In order to collect data on the study's variables, an online survey was completed by 367 students who were enrolled in the HyFlex learning environments at a Chinese college. The results indicated a direct and positive relationship between learner engagement and factors such as self-efficacy, learner motivation, and learners' perceived CoI presences. However, learner control did not have a direct and positive impact on learner engagement. Instead, it indirectly influenced learner engagement by affecting learners' perceived CoI presences. In addition, the relationships between learner motivation and engagement, as well as self-efficacy and learner engagement, were significantly mediated by the learners' perceived CoI presences. The findings offer fresh perspectives on the roles of learner control, self-efficacy, learner motivation, and learners' perceived CoI presences in HyFlex learning, with implications for learning processes and learner engagement.

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1. INTRODUCTION

China has a need for more high-quality, compound, innovative, and efficient professional and technical professionals to help a growing society thrive. On January 24, 2019, the State Council of China announced a policy of "National Vocational Education Reform Implementation Plan" and stressed that "it has the same important status as general higher education" [1]. Since then, China's higher colleges/universities began to implement enrollment expansion.

The TF College, a multi-campus private school located across three different cities in southwestern China, began its "1+4 socio-demographic segment diploma program" in the fall of 2019 semester in response to this societal and educational transition. The "1+4 socio-demographic segments" diploma program aims to cultivate these talents for society. In the meantime, the expansion of higher vocational education is mainly driven by the "1+4" socioeconomic segments. The group labelled as "1" includes both conventional high school graduates and vocational school graduates who have just completed their education. The "4" segments

generally pertain to social people, including veterans, those who have been laid off or unemployed, migrant laborers, and newly qualified farmers. By extending its reach beyond its normal student population, the institution commits to helping students from a variety of backgrounds. According to the TF College Research Centre, around 70% of the "4" segments were employed, with 30% working on a full-time basis.

In order to accommodate students who have social or family responsibilities, such as "4" segments, and enable their participation in regular sessions, the HyFlex course design was implemented. "HyFlex", which is an acronym for "hybrid flexible", was invented in 2005 by Brian Beatty at San Francisco State University to describe programs that allow students to participate whether they are in person or online, synchronously or asynchronously [2]. HyFlex courses offer students the flexibility to select their preferred learning method, which includes attending in-person classes on campus, participating in real-time online video conferences, or accessing course materials at their own pace through the learning management system [3]. Although the HyFlex instructional design is not new in the higher education setting in other countries [2]–[8], it was novel to Chinese institutions. Currently, as far as the researchers know, there have been few studies that specifically examine the impact of the HyFlex learning strategy on student learning in the context of China. This new study is an early exploration of the factors that impact learner engagement in the HyFlex approach in China. Despite conducting a comprehensive investigation, no pertinent literature was discovered. As learner engagement is directly related to the quality of education and student performance, it is a vital factor when assessing HyFlex courses [9]. Hence, it is crucial to determine the variables that can predict learner engagement and to examine how the indicators relate to students' learning engagement in HyFlex learning environments.

In previous studies, learner control was found to be related to learner engagement [10]–[14], additionally, self-efficacy [15]–[17], learning motivation [18]–[20] and learners' perceived community of inquiry (CoI) presences [21]–[25] all predict learner engagement. The correlational research between learner control, self-efficacy, learning motivation, learners' perceived CoI presences and learner engagement has been conducted by researchers separately, however, there is a lack of research to examine how these variables collectively influence learner engagement in HyFlex learning environments. Therefore, the present study aimed to i) examine the direct influence of the factors on HyFlex learner engagement in Chinese context and ii) investigate the impact of the mediating factor learners' perceived CoI presences on the link amid (learner control and learner engagement), (self-efficacy and learner engagement), and (learner motivation and learner engagement). The results are expected to help researchers and educators understand factors that affect learner engagement and assist them in the design of HyFlex courses and to provide necessary support for HyFlex learners. Therefore, the present investigation aims to address the following research questions (RQ):

- RQ1: To what extent does learner control significantly influence learners' engagement in the HyFlex College English course?
- RQ2: To what extent does self-efficacy significantly influence learners' engagement in the HyFlex College English course?
- RQ3: To what extent does learning motivation significantly influence learners' engagement in the HyFlex College English course?
- RQ4: To what extent do learners' perceived CoI presences significantly influence learners' engagement in the HyFlex College English course?
- RQ5: To what extent does learner control significantly influence learners' perceived CoI presences in the HyFlex College English course?
- RQ6: To what extent does self-efficacy significantly influence learners' perceived CoI presences in the HyFlex the College English course?
- RQ7: To what extent does learning motivation significantly influence learners' perceived CoI presences in the HyFlex College English course?
- RQ8: To what extent does the relationship between learner control and learners' engagement in the HyFlex College English course be mediated by the influence of learners' perceived CoI presences?
- RQ9: To what extent does the relationship between learners' self-efficacy and their engagement in the HyFlex College English course be mediated by the influence of learners' perceived CoI presences?
- RQ10: To what extent does the relationship between learning motivation and learners' engagement in the HyFlex College English course be mediated by the influence of learners' perceived CoI presences?

