

Learning Beliefs and Blended Learning Engagement among Vocational College Students: The Mediating Role of Technology Acceptance

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Abstract

This study examines how learning beliefs—specifically growth mindset (GM) and ICT self-efficacy (ICTSE)—influence blended learning engagement (BLE) among vocational college students in Chongqing, China, through the mediating mechanisms of perceived ease of use (PEOU) and perceived usefulness (PU) within the Technology Acceptance Model (TAM). Three objectives guided the study: (1) to examine the direct effects of GM and ICTSE on BLE and of GM on ICTSE; (2) to determine the mediating roles of PEOU and PU, including serial mediation effects; and (3) to construct and validate an integrated “Learning Beliefs → TAM → BLE” model. A cross-sectional survey was administered to 608 students across six vocational colleges in Chongqing, using two-stage stratified sampling. Data were analyzed via hierarchical regression and structural equation modeling (SEM) in SPSS and AMOS. All 14 hypotheses were supported. GM and ICTSE both positively predicted BLE, with ICTSE exerting a stronger direct effect; GM significantly predicted ICTSE, establishing mindset as foundational to technology confidence. PEOU and PU functioned as significant mediators, including a novel four-step serial chain (GM → ICTSE → PEOU → PU → BLE). Critically, GM operated predominantly through indirect pathways (67.9% of total effect), whereas ICTSE exerted a stronger direct influence (61.1%)—revealing qualitatively distinct psychological mechanisms. The integrated model achieved excellent fit and explained 46.9% of BLE variance. These findings advance the theoretical integration of implicit theory, social cognitive theory, and TAM, and offer a validated framework for designing belief- and technology-targeted interventions in vocational education.

Keywords: growth mindset; ICT self-efficacy; TAM; blended learning engagement; vocational education

Introduction

The rapid advancement of the Fourth Industrial Revolution has fundamentally reshaped global labor markets and intensified the demand for highly skilled technical workers. The World Economic Forum (2020) projects that by 2025 approximately 50% of the global workforce will require reskilling, while the International Labour Organization (2023) reports that over 40% of employers face critical difficulties recruiting qualified technical talent, particularly in manufacturing, information technology, and modern services. Against this backdrop, higher vocational education has emerged as a strategic pillar for cultivating the skilled workforce that modern economies require. In China, the tertiary sector's share of GDP reached 56.3% in 2023, a structural shift that has fundamentally altered talent demand patterns (National Bureau of Statistics of China, 2024), and skilled-occupational roles accounted for more than 80% of China's most in-demand positions in the same year (Ministry of Human Resources and Social Security, 2024). Concomitantly, the proliferation of blended learning—an integrated pedagogical ecosystem that embeds digital technology across the full learning cycle—has redefined what effective student engagement means in vocational contexts (Clark & Mayer, 2023).

Despite its institutional adoption, blended learning engagement remains uneven among vocational college students. The majority of higher vocational enrollees in China are drawn from lower-achieving cohorts in the national college entrance examination; notably, in Chongqing, more than 60% originate from rural or urban low-income households (China Higher Education Society, 2023). These students commonly enter higher education with accumulated experiences of academic failure, which predispose them to fixed mindsets—the belief that ability is essentially immutable—and to markedly lower levels of ICT self-efficacy (ICTSE), defined as individuals' confidence in their capacity to use information and communication technologies for learning (Compeau & Higgins, 1995; Dweck, 2006). Research consistently demonstrates that fixed mindsets suppress intrinsic motivation, persistence, and self-regulated learning (Yeager & Dweck, 2012), while low ICTSE amplifies technology anxiety, increases cognitive load during digital tasks, and reduces participation in online learning activities (Hatlevik et al., 2018). These converging deficits create a compound barrier to effective blended learning engagement—one that existing interventions targeting platform design or curriculum alone are insufficient to address. Critically, the

mechanisms through which learning beliefs translate into engagement behavior remain underspecified in the literature: existing studies have examined growth mindset, ICT self-efficacy, and technology acceptance predominantly in isolation, and have largely neglected the Chinese vocational education context where these psychological barriers are most acute.

