Examining the Impact of Learning Autonomy on Learning Performance in Blended Learning: Evidence from Higher Vocational Food Science Students

Yaru Xue[1,2], Nurhanim Saadah Binti Abdullah[1*]

[1]Faculty of Technical and Vocational Education, Universiti Tun Hussein Onn Malaysia, Parit Raja, Batu Pahat, Johor, 86400, Malaysia

[2]Faculty of Light Industry, Liming Vocational University,298 Tonggang West Street, Donghai Avenue, Fengze District, Quanzhou, 362000, China

***Corresponding author**

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ABSTRACT

Blended learning has become a pivotal instructional approach in higher vocational education; however, the factors that influence student performance within this context remain insufficiently examined. This study examines the effects of learning autonomy, learning satisfaction, and learning engagement on learning performance among students enrolled in Higher Vocational Food Science programs within a blended learning environment. A quantitative research design was adopted, and data were collected through a structured survey administered to a sample of students. Structural Equation Modeling (SEM) was employed to analyze the relationships among the core variables. The results indicate that learning autonomy, learning satisfaction, and learning engagement all significantly influence learning performance. Moreover, both learning satisfaction and learning engagement serve as significant mediators in the relationship between learning autonomy and performance. These findings underscore the importance of promoting learning autonomy to enhance engagement and satisfaction, ultimately leading to improved academic outcomes. This study contributes to the growing body of research on student success in vocational education and offers practical implications for optimizing blended learning strategies.

Keywords: Learning autonomy, satisfaction, engagement, learning performance, blended learning, higher vocational institution, food science

INTRODUCTION

In recent years, blended learning, which integrates face-to-face instruction with online learning components, has gained significant traction in higher vocational education due to its potential to enhance instructional flexibility, student engagement, and personalized learning [1-6]. In particular, BL has been increasingly adopted in vocational programs to address the growing need for skill-oriented, learner-centered education that bridges theoretical knowledge and practical application [7, 8]. Despite the growing interest in BL, understanding of the factors that influence student learning outcomes in this context remains limited, especially in vocational settings where learners often possess diverse backgrounds, motivations, and learning needs [9].

In the context of blended learning environments, a range of factors have been identified as predictors of academic success. Among these, learning autonomy has emerged as a construct of increasing relevance [10, 11]. Rooted in Self-Determination Theory, learning autonomy refers to students' ability to regulate and take ownership of their learning processes [12]. Prior studies have shown that autonomy-supportive learning environments contribute to increased satisfaction and academic engagement [13-16]. However, the mechanisms through which learning autonomy influences performance in vocational blended learning contexts remain insufficiently learning autonomy understood. While a growing body of research has examined the role of satisfaction and

engagement as mediators of learning outcomes [17], few studies have investigated how these variables interact with autonomy to shape student performance, particularly in practice-intensive fields such as food science.

Moreover, higher vocational education represents a distinct educational sector characterized by a focus on technical competencies, hands-on learning, and immediate labor market relevance [18]. This context requires pedagogical approaches that not only impart knowledge but also encourage students to actively engage in their own learning processes. In this regard, understanding how autonomy operates in conjunction with satisfaction and engagement can inform more effective BL design that aligns with the needs of vocational learners.

To address this gap, the present study examines the impact of learning autonomy on learning performance among students enrolled in Higher Vocational Food Science programs in a BL environment. Specifically, it explores the mediating roles of learning satisfaction and learning engagement in this relationship. By employing Structural Equation Modeling (SEM) to analyze survey data collected from higher vocational learners, this study aims to provide empirical insights into how autonomy contributes to academic outcomes in BL settings. The findings not only contribute to the theoretical understanding of learning autonomy in vocational education but also offer practical implications for enhancing the effectiveness of blended instructional strategies.

LITERATURE REVIEW AND HYPOTHESIS

A. Literature Review

Blended learning represents an innovative pedagogical model that deliberately integrates face-to-face instruction with online learning components in a coherent and complementary manner [19]. Originating from early experiments at Stanford University in the 1960s and 1970s through the use of instructional videos, BL has evolved alongside technological advancements to encompass diverse modalities such as computer-based, mobile, and distance learning [20]. This flexibility allows educators to design instructional models that are adaptable to the needs of learners, instructors, and subject-specific content [21, 22].

Unlike fully online or traditional face-to-face learning models, BL offers a hybrid structure that draws upon the strengths of both paradigms. It promotes ubiquity, self-paced learning, and autonomy while preserving the immediacy and relational dynamics of in-person instruction [1]. As such, it offers a hybrid structure that enhances learner-centeredness, fosters self-paced learning, and supports individualized learning trajectories. This hybrid format is particularly conducive to promoting learning autonomy, as it empowers students to exert greater control over the pace, sequence, and location of their learning [23, 24].

Empirical studies have shown that BL environments are positively associated with learning engagement, student satisfaction, and improved academic outcomes [21, 25-27]. Specifically, flipped classroom models, which represent a form of BL, have demonstrated that engaging with materials before class enhances collaboration and problem-solving during class, leading to deeper understanding and stronger emotional and cognitive engagement. [28, 29].

However, BL is not without challenges. Digital inequities, such as disparities in access to technology and internet connectivity, as well as differences in learners' digital literacy and self-regulatory abilities, may affect the efficacy of BL implementation [20, 21]. Therefore, successful BL depends not only on institutional infrastructure but also on learners' capacity for autonomous learning.

In the context of higher vocational education, particularly within food science programs, blended learning is especially valuable for its capacity to integrate theoretical knowledge with practical skills. The digital components facilitate flexible acquisition of conceptual content, while face-to-face sessions support hands-on learning. Given the dual nature of vocational competencies, the effectiveness of BL in this setting is significantly influenced by learner characteristics such as autonomy, engagement, and satisfaction, which in turn shape overall learning performance.

1) Learning Autonomy: Learning autonomy has emerged as a cornerstone of contemporary educational theory, particularly within blended and student-centered learning paradigms. Philosophically grounded in classical thought (e.g., Socrates, Plato, Aristotle) and further developed in modern pedagogical discourse, autonomy refers

to learners' ability to regulate and take responsibility for their own educational processes [30].

Holec [31] defined learning autonomy as "the ability to take charge of one's own learning," encompassing the capacity to set learning objectives, choose appropriate methods and resources, monitor one's own progress, and evaluate outcomes. Subsequent scholars such as Little [32] and Benson and Voller [33] emphasized its psychological, social, and rights-based dimensions, positioning autonomy as both a personal capacity and an educational goal.

Theoretically, learner autonomy aligns with humanistic, constructivist, and experiential learning frameworks, which emphasize learner agency, reflective thinking, and the construction of knowledge through active participation [34, 35]. In higher education, particularly under the influence of the Bologna Process, autonomy is increasingly seen not merely as an individual trait but as a transferable competence that can be fostered through intentional curriculum design [36, 37].