Previous studies showed that there are significant relationships among learner control, self-efficacy, learning motivation, learners' perceived CoI presences and learner engagement. The purpose of this study was to investigate the connections that exist between these variables. The research model is illustrated in Figure 1. The hypotheses are as:

- H1: Learner control has a positive direct effect on learners' engagement in HyFlex College English course.
- H2: Self-efficacy has a positive direct effect on learners' engagement in HyFlex College English course.

- H3: Learning motivation has a positive direct effect on learners' engagement in HyFlex College English course.
- H4: Learners' perceived CoI presences have positive direct effects on learners' engagement in HyFlex College English course.
- H5: Learner control has a positive direct effect on learners' perceived CoI presences in HyFlex College English course.
- H6: Self-efficacy has a positive direct effect on learners' perceived CoI presences in HyFlex College English course.
- H7: Learning motivation has a positive direct effect on learners' perceived CoI presences in HyFlex College English course.
- H8: Learners' perceived CoI presences mediate the relationship between learner control and learners' engagement in HyFlex College English course.
- H9: Learners' perceived CoI presences mediate the relationship between self-efficacy and learners' engagement in HyFlex College English course.
- H10: Learners' perceived CoI presences mediate the relationship between learning motivation and learners' engagement in HyFlex College English course.

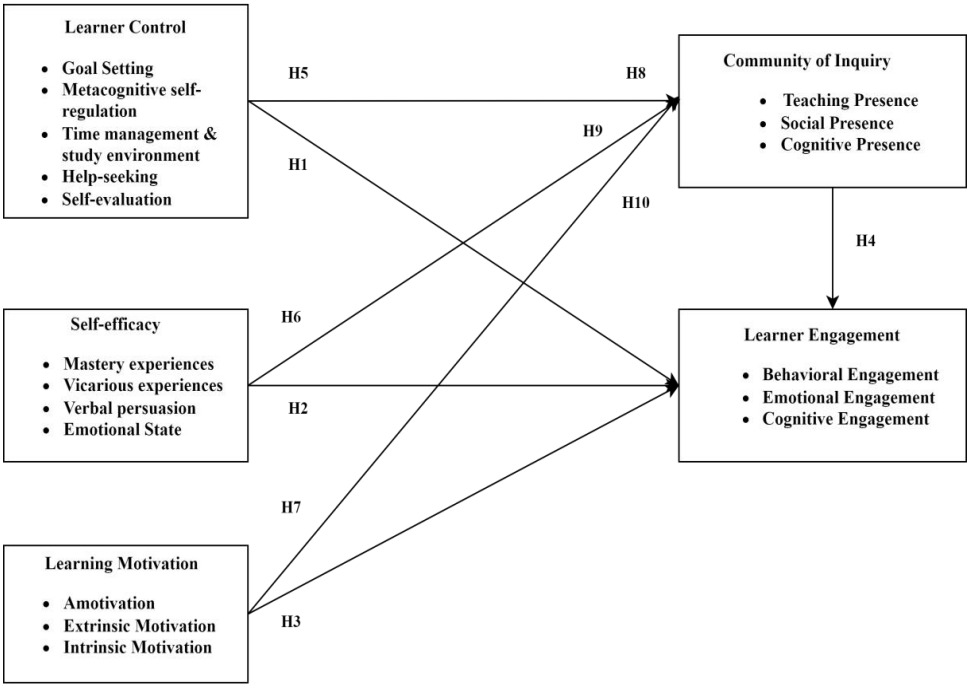

Figure 1. Proposed model

2. METHOD

2.1. Participants and procedures

Utilizing structural equation modeling (SEM), this quantitative study examined the structural relationships among learner control, self-efficacy, learner motivation, learners' perceived CoI presences and learner engagement. Furthermore, this study was conducted between March and July 2022 at a private college with three campuses in southwestern China. Participants were HyFlex students in their first and second years who were enrolled in a college English course. To guarantee a sample that is both fair and representative of the population, a cluster sampling method was implemented. 400 sets of questionnaires were distributed to three campuses of the college (Mianyang, Deyang, and Chengdu) where the research conducted. From the 400 questionnaires, 5 respondents (1.25%) did not return the questionnaire resulting in 395 returned data. Finally, the outliers and missing data (28 or 7.09%) were deleted, which resulted in 367 usable responses. Table 1 displays a summary of the data screening process.