The present study addresses this gap by constructing and testing an integrated theoretical model that traces the pathway from learning beliefs to blended learning engagement through technology acceptance mechanisms. Grounded in implicit theory (Dweck & Leggett, 1988), social cognitive theory (Bandura, 1986), and the Technology Acceptance Model (Davis, 1989), the model posits that GM and ICTSE—collectively operationalized as “learning beliefs”—influence BLE both directly and indirectly through TAM (PEOU/PU). Data were collected from 608 students enrolled in six vocational colleges in Chongqing, China, via a validated multi-scale survey instrument, and were analyzed using hierarchical regression analysis and structural equation modeling (SEM). By systematically examining 14 hypothesized relationships, this study provides the first integrated empirical test of the “learning beliefs → technology acceptance → blended learning engagement” framework in the Chinese vocational education context. The findings are expected to inform vocational institutions on how to prioritize psychological and technological support—specifically, where along the belief-efficacy-cognition chain interventions will yield the greatest gains in student engagement—and to offer students a theoretically grounded rationale for the role of mindset and technology confidence in their own learning trajectories.

This research article is structured as follows: Section 2 reviews the theoretical foundations and presents the research hypotheses; Section 3 describes the methodology; Section 4 reports the empirical findings; and Section 5 discusses implications for theory, practice, and policy in vocational education.

Research Objectives

1. To examine the direct effects of GM and ICTSE on blended learning engagement among vocational college students in Chongqing, China, and to investigate the direct effect of GM on ICTSE.
2. To determine the mediating roles of TAM (PEOU/PU) in the relationships between learning beliefs (GM/ICTSE) and BLE, encompassing both simple mediation and serial mediation effects.

3. To construct and empirically validate an integrated theoretical model of “Learning Beliefs (GM/ICTSE) → TAM(PEOU/PU) → BLE” that systematically explains how GM and ICTSE influence BLE through the TAM among vocational college students in Chongqing, China.

Literature Review

Blended learning engagement refers to the multidimensional, sustained involvement of learners in technology-enhanced learning ecosystems that organically integrate face-to-face and online instructional modalities (Bond et al., 2020). Drawing on Fredricks et al.’s (2004) foundational three-dimensional framework, blended learning engagement encompasses behavioral engagement (active participation in online and offline learning tasks), emotional engagement (affective responses such as interest, enjoyment, and belonging), and cognitive engagement (depth of information processing and metacognitive regulation). Unlike conventional engagement constructs, blended learning engagement is distinguished by its dual-context participation demands, its constitutive reliance on technology-mediated interaction, and its heightened requirement for self-regulated learning (Halverson et al., 2023; Rasheed et al., 2020). For vocational college students, who frequently enter higher education with heterogeneous academic backgrounds and variable digital competence, these characteristics present distinctive participation challenges that merit targeted investigation (Chen et al., 2024).

Growth mindset—defined as the belief that intelligence and competence can be developed through effort, effective strategies, and guidance (Dweck, 2006)—exerts its influence on learning engagement through three interlocking mechanisms: cognitive reframing of obstacles as growth opportunities, motivational reorientation from performance goals toward mastery goals, and strategic behavioral shifts toward deeper learning approaches (Yeager & Dweck, 2012). A large-scale randomized controlled trial (N = 12,490) by Yeager et al. (2019) demonstrated that a brief growth mindset intervention significantly raised GPA among lower-achieving high school students, underscoring the construct’s practical potency. In technology-enhanced environments, growth mindset further predicts openness to adopting unfamiliar digital tools and persistence when encountering technical difficulties (Baber, 2021). Burnette et al.’s (2023) meta-analysis of 53 RCTs confirmed consistent positive effects of growth mindset on academic outcomes ($d = 0.09–0.14$), with effect sizes amplified under high implementation fidelity. ICT self-efficacy (ICTSE)—rooted in Bandura’s (1997) social cognitive theory and originally operationalized by Compeau and Higgins (1995) as computer self-efficacy—captures learners’ domain-specific confidence in using

information and communication technologies for learning. High ICTSE reduces the cognitive load associated with navigating digital platforms, buffers technology-induced anxiety, and directly stimulates exploratory online participation (Feng et al., 2023; Hatlevik et al., 2018). Panigrahi et al. (2022) documented significant positive effects of internet self-efficacy on all three engagement dimensions ($\beta = 0.219\text{--}0.293$), while Getenet et al. (2024) confirmed that digital technology self-efficacy is a robust predictor of multidimensional online learning engagement. However, a notable limitation of this body of work is that GM and ICTSE have been examined predominantly as independent predictors, with few studies investigating whether and how they interact—specifically, whether mindset-level beliefs shape the formation of domain-specific efficacy in technology-mediated learning contexts.