In BL environments, where learners must navigate both structured face-to-face and flexible online components, autonomy becomes especially critical. The asynchronous nature of digital learning requires students to manage their time, motivation, and cognitive strategies independently. Research confirms that autonomous learners exhibit higher confidence, stronger self-efficacy, and greater engagement in blended settings [38, 39].

Importantly, learning autonomy is a multidimensional construct involving motivational (goal-setting), volitional (self-discipline), and cognitive (planning and monitoring) elements [30]. These dimensions enable learners to actively manage their academic progress, which constitutes a critical skill in vocational programs that require the integration of theoretical knowledge and practical skills.

For vocational learners in food science, autonomy facilitates not only content mastery but also the development of applied skills, lifelong learning habits, and adaptability to industry changes. Thus, cultivating learning autonomy is central to optimizing student performance in blended vocational education.

2) Learning Performance: Learning performance refers to students' achievement of educational objectives and their perceived competence in academic tasks. In blended learning contexts, where self-directed learning is prevalent, performance is often captured through students' self-assessment, which reflects their ability to critically evaluate their learning progress [40].

Self-assessment enhances metacognition and self-regulated learning by encouraging learners to reflect on their strengths, identify areas for improvement, and adjust learning strategies accordingly [41, 42]. In technology-supported environments, digital platforms provide timely feedback and tracking mechanisms that further reinforce these self-evaluative behaviors [1].

Critically, self-assessment is both a manifestation and a catalyst of learning autonomy. Autonomous learners are more capable of engaging in reflective practices, which in turn strengthens their ability to self-regulate and maintain academic motivation [43, 44]. This bidirectional relationship underscores the importance of fostering autonomy to enhance learning performance in BL contexts.

In vocational settings, such as food science programs, where applied competencies are emphasized, self-assessment supports the development of practical, reflective, and transferable skills. Empirical studies confirm that self-assessment significantly improves learning performance and autonomy in both theoretical and practicum settings [40, 45, 46].

3) Learning Satisfaction: Learning satisfaction denotes students' subjective evaluation of their learning experiences, encompassing perceived relevance, instructional quality, and emotional engagement [47, 48]. Within BL environments, satisfaction is influenced by multiple factors, including instructional design, technological usability, teacher presence, and learner autonomy [49, 50].

Autonomy has been shown to be a powerful predictor of learning satisfaction. Learner autonomy, by allowing control over pace, learning paths, and strategies, fosters motivation and emotional engagement, both of which significantly contribute to learning satisfaction [50, 51]. Studies affirm that autonomous learners report higher

satisfaction with blended learning environments, which, in turn, promotes sustained academic engagement and performance [51, 52].

In vocational education, satisfaction plays a crucial role in ensuring persistence and success. When students feel empowered and supported in managing their learning, especially in demanding programs like food science, their overall satisfaction improves, contributing positively to academic achievement and skill development [53, 54].

4) Learning Engagement: Learning engagement is defined as the extent to which students are behaviorally, emotionally, and cognitively invested in their learning activities [55]. In BL settings, engagement is essential, as students must balance autonomous online study with structured face-to-face interactions. This dual demand increases the importance of self-regulation and learning autonomy [55, 56].

Research consistently indicates a strong positive correlation between engagement and academic performance [57, 58]. Students who are behaviorally engaged demonstrate greater participation; those who are emotionally engaged exhibit higher levels of interest and enthusiasm; and cognitively engaged students employ deep learning strategies. Each of these forms of engagement contributes to improved academic outcomes [59].

Autonomous learners tend to exhibit higher levels of engagement, as they take initiative, set goals, and persist through challenges [60, 61]. In turn, engagement mediates the relationship between autonomy and performance, acting as a conduit through which self-directed learning translates into academic success [62].

In vocational food science programs, where experiential learning is key, engaged learners are better positioned to connect theory to practice, enhancing both immediate academic performance and long-term professional competence.

B. Research Hypotheses

Based on the literature reviewed, the following hypotheses are proposed:

H1: Learning autonomy has a positive impact on learning performance in blended learning among food science students.

H2: Learning autonomy has a positive impact on the learning satisfaction of food science students in blended learning.

H3: Learning autonomy has a positive impact on the learning engagement of food science students in blended learning.

H4: Learning satisfaction has a positive impact on the learning performance of food science students in blended learning.

H5: Learning engagement has a positive impact on the learning performance of food science students in blended learning.

H6: Learning satisfaction mediates the effects of learning autonomy on the learning performance in blended learning.

H7: Learning engagement mediates the effects of learning autonomy on the learning performance in blended learning.

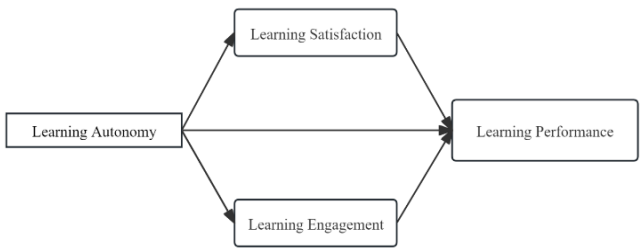

Fig. 1 Hypothesized model

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TABLE I Variables And Items Used In This Study

Variable	Sub-constructs	Item	Adapted from
Learning Autonomy	Autonomy Willingness	LA1	Chai [63]
		LA2	
		LA3	
	Learning Independence	LA4	
		LA5	
		LA6	
		LA7	
	Learning Programmability	LA8	
		LA9	
		LA10	
		LA11	
	Learning Creativity	LA12	
		LA13	
		LA14	
		LA15	
Learning Satisfaction	Course Satisfaction	SAT1	Wang [64]
		SAT2	
		SAT3	
		SAT4	
	Teaching Satisfaction	SAT5	
		SAT6	
		SAT7	
	Course Platform Satisfaction	SAT8	
		SAT9	
		SAT10	
	Expected Service Quality Satisfaction	SAT11	
		SAT12	
		SAT13	
	Perceived Service Quality Satisfaction	SAT14	
		SAT15	
		SAT16	
		SAT17	
	Overall Satisfaction	SAT18	
		SAT19	

		SAT20	
Learning Engagement	Cognitive Engagement	ENG1	Wang [64]
		ENG2	
		ENG3	
		ENG4	
	Emotional Engagement	ENG5	
		ENG6	
		ENG7	
		ENG8	
	Behavioral Engagement	ENG9	
		ENG10	
		ENG11	
		ENG12	
		ENG13	
Learning Performance	Knowledge and Skills	LO1	Wang [64]
		LO2	
		LO3	
	Enjoyment of and Proficiency in Learning	LO4	
		LO5	
		LO6	
		LO7	
		LO8	
	Social Participation	LO9	
		LO10	
		LO11	
	Professional Competence	LO12	
		LO13	

Fig. 1 illustrates the proposed hypothesized model, which depicts the hypothesized relationships among learning autonomy, learning satisfaction, learning engagement, and learning performance in the blended learning context.