Data collection was conducted using a questionnaire that was administered to the respondents through an online platform which is called WenJuanXing, a free online survey tool widely used in mainland

China. The time for the data collection process was around six weeks. Before distributing surveys, consent was obtained from the respondents. In addition, the participants were duly informed that the data they provided would be kept in absolute confidentiality and privacy. The study was confirmed by the research ethics committee at the authors' university to be in compliance with the worldwide principles for human research protection stated in the Helsinki Declaration.

Table 1. Data screening process

Information	Frequency	Percentage
Data distribution	400	100%
Not returned	5	1.25%
Total data (returned)	395	98.75%
Dropped data: missing data (15), extreme outliers (13)	28	7.09%
Cleaned and normal data	367	92.91%

2.2. Research instrument

The questionnaire consisted of two primary sections. Section A collected data on respondents' gender, age, year level, major, and type of study mode. Section B collected data on the factors examined in the study, which encompassed learner control, self-efficacy, learner motivation, learners' perceptions of CoI presences, and learner engagement.

Adapted from Pintrich *et al*. [26], the motivated strategies for learning questionnaire (MSLQ) was utilized to evaluate learner control. This scale comprised 20 items that corresponded to the following 6 primary domains: goal setting, metacognition, self-regulation, time management, help seeking, and self-evaluation. The language was changed to better fit the HyFlex learning situation. For example, "I set short-term goals as well as long-term goals to help me manage study time for my course" was modified to "I set short-term (daily or weekly) goals as well as long-term goals (monthly or for the semester) to help me manage study time for my online/face-to-face course" to fit the HyFlex learning environments. The instrument used a 7-point Likert scale to measure the level of learner control, and the reliability alpha was 0.971 for learner control.

Self-efficacy was measured using the MSLQ's Self-Efficacy for Learning & Performance scale, which was developed by Pintrich *et al*. [26] (Example scale item: "I believe I will receive an excellent grade in this class"). The instrument consists of 4 items rated on a 7-point Likert scale. Cronbach's alpha was utilized to determine the reliability coefficient, which was α=0.929.

Learning motivation was measured by using the questionnaire dealing with students' orientations towards language learning from Noels *et al*. [27] that published in the paper entitled "Why Are You Learning a Second Language? Motivational Orientations and Self-Determination Theory" (Example scale item: "Because I think it is good for my personal development"). Three primary domains comprised the 3-item instrument: intrinsic motivation, extrinsic motivation, and amotivation. The questionnaire utilized a 5-point Likert scale to collect responses. The scale's data indicated a high degree of reliability, as indicated by Cronbach's alpha (α)=0.914.

Learners' perceived CoI presences were assessed using an adapted version of a questionnaire developed by Arbaugh *et al*. [28] (Example scale item: "The instructor clearly communicated important course topics"). The instrument which consists of 9 items was divided into 3 main areas: teaching presence, social presence and cognitive presence. The questionnaire utilized a 5-point Likert scale to collect responses. Based on Cronbach's alpha (α=0.956), the scale exhibited a high degree of reliability.

Learner engagement was assessed by using a set of survey scales developed by Hiver *et al*. [29] (Example scale item: "I participated in all the activities"). Ten items, each rated on a 5-point Likert scale, comprise the instrument. The scale was highly reliable in terms of Cronbach's alpha: α=0.944.

2.3. Research instrument validity and reliability

A pilot study was conducted prior to the primary study to evaluate the questionnaire's validity and reliability, which included measures of learner control, self-efficacy, learner motivation, learners' perceived CoI presences, and learner engagement. Five experts utilized the content validity ratio (CVR) method to evaluate the design of the questionnaire. This approach has been extensively employed to attain and assess the content validity of research tools in many domains of inquiry, including market research, organizational development, personal psychology and healthcare [30]–[32], as well as in e-learning investigations [33]. When measuring the validity of expert judges in the literature on research instrument items, it is generally considered a standard to achieve 80% agreement across experts. Among the 60 items of the questionnaire, there were 7 items with a CVR score of 0, which was lower than 0.8 and were deleted. Finally, the final survey for data collection consisted of 53 items that received unanimous agreement (CVR=1) from all 5 experts.