The Technology Acceptance Model (Davis, 1989) proposes that perceived usefulness (PU)—the degree to which an individual believes a technology enhances task performance—and perceived ease of use (PEOU)—the degree to which use of the technology is expected to be free of cognitive effort—jointly determine behavioral intention and actual technology use. In educational contexts, both constructs have been consistently linked to learning engagement: PU exerts the stronger direct influence by activating instrumental motivation, whereas PEOU operates primarily through its positive effect on PU and through independent reductions in learning anxiety (Al-Adwan et al., 2023; Deng et al., 2022). Crucially, TAM serves in the present model not merely as a technology acceptance framework but as the cognitive mediating bridge connecting learning beliefs to behavioral engagement. Research documents that growth mindset shapes learners' appraisals of technology's developmental value (Ma et al., 2024), while ICTSE systematically elevates both PU and PEOU judgments (Ariff et al., 2012; Isaac et al., 2017). The sequential structure within TAM—wherein PEOU positively predicts PU (Davis, 1989; Nur & Joviando, 2021)—further enables a chain-mediation pathway from learning beliefs through PEOU and PU to engagement. Nevertheless, TAM-based engagement studies have rarely positioned technology acceptance constructs as mediators within a broader belief-driven causal architecture; most treat PU and PEOU as distal antecedents or parallel predictors rather than as the cognitive transmission layer through which upstream psychological beliefs operate.

The reviewed theories collectively establish that learning beliefs (GM/ICTSE) serve as distal antecedents of blended learning engagement, while TAM constructs (PEOU/PU) function as proximal cognitive mediators. Specifically, the present study integrates these frameworks not as parallel predictors but as a hierarchically ordered system: implicit theory explains why students

hold different capacity beliefs; social cognitive theory explains how those beliefs crystallize into domain-specific technology efficacy; and TAM explains how efficacy shapes technology cognitions that, in turn, activate engagement behavior. This integrated perspective addresses the critical gap in existing research, which has predominantly examined these frameworks in isolation and has neglected the vocational education context in China.

Based on the theoretical frameworks reviewed above, 14 directional hypotheses were formulated to guide the empirical analysis, as shown in Table 1.

Table 1 Summary of Research Hypotheses

Category	H	Hypothesis
<i>Direct effects of learning beliefs</i>		
	H1:	GM positively predicts ICTSE.
	H2:	GM positively predicts BLE.
	H3:	ICTSE positively predicts BLE.
<i>Effects of learning beliefs on TAM constructs</i>		
	H4a:	GM positively predicts PEOU.
	H4b:	GM positively predicts PU.
	H5a:	ICTSE positively predicts PEOU.
	H5b:	ICTSE positively predicts PU.
<i>TAM internal paths and direct effects on BLE</i>		
	H6:	PEOU positively predicts PU.
	H7:	PU positively predicts BLE.
	H8:	PEOU positively predicts BLE.
<i>Simple mediation effects</i>		
	H9:	PU mediates the relationship between PEOU and BLE.
	H10a:	PEOU mediates the relationship between GM and BLE.
	H10b:	PU mediates the relationship between GM and BLE.
	H11a:	PEOU mediates the relationship between ICTSE and BLE.
	H11b:	PU mediates the relationship between ICTSE and BLE.
<i>Serial mediation effects</i>		
	H12:	PEOU and PU serially mediate GM → BLE (GM → PEOU → PU → BLE).
	H13:	PEOU and PU serially mediate ICTSE → BLE (ICTSE → PEOU → PU → BLE).
	H14:	ICTSE, PEOU, and PU serially mediate GM → BLE (GM → ICTSE → PEOU → PU → BLE).

Note: GM = growth mindset; ICTSE = ICT self-efficacy; PEOU = perceived ease of use; PU = perceived usefulness; BLE = blended learning engagement.