METHODOLOGY

This study adopts a comprehensive SEM approach to explore the relationships among learning autonomy, satisfaction, engagement, and

TABLE II Criteria For Reliability Indicators

Internal Consistency Cronbach's α Values	Sub-scale Reliability
＞0.900	Highly satisfactory
0.800-0.899	Excellent

0.700-0.799	Good
0.600-0.699	Fair
0.500-0.599	Acceptable, but on the lower side
＜0.500	Unsatisfactory, better to delete

performance in blended learning environments for food science majors at higher vocational institutions. It investigates the direct effects of learning autonomy, satisfaction, and engagement on performance and further explores the mediating roles of satisfaction and engagement in the relationship between autonomy and performance.

A. Research Design

To gain a comprehensive understanding of the relationship between learning autonomy and learning performance in blended learning environments, a hypothesized model was developed following a detailed literature review. Based on this model, an online questionnaire was constructed and disseminated via the Learning Management System (LMS).

The questionnaire consisted of five parts: demographic information, learning autonomy, learning satisfaction, learning engagement, and learning performance. Measurement items for learning autonomy were adapted from Chai [63], while items for satisfaction, engagement, and performance were adapted from Wang [64]. All items were rated on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree).

To ensure content validity, the questionnaire was reviewed by five experts, including two specialists in the field of food science and three experts in vocational education, all of whom have over five years of teaching experience. This expert review process ensured both the disciplinary relevance and pedagogical appropriateness of the questionnaire.

Data collection was conducted in March and April 2025. All respondents provided informed consent, and ethical protocols were strictly adhered to throughout the research process. The reliability of the instrument was assessed using Cronbach's alpha, and construct validity was evaluated through convergent and discriminant validity. SEM analysis was conducted using AMOS v.26, and bootstrapping was employed to assess the significance of the mediating effects. The measurement items are detailed in Table I.

B. Reliability and Validity of Instrument

Cronbach's alpha was used to evaluate the internal consistency of each construct, following Pallant [65]. A value above 0.900 indicates excellent reliability [66]. Items with alpha values below 0.600 were considered for elimination [67].

The instrument measured five dimensions: demographic information, learning autonomy, learning satisfaction, learning engagement, and learning performance. Internal consistency and specific thresholds for each subscale are reported in Table II.

Construct validity was examined through Confirmatory Factor Analysis (CFA) in AMOS v.26. Convergent validity was assessed via factor loadings, Average Variance Extracted (AVE), and Composite Reliability (CR). The accepted cut-off values were 0.5 for factor loadings and AVE, and 0.7 for CR [68]. Discriminant validity was established by confirming that the square root of the AVE for each latent construct exceeded its corresponding inter-construct correlations [69].

The reliability and validity outcomes are summarized in Table III. All subscales showed Cronbach's alpha values > 0.7, factor loadings > 0.5, and satisfactory AVE and CR values.

Table IV demonstrates that each construct achieved discriminant validity, as each construct's AVE square root exceeded the inter-construct correlations.

C. Respondents Profile

Respondents were from three majors: Food Inspection and Testing Technology, Intelligent Food Processing Technology, and Food Quality and Safety at Liming Vocational University (LMU). Data were collected through Wjx.cn. The process included a pilot test and used random sampling. Of the 985 responses collected, 974 valid responses were retained after data screening.

Demographic details are shown in Table V. Of the participants, 66.02% were female. In terms of academic majors, 59.34% studied Food Inspection and

Table III Reliability And Validity Of Measures

Main constructs	Sub-constructs	Item	Mean	SD	Loading	α	CR	AVE
Learning Autonomy	Autonomy Willingness	LA1	4.53	1.956	0.922	0.795	0.832	0.952
		LA2	4.28	1.573				
		LA3	4.26	1.556				
	Learning Independence	LA4	4.22	1.563	0.914	0.815		
		LA5	4.29	1.540				
		LA6	4.28	1.567				
		LA7	4.25	1.561				
	Learning Programmability	LA8	4.20	1.536	0.909	0.858		
		LA9	4.27	1.540				
		LA10	4.24	1.547				
		LA11	4.22	1.518				
	Learning Creativity	LA12	4.25	1.521	0.904	0.893		
		LA13	4.16	1.535				
		LA14	4.25	1.511				
		LA15	4.23	1.522				
Learning Satisfaction	Course Satisfaction	SAT1	4.51	1.897	0.922	0.877	0.8	0.96
		SAT2	4.30	1.553				
		SAT3	4.26	1.559				
		SAT4	4.26	1.551				
	Teaching Satisfaction	SAT5	4.33	1.573	0.89	0.832		
		SAT6	4.30	1.533				
		SAT7	4.24	1.548				
	Course Platform Satisfaction	SAT8	4.27	1.563	0.888	0.812		
		SAT9	4.23	1.526				
		SAT10	4.29	1.578				
	Expected Service Quality	SAT11	4.30	1.572	0.873	0.842		
		SAT12	4.30	1.496				

	Satisfaction	SAT13	4.25	1.564				
	Perceived Service Quality Satisfaction	SAT14	4.25	1.534	0.91	0.821		
		SAT15	4.23	1.523				
		SAT16	4.30	1.576				
		SAT17	4.30	1.564				
	Overall Satisfaction	SAT18	4.34	1.523	0.882	0.877		
		SAT19	4.29	1.543				
		SAT20	4.23	1.586				
Learning Engagement	Cognitive Engagement	ENG1	4.51	1.973	0.93	0.839	0.854	0.946
		ENG2	4.24	1.558				
		ENG3	4.21	1.530				
		ENG4	4.25	1.577				
	Emotional Engagement	ENG5	4.22	1.582	0.913	0.933		
		ENG6	4.30	1.617				
		ENG7	4.25	1.573				
		ENG8	4.18	1.505				
	Behavioral Engagement	ENG9	4.22	1.562	0.929	0.882		
		ENG10	4.29	1.539				
		ENG11	4.25	1.553				
		ENG12	4.21	1.606				
		ENG13	4.21	1.593				
Learning Performance	Knowledge and Skills	LO1	4.51	1.733	0.898	0.876	0.771	0.931
		LO2	4.23	1.431				
		LO3	4.21	1.439				
	Enjoyment and Proficiency in Learning	LO4	4.24	1.471	0.927	0.931		
		LO5	4.19	1.442				
		LO6	4.24	1.413				
		LO7	4.18	1.473				
		LO8	4.25	1.450				
	Social Participation	LO9	4.22	1.415	0.872	0.779		
		LO10	4.22	1.477				
		LO11	4.24	1.481				
	Professional Competence	LO12	4.30	1.464	0.81	0.788		
		LO13	4.18	1.470				

Testing, 7.70% studied Intelligent Food Processing, and 32.96% studied Food Quality and Safety. Regarding computer skills, 43.63% rated themselves as low, 37.78% as intermediate, and 18.58% as high.