In addition, Cronbach's alpha (α) was utilized to determine the internal consistency of the pilot test. According to Hair *et al.* [34], a value of α ≥0.8 is considered good, while a value of α ≥0.9 is considered exceptional. Table 2 demonstrates that the overall value has a dependability of 0.974. The Cronbach's alpha (α) for all five factors exceeded 0.8. Thus, the remarkable reliability was validated by the results of the pilot study.

Table 2. Alpha value for the pilot test

Variables	α value	Items
Learner control (LC)	0.989	20
Self-efficacy (SEFF)	0.961	4
Learning motivation (MOT)	0.808	7
Learners' perceived CoI presences	0.983	9
Learner engagement (ENG)	0.964	13
Overall	0.974	53

2.4. Data analysis

In determining the appropriate sample size for SEM, the sample-to-parameter ratio is frequently applied, which takes into account the number of estimated parameters. At least a 5-to-1 ratio is required [35], [36]. For instance, 50 respondents would be necessary to complete a study with 10 parameters. The minimum required sample size for this investigation, which comprises 20 parameters, is 100. Data for the current study were gathered from a sample of 400 students; thus, the sample size is adequate for performing SEM analysis. To process the data, the researchers initially utilized SPSS version 24.0 to do a preliminary analysis, which involved handling missing data and producing descriptive findings. Subsequently, the study model and associated assumptions were validated using Smart PLS version 3.3.3.

3. RESULTS

3.1. Descriptive statistics and correlations

In order to obtain a thorough comprehension of the gathered information, data was analyzed carefully using descriptive statistics and correlation analysis. These analyses provided valuable insights into the measured variables, which are summarized in Table 3. The computed statistical measures, such as the mean (representing averages) and standard deviations (indicating variances), exhibited a range of values, showing the diversity within the data. A standard deviation of 0.51 to 0.91 shows the degree of dispersion, while the mean values ranged from 3.55 to 4.78, indicating central tendencies. The data adhered to the normality assumptions for the purpose of SEM. Furthermore, all correlations among the variables were found to be statistically significant at a significance level of 0.05. The results indicate that the variables under consideration are meaningfully related and correlated. This comprehensive analysis aids in painting a clearer picture of the data set and the interconnections among the variables.

Table 3. Descriptive statistics and correlations of study variables

Variables	1	2	3	4	5
1 LC	1				
2 SEFF	.763**	1			
3 MOT	.417**	.513**	1		
4 CoI	.476**	.535**	.485**	1	
5 ENG	.597**	.667**	.622**	.703**	1
Mean	4.70	4.78	3.55	3.88	3.82
SD	.91	.89	.56	.57	.51
Skewness	-.13	.10	-.06	-.13	-.25
Kurtosis	2.08	.79	1.01	1.07	1.31

Note: N=367, **p<0.01, LC=Learner Control, SEFF=Self-efficacy, MOT=Motivation, CoI=Learners' perceptions of CoI presences, ENG=Engagement.

3.2. Evaluation of measurement model

To begin the examination of PLS-SEM data, it is necessary to analyze the measurement models. As stated in reference [37], the reflective measurement model is typically assessed using three fundamental criteria: convergent validity, discriminant validity, and internal consistency reliability. A summary of the evaluation's results is provided.

3.2.1. Internal consistency reliability

Cronbach's alpha (α) is the predominant measure utilized to evaluate internal consistency. The minimum threshold for α is 0.70, as stated in reference [34]. The SPSS 23.0 software was utilized to analyze the Cronbach's alpha coefficient, which yielded a value of 0.979 for a total of 46 items. As shown in Table 4, each factor and subscale surpassed Cronbach's alpha's recommended threshold level of 0.70, demonstrating the constructs' reliability. Therefore, the internal consistency reliability of the sample is guaranteed.

Table 4. The reliability test results

Item	α value	Item	α value	Item	α value
LC factor	0.973	LC17	0.978	CoI4	0.979
LC1	0.978	LC18	0.978	CoI5	0.979
LC2	0.978	LC19	0.978	CoI6	0.979
LC3	0.978	LC20	0.978	CoI7	0.979
LC4	0.978	SEFF factor	0.939	CoI8	0.979
LC5	0.978	SEFF1	0.978	CoI9	0.979
LC6	0.978	SEFF2	0.978	ENG factor	0.942
LC7	0.978	SEFF3	0.978	LE1	0.979
LC8	0.978	SEFF4	0.978	LE2	0.979
LC9	0.978	MOT factor	0.884	LE3	0.979
LC10	0.978	IM1	0.979	LE4	0.979
LC11	0.978	IM2	0.979	LE5	0.979
LC12	0.978	IM3	0.979	LE6	0.979
LC13	0.979	CoI factor	0.959	LE7	0.979
LC14	0.978	CoI1	0.979	LE8	0.979
LC15	0.978	CoI2	0.979	LE9	0.979
LC16	0.978	CoI3	0.979	LE10	0.979