Conceptual Framework

This research is a quantitative, cross-sectional survey study. The researcher has defined the research conceptual framework based on the integrated theoretical concepts of implicit theory (Dweck & Leggett, 1988), social cognitive theory (Bandura, 1986), and the Technology Acceptance Model (Davis, 1989), consisting of four latent constructs—growth mindset, ICT self-efficacy, TAM variables (PEOU and PU), and blended learning engagement—with details as follows:

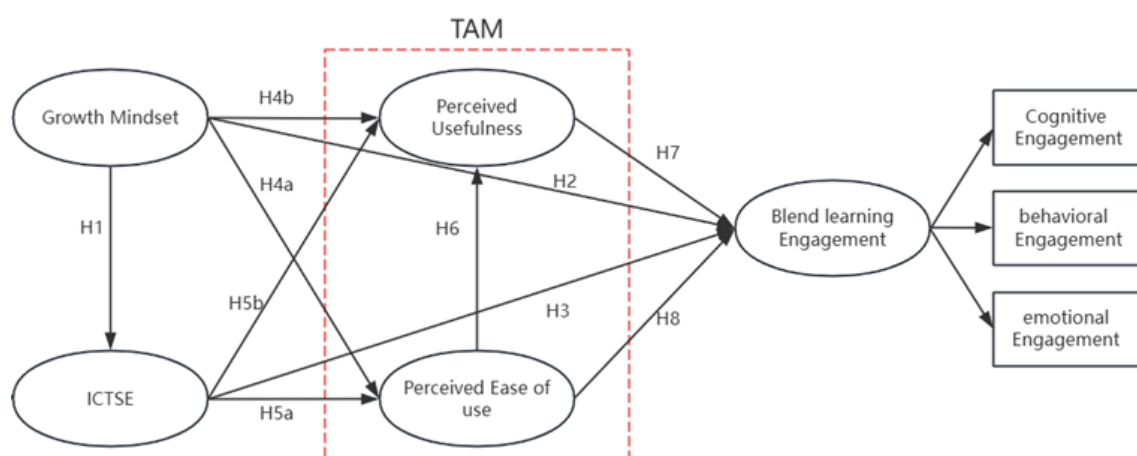


Figure 1 Research Conceptual Framework of the Study

Research Methodology

This research is a quantitative cross-sectional survey study. The sampling frame comprised all 41 public higher vocational colleges in Chongqing Municipality with a total enrollment of approximately 342,000 students as of 2025. Institutional selection employed systematic probability proportional to size (PPS) sampling: colleges were ranked by enrollment size, cumulative enrollment was calculated, and 6 colleges were selected at equal intervals of (total enrollment ÷ 6), yielding a representative cross-section of institutional scale and disciplinary composition. At the student level, stratified random sampling was applied within each selected college, consistent with international large-scale educational survey protocols (Hair et al., 2019; Lohr, 2021). The final sample consists of 608 students (male = 324, 53.3%; female = 284, 46.7%), predominantly second-year students (69.6%), drawn from four major disciplinary categories: engineering and technology (51.6%), medical and health sciences (20.1%), business and services (20.1%), and culture and arts (8.2%).

The research instruments comprised four validated scales measuring the study's core constructs:

1) *Growth Mindset Scale* — Rammstedt et al.'s (2022) three-item scale derived from Dweck et al.'s (1995) Implicit Theories Scale, scored on a 6-point Likert format (1 = strongly agree, 6 = strongly disagree) with reverse coding; $\alpha = 0.76$ in the present sample.

2) *ICT Self-Efficacy Scale* — Li et al.'s (2023) 15-item, four-dimension instrument (privacy and security, differencing, communication, learning and application), scored on a 4-point Likert scale; total $\alpha = 0.89$, sub-scale α range = 0.78–0.84.

3) *Technology Acceptance Scale* — Performance expectancy (PU) and effort expectancy (PEOU) subscales from Venkatesh et al.'s (2003) UTAUT, each comprising four items scored on a 7-point Likert scale; $\alpha > 0.85$ for both subscales.