D. Data Collection Procedures

The data for this study were collected through an online questionnaire hosted on the Chinese survey platform Wjx.cn. Prior to distribution, ethical approval was obtained from the relevant institutional review board to ensure compliance with research ethics. The survey link was then disseminated via the institution's LMS, allowing convenient access for the target participants. Before completing the questionnaire, participants were provided with an informed consent statement outlining the study's objectives, the voluntary nature of participation, and assurances of confidentiality and anonymity. Only those who agreed to the

Table IV Discriminant Validity

Constructs	**1**	**2**	**3**	**4**
1. Learning Autonomy	**0.912**			
2. Learning Satisfaction	0.429**	**0.894**		
3. Learning Engagement	0.439**	0.459**	**0.924**	
4. Learning Performance	0.493**	0.505**	0.549**	**0.878**

Note: Diagonal values in bold represent the square root of the AVE; off-diagonal values indicate inter-construct correlations. ** indicates significance at $p < 0.01$.

TABLE V Characteristics Of The Sample

Characteristics	%
Major	
Food Inspection and Testing Technology	59.34
Food Intelligent Processing Technology	7.70
Food Quality and Safety	32.96
Gender	
Male	33.98
Female	66.02
Computer skill level	
Low	43.63
Medium	37.78
High	18.58

terms proceeded to complete the survey, ensuring that data collection adhered to ethical and procedural standards.

E. Data Analysis Procedures

The collected data were first screened and coded using SPSS v.21. Descriptive statistics, reliability analysis, and correlation analysis were conducted to ensure the quality and suitability of the dataset for further

modeling. SEM was then performed using AMOS v.26 to test the hypothesized structural relationships among learning autonomy, satisfaction, engagement, and performance. To assess the mediating effects of learning satisfaction and learning engagement on the relationship between autonomy and academic performance, the bootstrapping method with 5,000 resamples was applied. This non-parametric technique provided bias-corrected

confidence intervals for the indirect effects, thereby offering a robust test of mediation pathways.

F. Qualitative Procedure

To complement the quantitative findings and gain deeper insights into students' experiences of learning autonomy and engagement, a qualitative phase was conducted using semi-structured interviews. A purposive sampling strategy was adopted to recruit 10 students from the original survey pool who expressed willingness to participate in follow-up interviews.

Each interview lasted approximately 35–45 minutes and was conducted via online conferencing platforms. The interview protocol focused on students' perceptions of learning autonomy, engagement, and satisfaction with the blended learning environment. All interviews were audio-recorded with participants' consent and subsequently transcribed verbatim in Chinese. For the purpose of reporting and thematic analysis, relevant excerpts were translated into English and checked by a bilingual expert to ensure accuracy.

Thematic analysis was used to analyze the interview data, following Braun and Clarke's six-phase framework [70]. Codes were generated inductively and grouped into broader themes that reflected common patterns across participants. To ensure trustworthiness, two researchers independently coded a subset of transcripts and discussed discrepancies to reach consensus.

RESULTS AND DISCUSSION

SEM was conducted using AMOS v.26 to examine the hypothesized relationships among learning autonomy, satisfaction, engagement, and academic performance. The model estimation employed the maximum likelihood method, which is widely recognized for its robustness and suitability for large sample sizes and normally distributed data. This analytical approach enabled the simultaneous testing of both direct and indirect effects among the variables, offering a comprehensive understanding of the structural pathways.

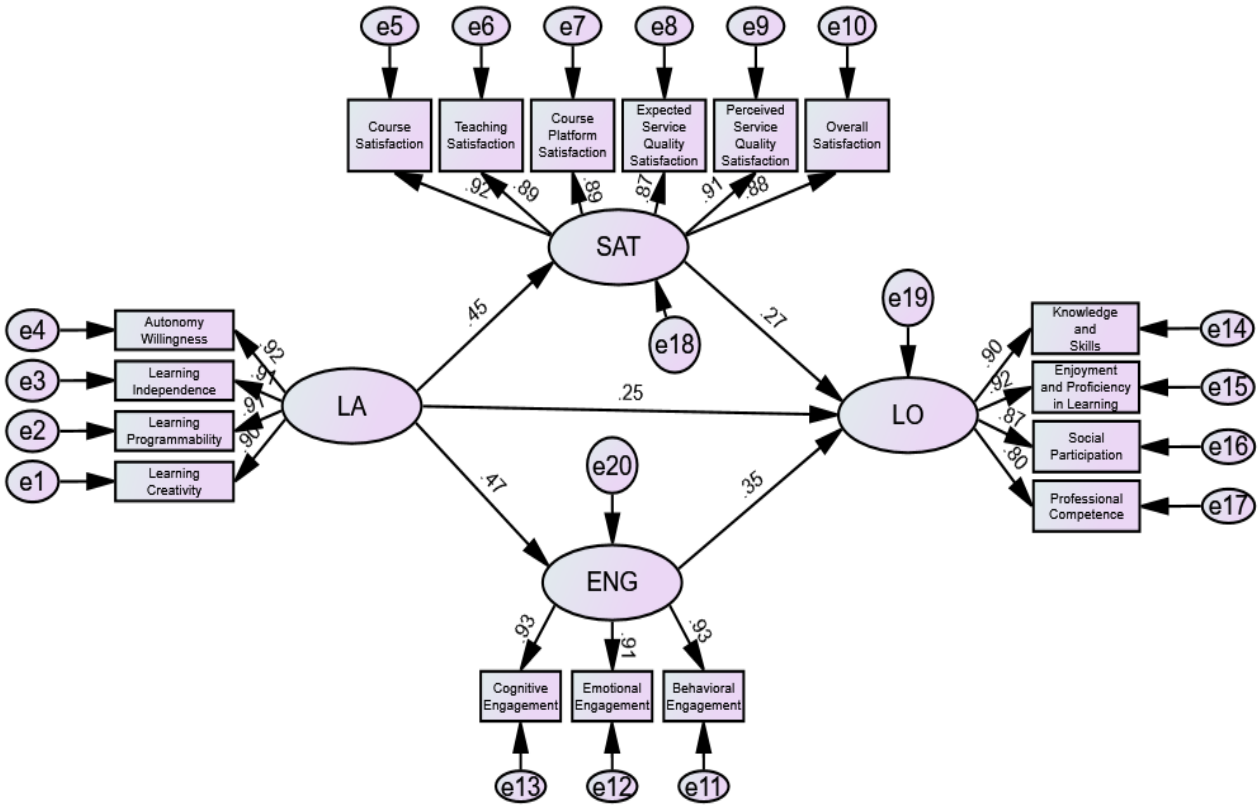

Fig. 2 Estimation of model

Table VI Fit Indices

Category	Indicator Name	Fit Criterion	Test Result	Acceptable
Absolute Fit Indices	GFI	>0.8	0.962	Accepted
	AGFI	>0.8	0.949	Accepted
	RMSEA	<0.08	0.045	Accepted
Incremental Fit Indices	NFI	>0.8	0.981	Accepted
	IFI	>0.8	0.987	Accepted
	CFI	>0.8	0.987	Accepted
	RFI	>0.8	0.977	Accepted
Parsimony Fit Indices	CMIN/df	<3	2.973	Accepted
	PGFI	>0.5	0.717	Accepted

The subsequent sections present and interpret the results of the model fit and path coefficient analysis.