3.2.2. Convergent validity

Convergent validity is often assessed using factor loading indices, which is achieved when the loading value is statistically significant. In order to achieve convergent validity, it is advised that the outer loadings should be greater than 0.50. Additionally, composite reliability (CR) and average variance extracted (AVE) values are utilized to evaluate convergent validity. When the CR is equal to or greater than 0.7 or 0.8 and the AVE is equal to or greater than 0.5, convergent validity is achieved [34]–[36]. All items had factor loadings exceeding the threshold of 0.5, as shown in Table 5. The CR for the factors exceeded the recommended minimum threshold of 0.7, with values of 0.9 and above. All the factors had an average value AVE that exceeded 0.5. The measurement model's results demonstrated that all the components exhibited sufficient convergent validity.

Table 5. The convergent validity results

No.	Construct	Items	Factor loading	CR	AVE	No.	Construct	Items	Factor loading	CR	AVE
1.	Learner control	GS1	0.789	0.975	0.662	3.	Motivation	IM1	0.900	0.929	0.813
		GS2	0.788					IM2	0.896		
		GS3	0.808					IM3	0.909		
		GS4	0.788			4.	Community of inquiry	TP1	0.853	0.966	0.758
		GS5	0.835					TP2	0.875		
		MSR1	0.797					TP3	0.879		
		MSR2	0.806					SP1	0.894		
		MSR3	0.811					SP2	0.824		
		TMSE1	0.798					SP3	0.885		
		TMSE2	0.810					CP1	0.885		
		TMSE3	0.862					CP2	0.872		
		TMSE4	0.791					CP3	0.869		
		HS1	0.760			5.	Learner engagement	BE1	0.720	0.951	0.659
		HS2	0.802					BE2	0.759		
		HS3	0.833					EE1	0.864		
		HS4	0.823					EE2	0.853		
		SE_1	0.832					EE3	0.849		
		SE_2	0.847					EE4	0.887		
		SE_3	0.812					EE5	0.850		
		SE_4	0.867					CE1	0.705		
2.	Self-efficacy	SEFF1	0.919	0.957	0.847			CE2	0.840		
		SEFF2	0.933					CE3	0.769		
		SEFF3	0.932								
		SEFF4	0.896								

3.2.3. Discriminant validity

The Fornell-Larcker criterion [38] is a frequently referenced and cautious metric used to evaluate discriminant validity. When applying the Fornell-Larcker criterion, it is important to ensure that the variance shared by all model constructs does not exceed the AVEs [35], [36]. The data presented in Table 5 indicates that the AVE exceeds the corresponding shared variance for each construct. For instance, the AVE for the construct of LC is .805, which exceeds all the shared variance values listed in the LC column. The results of the assessment of discriminant validity utilizing the Fornell-Larcker criterion are presented in Table 6. The confirmation of discriminant validity was achieved through the assessment of the Fornell-Larcker criterion using PLS-SEM.

Table 6. Results of discriminant validity based on the assessment of Fornell-Larcker criterion

	LC	SEFF	MOT	CoI	ENG
	0.805				
SEFF	0.726	0.908			
MOT	0.422	0.478	0.924		
CoI	0.480	0.497	0.391	0.863	
ENG	0.574	0.621	0.654	0.667	0.818

3.3. Evaluation of structural model

Next, the evaluation of PLS-SEM data entails analyzing the structural model. As stated in reference [37], the conventional evaluation criteria for the structural model comprise the following five aspects: assessment of collinearity, path coefficients of the structural model, coefficient of determination (R2), effect size (f2), and predictive relevance (Q2). Additionally, the study investigated how learners' perceived CoI presences mediated the relationship between each of the predictor variables (learner control, self-efficacy, and learner motivation) and learner engagement. The evaluation's findings are clearly detailed as follows:

3.3.1. Collinearity assessment

When assessing structural equation modeling, it is imperative to verify that the issue of collinearity has been resolved. The assessment of collinearity is conducted through the examination of the construct's variance inflation factor (VIF). As stated in reference [34], the VIF value of the construct should fall between the range of 0.20 to 5 in order to prevent collinearity problems. The VIF value of the SEM in this study, as shown in Table 7, ranges from 1.483 to 2.807, suggesting the absence of collinearity among the study dimensions.