4) *Blended Learning Engagement Scale* — Li et al.'s (2023) Generic Student Engagement Scale (GSES), grounded in the three-dimensional theoretical framework of Fredricks et al. (2004) and specifically designed for blended learning environments, 29 items across five dimensions scored on a 5-point Likert scale; total $\alpha = 0.93$.

All scales underwent rigorous forward-backward translation following Brislin's (1980) protocol and content validity review by five subject-matter experts (Content Validity Index > 0.78). A pilot study with 80 students confirmed acceptable reliability (Cronbach's $\alpha > 0.70$) and item-total correlations ($r > 0.30$) prior to main data collection. Instrument psychometric properties are summarized in Table 2.

Table 2 Psychometric properties of research instruments

Scale	Items	α	CR	AVE	Validity
GM	3	0.76	0.79	0.56	Confirmed
ICTSE	15	0.89	0.91	0.63	Confirmed
PEOU	4	0.88	0.90	0.69	Confirmed
PU	4	0.87	0.90	0.69	Confirmed
BLE	29	0.93	0.94	0.61	Confirmed

Note: α = Cronbach's alpha; CR = composite reliability; AVE = average variance extracted.

Data collection was conducted via the Wenjuanxing online survey platform between November 2025 and January 2026. Questionnaire links were distributed to participating students through institutional coordinators at each of the six colleges, who shared the survey via class

group messaging channels. Participation was voluntary and anonymous. Of 660 questionnaires distributed, 626 were returned (response rate = 94.85%); after excluding 18 incomplete responses (defined as more than 10% of items unanswered), 608 valid cases were retained for analysis. Common method bias was assessed using Harman's single-factor test (largest factor variance = 27.34%, well below the 40% threshold) and an unmeasured latent method factor model ($\Delta\text{CFI} < 0.012$), confirming that common method variance did not constitute a substantive threat to validity. Normality screening showed all 55 items met the criteria of $|\text{skewness}| < 2$ and $|\text{kurtosis}| < 7$ (Kline, 2023).

Quantitative data were analyzed using SPSS and AMOS. The analytical strategy proceeded in three stages. First, confirmatory factor analysis (CFA) within a structural equation modeling (SEM) framework was used to assess the measurement model, evaluating construct reliability (composite reliability, $\text{CR} > 0.70$), convergent validity (average variance extracted, $\text{AVE} > 0.50$), and discriminant validity ($\text{AVE} > \text{squared inter-construct correlations}$). Second, hierarchical regression analysis (HRA) was used to test direct effects and to decompose mediation pathways sequentially, with demographic variables entered as covariates. Third, full SEM with bias-corrected bootstrapping (5,000 resamples; 95% confidence intervals) was employed to test the complete integrated model and to evaluate all mediation hypotheses (H9–H14) (Preacher & Hayes, 2008). Model fit was evaluated against established criteria: $\text{CMIN/DF} < 3$, $\text{CFI} > 0.90$, $\text{TLI} > 0.90$, $\text{AGFI} > 0.85$, $\text{RMSEA} < 0.08$, and $\text{SRMR} < 0.05$ (Hair et al., 2019). Although the four scales employed different Likert response formats (4-, 5-, 6-, and 7-point), this heterogeneity does not compromise the validity of SEM parameter estimates. SEM operates on the covariance structure among latent variables rather than on raw item scores; each construct was modeled as a latent variable with its own observed indicators, and all items were treated as reflective ordinal measures within their respective scales. Scale format differences therefore affect only the metric of individual items, not the standardized path coefficients or the latent variable covariances that underpin hypothesis testing (Kline, 2023). No cross-scale standardization was applied, as the latent variable framework renders such transformation unnecessary.

Research Results

Objective 1. The research results found that learning beliefs directly influence blended learning engagement and that growth mindset significantly predicts ICT self-efficacy, as detailed below.