A. Structural Model

The structural model demonstrated an acceptable fit to the data, as evidenced by the fit indices presented in Fig. 2 and Table VI, indicating a satisfactory model fit.

As shown in Table VII, the path coefficient analysis revealed that learning autonomy exerted significant positive effects on learning satisfaction ($\beta = 0.12$, $p < 0.001$), learning engagement ($\beta = 0.148$, $p < 0.001$), and academic performance ($\beta = 0.076$, $p = 0.011$). These results highlight the importance of fostering autonomy-supportive learning environments. Students who perceive higher levels of autonomy tend to report greater satisfaction with their learning experiences, likely due to the fulfillment of intrinsic psychological needs, as posited by Self-Determination Theory [71].

This positive association suggests that autonomous learners tend to engage more cognitively, emotionally, and behaviorally in learning activities, which significantly predicts academic success [72]. Although the direct effect of autonomy on academic performance is relatively modest, it remains statistically significant. This finding supports prior research suggesting that autonomy enhances learners' self-regulatory strategies, thereby indirectly contributing to improved academic outcomes [73-78].

Furthermore, both learning satisfaction and learning engagement significantly predicted learning performance, with engagement exerting a stronger influence ($\beta = 0.183$, $p < 0.001$) than satisfaction ($\beta = 0.086$, $p = 0.004$). This is consistent with previous research identifying learning satisfaction as a meaningful predictor of learning performance [51, 79, 80]. However, the stronger effect of engagement underscores its more immediate and impactful role in shaping academic outcomes. While satisfaction captures learners' affective evaluations of their educational experience, engagement reflects their active participation and sustained effort, which are essential for academic success [60, 81, 82].

The greater impact of engagement suggests that satisfaction alone is insufficient; sustained and meaningful engagement serves as a more powerful driver of learning performance [82-84]. These findings align with prior studies that position engagement as a key mediating mechanism linking autonomy to tangible learning performance.

B. The Mediation Roles of Learning Satisfaction and Learning Engagement

Table VII presents the results of the mediation analysis examining the

Table VII Structural Model Results

Path	Standardized Path Coefficient	Unstandardized Path Coefficient	S.E.	C.R.	*p*	H
LA →SAT	0.12	0.138	0.039	3.498	***	Supported
LA→ENG	0.148	0.175	0.041	4.266	***	Supported
LA→LP	0.076	0.08	0.032	2.538	0.011	Supported
SAT→LP	0.086	0.079	0.027	2.901	0.004	Supported
ENG→LP	0.183	0.163	0.027	6.091	***	Supported

TABLE VIII Mediating Analysis

Mediating Paths	Parameter	Estimate	Lower	Upper	P
Learning Autonomy → Learning Satisfaction → Learning Performance	Direct effect	0.076	0.007	0.138	0.029
	Mediate effect	0.01	0.002	0.025	0.006
	Total effect	0.086	0.019	0.149	0.009
Learning Autonomy → Learning Engagement → Learning Performance	Direct effect	0.076	0.007	0.138	0.029
	Mediate effect	0.027	0.012	0.048	0
	Total effect	0.103	0.036	0.168	0.002

indirect effects of learning satisfaction and learning engagement on the relationship between learning autonomy and learning performance. Two mediation pathways were tested: (1) learning autonomy → learning satisfaction → learning performance, and (2) learning autonomy → learning engagement → learning performance.

The results indicate that learning satisfaction significantly mediated the relationship between autonomy and performance, with a mediation effect of 0.010 (95% CI [0.002, 0.025], $p = 0.006$). The total effect for this pathway was 0.086 ($p = 0.009$), while the direct effect remained significant at 0.076 ($p = 0.029$), suggesting a partial mediation. Similarly, learning engagement also served as a significant mediator, with a mediation effect of 0.027 (95% CI [0.012, 0.048], $p < 0.001$). The total effect for this pathway was 0.103 ($p = 0.002$), while the direct effect remained at 0.076 ($p = 0.029$), confirming partial mediation.

These findings emphasize the critical mediating roles of both satisfaction and engagement in translating learning autonomy into improved academic outcomes. Consistent with Self-Determination Theory [71], autonomy fulfills a basic psychological need that fuels intrinsic motivation, leading to greater satisfaction with the learning process [83-85]. Learning environments that support autonomy enhance students' sense of agency and purpose, thereby promoting greater satisfaction [13, 86, 87]. The observed mediating effect of satisfaction reinforces the notion that emotionally positive learning experiences foster academic persistence and sustained effort.

Importantly, learning engagement demonstrated a stronger mediating effect than satisfaction, suggesting that cognitive and behavioral investment in learning plays a more immediate role in driving academic performance. Autonomous learners are generally more proactive, self-regulated, and actively engaged in academic tasks, which leads to deeper cognitive and emotional engagement [72]. Philp and Duchesne (2016) argue that learner engagement comprises multiple interrelated dimensions, including cognitive, behavioral, emotional, and social aspects [88], all of which have been consistently linked to improved academic achievement [60]. These findings align with existing empirical evidence confirming the mediating role of engagement in the relationship between autonomy and learning performance [17].

C. Qualitative Findings

To further interpret and contextualize the quantitative findings, semi-structured interviews were conducted with ten students from the original survey

TABLE IX Themes Identified From Semi-Structured Interviews

Theme	Description	Sample Quote
Autonomous Learning Strategies	Students described self-directed planning, goal-setting, and LMS navigation.	"I always set a weekly plan and check off tasks on the LMS." – P3
Challenges in Self-Regulation	Some students reported procrastination and distraction in online learning.	"Without a teacher watching, I just keep postponing tasks." – P7
Engagement through Practice	Practical tasks increased relevance and motivation.	"When we do food experiments, I feel more engaged." – P5
Feedback and Interaction	Timely teacher feedback and LMS interaction boosted satisfaction.	"Quick replies from the teacher made me feel they cared." – P2
Need for Structured Support	Students suggested that guided modules or reminders help stay on track.	"Autonomy is good, but reminders help me stay disciplined." – P9

Note: P1–P10 refer to anonymized participant codes used to protect student identities. All quotes were translated from Mandarin Chinese and lightly edited for clarity and readability.

sample. A thematic analysis of the interview data revealed five core themes: autonomous learning strategies, challenges in self-regulation, engagement through practice, the role of feedback and interaction, and the need for structured support. These themes are summarized in Table IX.

Many students appreciated the flexibility of blended learning, which enabled them to take control of their learning schedules and revisit online materials as needed. As one participant described, "I can study at my own pace and go back to videos when I don't understand something." Such autonomy was closely tied to increased motivation and confidence.

However, autonomy was not universally positive. Several students expressed difficulty maintaining self-discipline in online settings, citing procrastination and distraction. One student noted, "Without a teacher watching, I get distracted easily and often delay my work." These insights suggest that while autonomy promotes learner agency, it may also create barriers for students lacking in self-regulation.