Table 7. The collinearity assessment results

Model		Collinearity statistics	
		Tolerance	VIF
1	LC	0.412	2.428
	SEFF	0.356	2.807
	MOT	0.674	1.483
	CoI	0.645	1.551

a. Dependent variable: LE

3.3.2. Structural model path coefficients

The path coefficients of the structured model were evaluated using bootstrapping with 5000 subsamples, a two-tailed test, and a 0.05 level of significance. Statistical analysis reveals that, with the exception of H1, each of the proposed associations is significant, see Table 8. Based on the findings presented in Table 8, learner engagement can be predicted by the following predictors: self-efficacy (β=0.220, p<0.01), motivation (β=0.376, p<0.001), and learners' perceived CoI presences (β=0.413, p<0.001). However, learner control (β=0.079) did not demonstrate a significant association with learner engagement (p>0.05). As a result, H1 was not supported, whereas hypotheses H2, H3, and H4 were. In predicting learners' perceived CoI presences, learner control (β=0.299, p<0.001) is the most significant construct, followed by learner motivation (β=0.286, p<0.001), lastly, self-efficacy (β=0.249, p<0.01) has also significant relationship to learners' perceived CoI presences. Therefore, H5, H6, and H7 were all supported.

Table 8. Bootstrapping result and hypotheses testing

Hypotheses	Relationship	Std β	Std error	t-value	p-value	Supported
H1	LC->ENG	0.079	0.060	1.321	0.186	No
H2	SEFF->ENG	0.220**	0.065	3.369	0.001	Yes
H3	MOT->ENG	0.376***	0.056	6.693	0.000	Yes
H4	CoI->ENG	0.413***	0.047	8.888	0.000	Yes
H5	LC->CoI	0.299***	0.078	3.815	0.000	Yes
H6	SEFF->CoI	0.249**	0.072	3.442	0.001	Yes
H7	MOT->CoI	0.286***	0.055	5.215	0.000	Yes

Note. *p<0.05, **p<0.01, ***p<0.001

3.3.3. Coefficient of determination (R^2)

R^2 is used in SEM to measure how much variance is explained by the endogenous construct(s); it can be viewed as one of the main indicators for evaluating the paths of a structural model. The R^2 values fall between zero and one. A higher value of R^2 signifies a higher level of predictive accuracy. According to study by Hair *et al*. [37], a R^2 value exceeding 0.67 is regarded as high, while a value ranging from 0.33 to 0.67 is deemed moderate, and a value falling below 0.33 is regarded as weak. Table 9 and 10 display the computation result of the coefficient determination (R^2). The R^2 value for learner engagement is 0.720 (high) and for learners' perceived CoI presences is 0.425 (moderate). The results show a good level of predictive accuracy.

Table 9. The result of R^2 value for learner engagement

Construct	Relationships	R^2	Result (R^2)
ENG	LC→ENG	0.720	High effect
	SEFF→ENG		
	MOT→ENG		
	CoI→ENG		

Table 10. The result of R^2 value for learners' perceived CoI presence

Construct	Relationships	R^2	Result (R^2)
CoI	LC→CoI	0.425	Moderate effect
	SEFF→CoI		
	MOT→CoI		

3.3.4. Effect size (f^2)

The value of the effect size (f^2) indicates the relative impact that exogenous constructs have on endogenous constructs. According to the criteria provided in references [34] and [37], a value of 0.02 is considered to have a little influence, 0.15 is considered to have a moderate effect, and 0.35 is considered to have a substantial effect [37]. Table 11 indicates that learner control does not have a significant impact on learner engagement, while self-efficacy has a minor influence on learner engagement. Conversely, learner motivation has a moderate impact on learner engagement, whereas learners' perceptions of CoI have a significant impact on learner engagement.

Table 11. Effect sizes (f^2) results

Hypotheses	Relationship	Effect size (f^2)	Effect size
H1	LC→ENG	0.006	no
H2	SEFF→ENG	0.045	small
H3	MOT→ENG	0.175	medium
H4	CoI→ENG	0.351	large
H5	LC→CoI	0.043	small
H6	SEFF→CoI	0.039	small
H7	MOT→CoI	0.089	small

3.3.5. Predictive relevance (Q^2)

The structural model's quality is assessed using Q2, a metric designed to quantify the predictive significance of the model [34]. The acquisition of Q2 was achieved by the implementation of blindfolding techniques utilizing SmartPLS 3. The findings from Table 12 and Table 13 demonstrate that the Q2 result for learner engagement (0.468>0.35) has a significant predictive value, indicating a strong relationship.