All direct-effect hypotheses (H1–H8) received full empirical support, as reported in Table 3. GM was positively associated with ICTSE (H1: $\beta = 0.485$, $p < .001$), confirming that mindset is foundational to technology confidence. Both GM and ICTSE exerted significant direct effects on BLE (H2: $\beta = 0.172$; H3: $\beta = 0.286$, both $p < .001$), with ICTSE's effect exceeding that of GM, indicating that task-specific efficacy constitutes a more proximal behavioral driver. GM and ICTSE also positively predicted both TAM constructs (H4a–H5b, all $p < .01$), and within TAM, PEOU was positively associated with PU (H6: $\beta = 0.393$, $p < .001$); both PEOU (H8: $\beta = 0.296$) and PU (H7: $\beta = 0.326$) were significantly associated with BLE. The measurement model demonstrated excellent fit (CMIN/DF = 1.217; CFI = 0.977; RMSEA = 0.019; SRMR = 0.032), with all composite reliability values exceeding 0.79 and all AVE values ≥ 0.56 , confirming convergent and discriminant validity.

Table 3 Standardized path coefficients of the structural equation model

Hypothesized Path	β	S.E.	C.R.	P
H1: GM→ICTSE	0.485	0.04	8.65	***
H4a:GM→PEOU	0.219	0.051	3.758	***
H4b:GM→PU	0.137	0.05	2.437	**
H2: GM→BLE	0.172	0.031	3.353	***
H5a: ICTSE→PEOU	0.293	0.069	5.178	***
H5b: ICTSE→PU	0.175	0.067	3.249	***
H3: ICTSE→BLE	0.286	0.042	5.591	***
H6: PEOU→PU	0.393	0.057	6.968	***
H8: PEOU→BLE	0.296	0.036	5.532	***
H7: PU→BLE	0.326	0.037	5.949	***

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

Objective 2. The research results found that PEOU and PU function as significant mediators between learning beliefs and blended learning engagement, including serial mediation effects.

All eight mediation paths were statistically significant, with bias-corrected 95% CIs excluding zero throughout (Table 4). Within TAM, PU partially mediated the PEOU → BLE relationship (H9), transmitting 30.2% of the total effect. GM's total effect on BLE (0.536) was predominantly indirect (67.9%; total indirect = 0.364), distributed across four distinct pathways

through PEOU, PU, and ICTSE (H10a, H10b, H12, H14). By contrast, ICTSE's total effect (0.468) was primarily direct (61.1%; direct = 0.286), with a smaller indirect component (38.9%; total indirect = 0.182) carried through PEOU and PU (H11a, H11b, H13). This asymmetry reveals a fundamental difference in mechanism: GM—a broad dispositional belief—operates predominantly through cognitive appraisal chains, whereas ICTSE—a task-specific efficacy belief—exerts more immediate influence on engagement behavior while still routing a meaningful proportion of its effect through technology acceptance cognitions. Table 4 summarizes all bootstrap-tested mediation effects.

Table 4 Bootstrap mediation effects (bias-corrected 95% CI, 5,000 resamples)