Engagement was found to be significantly enhanced by practical assignments and active learning components. Tasks related to real-world food production were particularly effective in maintaining focus and interest. Moreover, timely feedback and interactive features within the LMS were mentioned as critical factors contributing to satisfaction and ongoing engagement.

These qualitative findings reinforce the quantitative results and illustrate the nuanced role of autonomy in vocational blended learning. They highlight the importance of designing learning environments that balance flexibility with appropriate scaffolding to support diverse learner needs.

CONCLUSION

This study investigated the structural relationships among learning autonomy, satisfaction, engagement, and

academic performance in blended learning environments, with a focus on food science majors at higher vocational institutions. Using data from 974 valid responses, structural equation modeling (SEM) was employed to analyze both direct and indirect pathways among these key variables. Three primary findings emerged.

First, learning autonomy had a significant impact on learning performance, both directly and through mediating variables. Students who demonstrated higher levels of autonomy reported better academic outcomes. This supports Self-Determination Theory, which posits that autonomy fosters intrinsic motivation and enhances learning behaviors.

Second, both learning engagement and learning satisfaction were identified as mediators in the autonomy–performance relationship, with engagement exhibiting a stronger mediating effect. While satisfaction reflects affective responses to the learning environment, engagement—encompassing cognitive, emotional, and behavioral involvement—was more directly linked to academic achievement.

Third, learning engagement emerged as the strongest predictor of academic performance, emphasizing the importance of fostering active and sustained learner involvement in blended learning environments.

These findings have important theoretical and practical implications. Theoretically, the study enriches our understanding of how autonomy influences academic success, particularly through the dual mediating pathways of satisfaction and engagement. It also reinforces the applicability of Self-Determination Theory in technology-enhanced vocational education.

From a practical standpoint, the results offer actionable insights for curriculum designers and LMS developers. Curriculum designers should consider integrating autonomy-supportive strategies—such as self-paced learning modules, flexible assignment deadlines, and project-based learning—to foster student agency. Simultaneously, LMS developers can enhance learner engagement by embedding interactive tools, timely feedback mechanisms, and features that facilitate peer collaboration and progress tracking. Designing LMS environments that scaffold autonomy while minimizing the risks of learner disengagement (e.g., procrastination or lack of structure) is critical.

For vocational educators, these findings underscore the importance of balancing flexibility with structured guidance. While blended learning environments offer opportunities for personalized learning, they must be intentionally designed to support diverse learner needs through motivational scaffolds and meaningful engagement.

Finally, qualitative interview data provided additional insight into the psychological mechanisms underpinning learning autonomy and engagement, further validating the quantitative findings and emphasizing the need for pedagogical and technological designs that align with learners' motivational and self-regulatory profiles.

LIMITATIONS AND FUTURE DIRECTIONS

Despite the methodological rigor and robustness of the findings, several limitations must be acknowledged, particularly regarding the generalizability of the results.

First, this study was conducted within a single higher vocational institution in China and focused exclusively on students majoring in Food Science. While this context provides valuable insights into a specific and under-researched educational setting, the narrow institutional and disciplinary scope limits the generalizability of the findings. Institutional culture, program structure, student demographics, and subject-specific characteristics may vary across contexts and influence the applicability of the results. Moreover, these findings are primarily relevant to institutions that implement blended learning supported by a LMS. Therefore, caution is advised when extending these conclusions to different academic disciplines, technological infrastructures, or educational systems not utilizing LMS-based blended learning environments.

Second, the study did not incorporate several contextual factors that may significantly interact with the core variables. For example, instructional design, teaching style, and the specific configuration of blended learning

environments were not examined. Future studies should consider including such variables to offer a more comprehensive understanding of the dynamics influencing learning performance in blended settings.

To improve external validity and enhance the theoretical scope of this research, future work should replicate the study across multiple institutions, academic disciplines, and sociocultural contexts. Additionally, longitudinal research designs may uncover how learning autonomy, engagement, and satisfaction develop over time. Further investigations might also explore the moderating or mediating roles of institutional support, digital tools, and socio-emotional variables in shaping students' learning experiences and academic outcomes within blended learning environments.

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Conflict Of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: study conception and design: Yaru Xue; data collection: Yaru Xue; analysis and interpretation of results: Yaru Xue; draft manuscript preparation: Yaru Xue, Nurhanim Saadah Binti Abdullah. All authors reviewed the results and approved the final version of the manuscript.

REFERENCES

1. Alali, R. & Wardat, Y. (2024). The Essence of Blended Learning: What It Really Means? International Journal of Religion, 5(9), 1081-1088.
2. Vishal, A. (2024). Theoretical Perspectives on Blended Learning Integrating Traditional and Digital Pedagogies. International Journal For Multidisciplinary Research, 6(5).
3. Moreira, F.P. & Lima, D.A. (2024). Systematic literature review on the impact of Blended Learning in promoting student engagement and autonomy: findings and recommendations. Revista Brasileira de Informática na Educ., 32, 242-269.
4. Sun, X. & Guan, H. (2021). Research on Blended Learning Practice Based on Student Engagement. Proceedings of the 7th International Conference on Social Science and Higher Education (ICSSHE 2021).
5. Wafik, H., Mahbub, S., & Das, J. (2024). Optimizing Strategies for Enhanced Effectiveness in Blended Learning Models. Cognizance Journal of Multidisciplinary Studies, 4(7), 197-219.
6. Cheung, S., Lee, L.-K., Šimonová, I., et al. (2019). Blended Learning: Educational Innovation for Personalized Learning. 11546.
7. Yang, S. & Bai, H. (2020). Research on the Blended Learning Mode of "Theory + Practice" Curriculum. 2020 International Conference on Artificial Intelligence and Education (ICAIE), 485-488.
8. Demaidi, M.N., Qamhieh, M., & Afeefi, A. (2019). Applying Blended Learning in Programming Courses. IEEE Access, 7, 156824-156833.
9. Cao, Y., Aziz, A.A., & Arshard, W.N.R.M. (2024). Performance and Perception Disparities in Blended Learning Across Varied Vocational Academic Backgrounds. Journal of Educational Technology Development and Exchange, 17(2), 176-198.
10. Sun, S. (2023). The Effects of Learner Autonomy on Academic Performance Among Cambodian Students Studying English in Higher Education. International Journal of Scientific and Research