Similarly, the Q2 result for learners' perceived CoI presences (0.317>0.15) also has a predictive value, though it is of a moderate level.

Table 12. The results of Q^2 value for learner engagement

Construct	Relationships	Q^2	Result (Q^2)
ENG	LC→ENG	0.468	Large effect
	SEFF→ENG		
	MOT→ENG		
	CoI→ENG		

Table 13. The result of (Q^2) for learners' perceived CoI presences

Construct	Relationships	Q^2	Result (Q^2)
CoI	LC→CoI	0.317	Medium effect
	SEFF→CoI		
	MOT→CoI		

3.3.6. Testing for mediation effect

The effects of mediation were assessed using bootstrapping analysis. In the current study, it was hypothesized that learners' perceived CoI presences would act as a mediator in the association between each predictor (i.e., learner control, self-efficacy, and learning motivation) and learner engagement. With a confidence level of 95%, the research employed 5000 bootstrap samples to conduct bias-corrected percentile bootstrapping. By employing this technique, an examination was conducted into the indirect impacts of the variables on learner engagement, with a particular focus on the mediating function of learners' perceived CoI presences.

In Table 14, the findings of the bootstrapping analysis are shown. First, it was found that learner control had an effect on learner engagement in two ways: directly (β=0.104, p<0.05) and indirectly (β=0.224, p<0.05). This suggests that the relationships between learner control and learner engagement were partially mediated by the learners' perceived CoI presences. Second, the relationship between learning motivation and learner engagement was both direct (β=0.376, p<0.05) and indirect (β=0.178, p<0.05), suggesting that learners' perceived CoI presences partially mediated the relationships between learning motivation and learner engagement. Third, learner engagement was influenced both directly (β=0.176, p<0.05) and indirectly (β=0.249, p<0.05) by self-efficacy, indicating that learners' perceived CoI presences partially mediated the relationships between self-efficacy and learner engagement.

Table 14. Indirect effects of the model

Relationship	*P*-value	Supported
H8: LC→CoI→ENG	0.001	Yes
H9: SEFF→CoI→ENG	0.001	Yes
H10: MOT→CoI→ENG	0.000	Yes

Note: ***p<.001, **p<.01, *p<0.05; Mediator: Learners' perceived CoI presences (CoI)

4. DISCUSSION

The objective of the study was to investigate the factors that influence learner engagement within HyFlex learning environments. To accomplish this, an empirical research-based investigation was conducted. The important results and their consequences are summarized.

4.1. Discussion of direct findings

As the first objective, this study examined whether the variables directly correlated. Out of the seven hypotheses proposed, only the first hypothesis yields an insignificant outcome. This finding implies that elements of learner control, including goal setting, metacognitive self-regulation, time management, study environment, help-seeking, and self-evaluation, do not directly influence learner engagement or the enhancement of learner participation in HyFlex learning. The findings of the first hypothesis were supported by Mozgalina [14] who indicated that "too much choice had a negative effect on task motivation and engagement, particularly for beginner learners". However, the findings of this hypothesis were in contrast to some previous studies [8], [13], which revealed that supporting learners' autonomy(control) in learning tasks

can enhance their motivation and engagement. The contradictions might be due to the differences among the study contexts. Thus, further research into the interplay of these two variables should be conducted to prove or disprove this result.

In comparison to learner control, self-efficacy showed a strong relationship with learner engagement, supporting the research models' second hypotheses. This is supported by Baba Rahim [15], who revealed that self-efficacy was a prominent antecedent related to classroom engagement and learning. Learners with more self-efficacy are more involved in their learning, show more interest and achieve more than those with lower self-efficacy levels. In this study, students in HyFlex learning environments who possess greater levels of self-efficacy in learning will be inclined to actively employ self-regulation techniques to enhance their cognitive skills, ultimately leading to improved learning outcomes. Thus, instructors should acquaint themselves with the learning environment and platform to support HyFlex learners and develop courses that promote a strong sense of self-efficacy among HyFlex learners, hence enhancing student engagement in HyFlex learning settings.

Consistent with the results reported by Singh *et al*. [18], a positive correlation was observed between learning motivation and learner engagement, as predicted by hypothesis H3. According to the findings of Singh *et al*. [18], motivation positively influenced engagement in a significant and direct way. As stated by Chiu [19], motivation is an impetus for engagement. To improve student engagement in HyFlex learning, there ought to be an emphasis on achievable and effective techniques to enhance the students' learning motivation, particularly intrinsic motivation. For example, letting the learners take control, giving students autonomy and responsibility, connecting with students' goals, values and identities, developing students' self-efficacy.