Publications, 13(6), 206-210.
11. Jehanghir, M., Ishaq, K., & Akbar, R.A. (2023). Effect of learners' autonomy on academic motivation and university students' grit. Educ. Inf. Technol., 29, 4159-4196.
12. Anca, M.-I. (2023). Autonomous Learning – A Theoretical Approach. Journal Plus Education, 33(SI), 301-309.
13. Bonem, E., Fedesco, H., & Zissimopoulos, A. (2020). What you do is less important than how you do it: the effects of learning environment on student outcomes. Learning Environments Research, 23, 27-44.
14. Earl, S. (2019). Building autonomous learners: perspectives from research and practice using self-determination theory. British Journal of Educational Studies, 67, 269-271.
15. Kaplan, H. (2018). Teachers' autonomy support, autonomy suppression and conditional negative regard as predictors of optimal learning experience among high-achieving Bedouin students. Social Psychology of Education, 21, 223-255.
16. Soe, H.Y., Zhang, D., Fu, D., et al. (2025). How an autonomy-supportive learning environment influences students' achievements in science and mathematics. Social Psychology of Education, 28(1), 53.
17. Wei, X., Saab, N., & Admiraal, W. (2022). Do learners share the same perceived learning outcomes in MOOCs? Identifying the role of motivation, perceived learning support, learning engagement, and self-regulated learning strategies. Internet High. Educ., 56, 100880.
18. Xu, N. (2022). Prominent vocational characteristics are the core of higher vocational education teaching reform.
19. Garrison, D.R. & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. The Internet and Higher Education, 7(2), 95-105.
20. Batista-Toledo, S. & Gavilan, D. (2023). Student Experience, Satisfaction and Commitment in Blended Learning: A Structural Equation Modelling Approach. Mathematics, 11(3), 749.
21. Belur, J. & Bentall, C. (2023). Reviewing the 3C's of blended learning for police education: assessing capacity, building capability, and conquering challenges. Police Practice and Research, 25(2), 168-188.
22. Goedhart, N.S., Blignaut-van Westrhenen, N., Moser, C., et al. (2019). The flipped classroom: supporting a diverse group of students in their learning. Learning Environments Research, 22(2), 297-310.
23. Chen, M., Ye, L.P., & Weng, Y.C. (2022). Blended teaching of medical ethics during COVID-19: practice and reflection. BMC Medical Education, 22(1), 361.
24. Staker, H. & Horn, M.B. (2012). Classifying K-12 blended learning. Innosight institute.
25. Ballard, J., Gamage, S., Winfield, L., et al. (2023). Cognitive discourse during a group quiz activity in a blended learning organic chemistry course. Chemistry Teacher International, 5(3), 245-261.
26. Flynn, A.B. (2015). Structure and evaluation of flipped chemistry courses: organic & spectroscopy, large and small, first to third year, English and French. Chemistry Education Research Practice, 16(2), 198-211.
27. Liu, Y., Raker, J.R., & Lewis, J.E. (2018). Evaluating student motivation in organic chemistry courses: moving from a lecture-based to a flipped approach with peer-led team learning. Chemistry Education Research Practice, 19(1), 251-264.
28. Seery, M.K. (2015). Flipped learning in higher education chemistry: emerging trends and potential directions. Chemistry Education Research Practice, 16(4), 758-768.
29. Mooring, S.R., Mitchell, C.E., & Burrows, N.L. (2016). Evaluation of a flipped, large-enrollment organic chemistry course on student attitude and achievement. Journal of Chemical Education, 93(12), 1972-1983.
30. Dovhanets, V.I. (2020). Students' Cognitive Autonomy Formation In The Process of English for Specific Purposes Learning: A Model of It Implementation into Traditional Teaching. Information Technologies and Learning Tools, 78(4), 105-115.
31. Holec, H., *Autonomy and foreign language learning*. 1979: ERIC.
32. Little, D., *Learner Autonomy 1: Definitions, Issues and Problems*. 1991.
33. Benson, P. & Voller, P., *Autonomy and Independence in Language Learning*. Applied linguistics and language study. 1997: Longman.
34. Orakcı, Ş. & Gelişli, Y. (2017). Learner Autonomy Scale: A Scale Development Study. Malaysian Online Journal of Educational Sciences, 5, 25-35.
35. Woolfe, R., *Experiential learning in workshops*. 1st Edition ed. Experiential Training. 1992: Routledge. 224.

36. Duarte, M., Leite, C., & Mouraz, A. (2016). The effect of curricular activities on learner autonomy: the perspective of undergraduate mechanical engineering students. European Journal of Engineering Education, 41(1), 91-104.
37. Process, B. (2009). Communiqué of the Conference of European Ministers responsible for higher education. Leuven and Louvain-la-Neuve, 28-29.
38. Tsai, M.-H. & Tang, Y.-C. (2017). Learning attitudes and problem-solving attitudes for blended problem-based learning. Library Hi Tech, 35(4), 615-628.
39. Wu, J. & Casihan, M. (2024). Self-Efficacy and Effect on Blended Learning in Moral Education Course Among Students. Journal of Education and Educational Research, 8(3), 402-408.
40. Widiartini, N.K. & Sukerti, N.W. (2023). The Effect of Self-Assessment and Students' Learning Autonomy towards Students' Performance in Vocational Education. Journal Pendidikan dan Pengajaran, 56(1), 172-182.
41. Black, P. & Wiliam, D. (2009). Developing the theory of formative assessment. Educational Assessment, Evaluation and Accountability (formerly: Journal of personnel evaluation in education), 21, 5-31.
42. Ross, J.A. & Bruce, C.D. (2007). Teacher self-assessment: A mechanism for facilitating professional growth. Teaching and Teacher Education, 23(2), 146-159.
43. Beer, P. & Mulder, R.H. (2020). The Effects of Technological Developments on Work and Their Implications for Continuous Vocational Education and Training: A Systematic Review. Frontiers in Psychology, 11, 918.
44. Fotiadou, A., Angelaki, C., & Mavroidis, I. (2017). Learner autonomy as a factor of the learning process in distance education. European Journal of Open, Distance and E-learning, 20(1), 95-110.
45. Ratminingsih, N.M., Marhaeni, A., & Vigayanti, L.P.D. (2018). Self-Assessment: The Effect on Students' Independence and Writing Competence. International Journal of Instruction, 11(3), 277-290.
46. Huda, M.I., Musarokah, S., & Adi, A.B.P.K. (2020). Promoting Learner Autonomy Through Self-Assessment In Writing Class. Eternal (English Teaching Journal), 11(2), 36-50.
47. Chen, T., Luo, H., Feng, Q., et al. (2023). Effect of Technology Acceptance on Blended Learning Satisfaction: The Serial Mediation of Emotional Experience, Social Belonging, and Higher-Order Thinking. International Journal of Environmental Research and Public Health, 20(5), 4442.
48. Ke, F. & Kwak, D. (2013). Constructs of Student-Centered Online Learning on Learning Satisfaction of a Diverse Online Student Body: A Structural Equation Modeling Approach. Journal of Educational Computing Research, 48(1), 97-122.
49. Sonji, G.M., Halat, D.H., Mourad, N., et al. (2023). Pharmacy students' perceptions and satisfaction with blended instruction in quantitative chemical analysis course. Pharmacy Education, 23(1), 269-282.
50. Aldhahi, M., Alqahtani, A., Baattaiah, B., et al. (2021). Exploring the relationship between students' learning satisfaction and self-efficacy during the emergency transition to remote learning amid the coronavirus pandemic: A cross-sectional study. Education and Information Technologies, 27, 1323-1340.
51. Zhang, G., Yue, X., Ye, Y., et al. (2021). Understanding the Impact of the Psychological Cognitive Process on Student Learning Satisfaction: Combination of the Social Cognitive Career Theory and SOR Model. Frontiers in Psychology, 12, 712323.
52. Ko, W.-H. & Chung, F.-M. (2014). Teaching Quality, Learning Satisfaction, and Academic Performance among Hospitality Students in Taiwan. World Journal of Education, 4(5), 11-20.
53. Wang, X.Y., Chen, X.H., Wu, X.Y., et al. (2023). Research on the Influencing Factors of University Students' Learning Ability Satisfaction under the Blended Learning Model. Sustainability, 15(16), 12454.
54. Tuan, D.M. & Lan, L.T.D. (2025). Modeling the Nexus Between Students' Interaction, Satisfaction, and Acceptance of Online Learning. Turkish Online Journal of Distance Education, 26(1), 134-156.
55. An, D., Ye, C., & Liu, S. (2024). The influence of metacognition on learning engagement the mediating effect of learning strategy and learning behavior. Current Psychology, 43(40), 31241-31253.
56. Zhong, Q., Wang, Y., Lv, W., et al. (2022). Self-Regulation, Teaching Presence, and Social Presence: Predictors of Students' Learning Engagement and Persistence in Blended Synchronous Learning. Sustainability, 14(9), 5619.
57. Luo, Q., Chen, L., Yu, D., et al. (2023). The Mediating Role of Learning Engagement Between Self-Efficacy and Academic Achievement Among Chinese College Students. Psychology Research and Behavior Management, 16, 1533-1543.
58. You, J.W. (2016). Identifying significant indicators using LMS data to predict course achievement in