Lastly, the direct hypotheses found that learners' perceived CoI presences and engagement were significantly correlated. This finding was supported by some related literature [21]–[23] which showed that "teaching presence, cognitive presence and social presence were significant predictors of emotional engagement, behavioral engagement, and cognitive engagement." The results indicated that learners with high levels of perceptions of CoI presences engaged more than those who had low levels of perceptions of CoI presences in HyFlex learning environments.

4.2. Discussion of mediator findings

The second objective of this study was to investigate the indirect relationship between learner control and learner engagement, self-efficacy and learner engagement, and learner motivation and learner engagement, by considering the mediated effect of learners' perceived CoI presences. These hypotheses were supported. This result indicated that the role of learners' perceived CoI presences in HyFlex learning should be fully emphasized. Learners' perceived CoI presences, have been found to be a mediator in the previous literature related to online courses [39]–[41]. In this study, learners' perceived CoI presences play a significant role in enhancing the connection between learner control and engagement, self-efficacy and learner engagement, as well as learner motivation and engagement.

4.3. Theoretical implications

Based on the researchers' knowledge, this study is groundbreaking empirical research that intends to examine the factors that influence learner engagement in HyFlex learning settings specifically in the Chinese context. This study enhanced the current knowledge regarding the determinants of learner engagement in HyFlex learning settings. The implementation of HyFlex learning in China is now in its first stage, and this study will provide a complete framework for improving student engagement in HyFlex education. This model incorporated essential factors such as learner control, self-efficacy, and learner motivation. Additionally, the model highlighted the learners' perceived CoI presences as a mediator in the connection between learner engagement and these factors. Furthermore, there is a dearth of research studies conducted in the Chinese context that examine learner engagement in HyFlex learning environments using the SEM technique. However, this study enhanced the comprehension of the relationship between the variables by employing mediation analysis through the SEM approach. Thus, this study provided crucial assistance to prospective researchers by clarifying a novel methodological approach known as SEM, thereby facilitating its application in statistical analysis.

4.4. Practical implications

This research provides support for instructors and institutions of higher education that are adopting HyFlex learning approaches to assess and improve the level of student engagement during the learning process. To enhance learners' engagement in HyFlex learning, instructors should develop appropriate learning plans that prioritize certain factors such as learner control, self-efficacy, learner motivation, and learners' perceived CoI presences. Moreover, the institutions should employ the discoveries of these assessments to shape policy decisions.

4.5. Limitations and future research

This study is constrained by many limitations and constraints. First, this study is limited to individuals who are enrolled in a HyFlex learning program within a college English course at a private college located in the southwestern region of China. It is recommended to expand the research scope by incorporating more diverse courses (e.g., mathematics, accounting, art design) and universities (such as government universities) from various regions of China. Second, although the present study utilized a quantitative methodology, it is advisable that forthcoming studies integrate a qualitative approach to improve the accuracy and effectiveness of the factor analysis. Furthermore, the purpose of this research is to identify the variables that affect the level of engagement exhibited by HyFlex learners, including learner control, self-efficacy, learner motivation, and learners' perceived CoI presences. Additionally, it seeks to investigate how learners' perceived CoI presences mediate the connection between the aforementioned factors and learner engagement. This study can be expanded by examining supplementary latent variables, such as the HyFlex course design, the interaction between instructors and students, the teaching technique adopted by instructors, the characteristics of students, and how these factors impact the engagement of HyFlex learners.

5. CONCLUSION

HyFlex learning is gaining popularity in institutions of higher education due to its flexible and accessible nature. However, there are insufficient studies investigating student engagement in HyFlex learning and the factors that influence it. This study sought to investigate the determinants that impact student engagement in HyFlex learning, including learner control, self-efficacy, learning motivation, and learners' perceptions of CoI presences at a Chinese college. The findings revealed that self-efficacy, learner motivation, and learners' perceived CoI presences were directly and positively correlated with learner engagement. Nevertheless, learner control indirectly enhances learner engagement by means of the mediating influence of learners' perceived CoI presences. Moreover, learner' perceived CoI presences had an indirect influence on the connections between self-efficacy and learner engagement, as well as learner motivation and learner engagement. These results hold notable theoretical and practical significance for enhancing learner engagement in HyFlex learning settings. The theoretical aspect is that the comprehensive model established in this study bridges the gap between learner engagement and potential predictors, offering valuable insights for improving student engagement in HyFlex learning environments. From a practical standpoint, this research provides practical guidelines based on scientific evidence to enhance students' learning engagement in HyFlex courses, focusing on aspects like learner control, self-efficacy, motivation, and perceptions of CoI presences.

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