online learning. The Internet and Higher Education, 29, 23-30.
59. Guo, J.-P., Lv, S., Wang, S.-C., et al. (2023). Reciprocal modeling of university students' perceptions of the learning environment, engagement, and learning outcome: A longitudinal study. Learning and Instruction, 83, 101692.
60. Pang, H.-P. & Veloo, A. (2024). The Relation Between Learning Engagement and Academic Self-Efficacy Toward Academic Achievement among University Students. Qubahan Academic Journal, 4(2), 170-183.
61. Kahu, E.R. & Nelson, K. (2018). Student engagement in the educational interface: Understanding the mechanisms of student success. Higher education research & development, 37(1), 58-71.
62. Li, X.X. & Zhu, W.X. (2023). The influence factors of students' transferable skills development in Blended-Project-Based Learning environment: a new 3P model. Education and Information Technologies, 28(12), 16561-16591.
63. Chai, J. (2016). Research on the Development of Student Learning Autonomy. East China Normal University.
64. Wang, G. (2020). A study on the influence of college students' learner characteristics on the effectiveness of online and offline blended learning. China.
65. Pallant, J., *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. 2020: Routledge.
66. Tuckman, B.W. & Harper, B.E., *Conducting educational research*. 2012: Rowman & Littlefield Publishers.
67. Dinh, C. & Phuong, H. (2024). Examining Student Characteristics, Self-Regulated Learning Strategies, and Their Perceived Effects on Satisfaction and Academic Performance in MOOCs. Electronic Journal of e-Learning, 22(8), 41-59.
68. Hair, J., Black, W., Babin, B., et al, *Mutivariate Data Analysis*. Vol. 31. 2006.
69. Rahmawati, R., M.Si, Ak, et al. (2015). Application of Accounting Information Systems for Individual Performance. Information Management and Business Review, 7, 63-67.
70. Byrne, D. (2021). A worked example of Braun and Clarke's approach to reflexive thematic analysis. Quality & Quantity, 56, 1391-1412.
71. Howard, J., Bureau, J., Guay, F., et al. (2021). Student Motivation and Associated Outcomes: A Meta-Analysis From Self-Determination Theory. Perspectives on Psychological Science, 16, 1300-1323.
72. Tomasouw, J. & Marantika, J. (2020). Learner Autonomy as Strategy to Enhance the Quality of Learner. 504-510.
73. Marantika, J. (2021). Metacognitive ability and autonomous learning strategy in improving learning outcomes. Journal of Education and Learning (EduLearn), 15(1), 88-96.
74. Basilan, M.L.J. & Berber, L. (2024). Learner Autonomy as an Instructional Strategy in Enhancing Language Learning. International Education Forum, 2(4), 1-19.
75. Watson, M. (2018). Meeting Students' Needs for Competence and Autonomy. Oxford Scholarship Online, 163-196.
76. Tusaadia, A., Abdillah, A., Mahsup, M., et al. (2022). Learning Independence Towards Mathematics Learning Outcomes Based on Education Level. Indonesian Journal Of Educational Research and Review, 5(3), 577-587.
77. Juliana, N., Ampera, D., Farihah, et al. (2024). Digital Student Worksheets to Improving Students' Learning Independence. Journal of Education Technology, 8(1), 31-41.
78. Şakrak-Ekin, G. & Balçıkanlı, C. (2019). Does Autonomy Really Matter in Language Learning? Language Acquisition eJournal, 5(4), 98-111.
79. Ajisuksmo, C. (2023). Variables of Self-Regulated Learning as Predictors of Academic Achievement. Frontiers of Contemporary Education.
80. Karlen, Y., Hirt, C., Liska, A., et al. (2021). Mindsets and Self-Concepts About Self-Regulated Learning: Their Relationships With Emotions, Strategy Knowledge, and Academic Achievement. Frontiers in Psychology, 12, 661142.
81. Han, H., Kiatkawsin, K., Kim, W., et al. (2018). Physical classroom environment and student satisfaction with courses. Assessment & Evaluation in Higher Education, 43, 110-125.
82. Bowden, J., Tickle, L., & Naumann, K. (2019). The four pillars of tertiary student engagement and success: a holistic measurement approach. Studies in Higher Education, 46, 1207-1224.
83. Ahmed, M.K. & Hossain, K.I.H. (2024). Nurturing Learner Autonomy to Enhance Motivation and

Academic Achievement for the L2 Learners in ESL Contexts. IUBAT Review, 7(2), 176-196.
84. Al-Shboul, O., Rababah, L., Banikalef, A., et al. (2023). Role of learner autonomy in intrinsic motivation in EFL writing. International Journal of English Language and Literature Studies, 12(2), 107-116.
85. Evans, M. & Boucher, A. (2015). Optimizing the Power of Choice: Supporting Student Autonomy to Foster Motivation and Engagement in Learning. Mind, Brain, and Education, 9, 87-91.
86. Cheon, S., Reeve, J., Marsh, H., et al. (2022). Intervention-enabled autonomy-supportive teaching improves the PE classroom climate to reduce antisocial behavior. Psychology of Sport and Exercise, 60, 102174.
87. Flunger, B., Mayer, A., & Umbach, N. (2019). Beneficial for Some or for Everyone? Exploring the Effects of an Autonomy-Supportive Intervention in the Real-Life Classroom. Journal of Educational Psychology, 111, 210.
88. Philp, J. & Duchesne, S. (2016). Exploring Engagement in Tasks in the Language Classroom. Annual Review of Applied Linguistics, 36, 50-72.