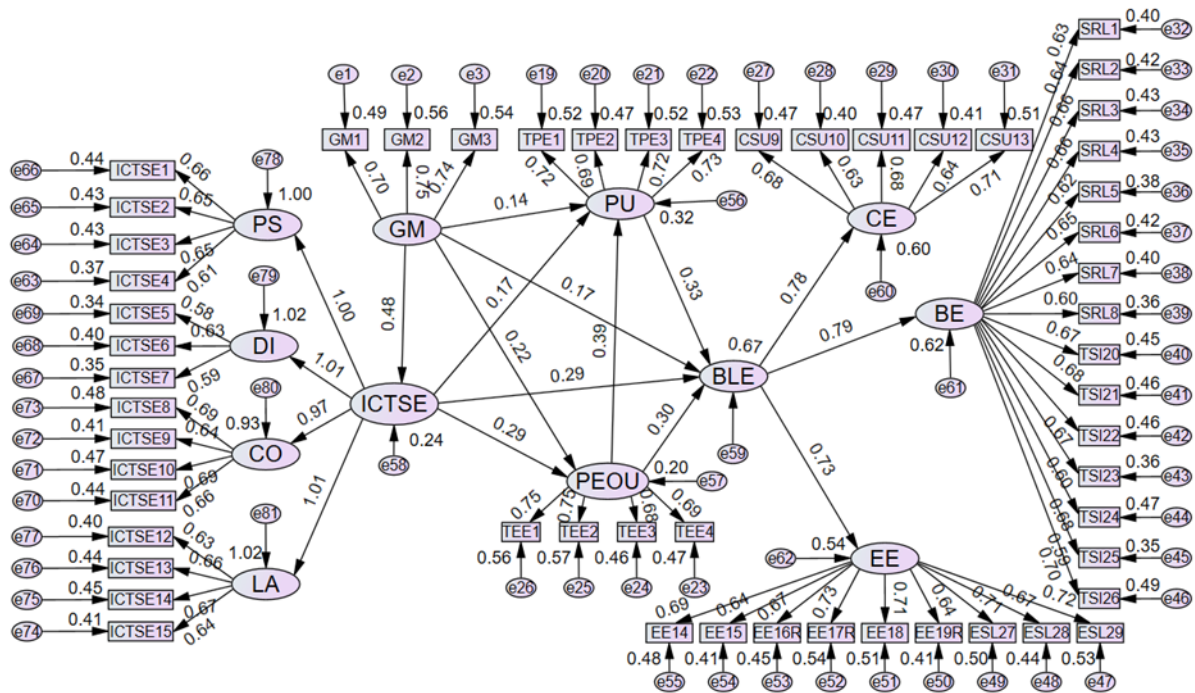
Mediation Path	Estimate	S.E.	Effect%	95% CI
H9: PEOU → PU → BLE	0.128	0.024	30.2%	[0.087, 0.183]
H10a: GM → PU → BLE	0.045	0.021	13.7%	[0.009, 0.093]
H10b: GM → PEOU → BLE	0.065	0.020	19.8%	[0.030, 0.110]
H11a: ICTSE → PU → BLE	0.057	0.021	12.2%	[0.022, 0.103]
H11b: ICTSE → PEOU → BLE	0.087	0.022	18.6%	[0.049, 0.134]
H12: GM → PEOU → PU → BLE	0.028	0.009	8.5%	[0.013, 0.049]
H13: ICTSE → PEOU → PU → BLE	0.038	0.010	8.1%	[0.022, 0.062]
H14: GM → ICTSE → PEOU → PU → BLE	0.018	0.005	5.6%	[0.011, 0.031]

Note: All 95% CIs exclude zero, indicating significance at $p < .05$. Effect% = proportion of total effect accounted for by the indirect path.

Objective 3. The research results found that the integrated “Learning Beliefs → Technology Acceptance → Blended Learning Engagement” model fit the data excellently and explained 46.9% of variance in BLE ($R^2 = 0.469$). All 14 hypotheses were empirically supported. The full serial chain GM → ICTSE → PEOU → PU → BLE (H14; indirect = 0.018, CI [.011, .031]) was confirmed, demonstrating that a mindset-level belief is associated with a four-step cognitive-efficacy pathway that culminates in behavioral engagement outcomes. Convergence between hierarchical regression results (ΔR^2 for the complete chain model = 0.458) and SEM path coefficients across all key paths provides methodological triangulation for the robustness of the integrated framework. Table 5 presents the model fit indices alongside established benchmarks, and Figure 2 depicts the full structural model with standardized path coefficients.

Table 5 Structural equation model fit indices

CMIN/DF	GFI	AGFI	IFI	TLI	CFI	RMSEA	SRMR
1.217	0.909	0.901	0.977	0.976	0.977	0.019	0.032

**Figure 2** Structural equation model with standardized path coefficients (N = 608)

Discussion

The results of the research objective 1 found that GM was significantly associated with both ICTSE ($\beta = 0.485$) and BLE ($\beta = 0.172$), while ICTSE exerted a stronger direct effect on BLE ($\beta = 0.286$). The $GM \rightarrow ICTSE$ association is theoretically coherent with Bandura's (1997) mastery experience framework: students who construe ability as developable are more likely to persist through early technology failures, accumulating the success experiences that consolidate domain-specific efficacy. The stronger direct effect of ICTSE on BLE reflects the task-specificity principle of social cognitive theory—domain-specific efficacy is associated with domain-specific behavior more proximally than broader dispositional beliefs (Panigrahi et al., 2022, $\beta = 0.219$ – 0.293 ; Getenet et al., 2024). Notably, a one-SD increase in GM was associated with a 0.172-SD increase in BLE—equivalent to moving a student from the 50th to approximately the 58th–59th percentile, a gain of 8–9 percentile points—underscoring the practical salience of mindset even as a distal predictor. The absence of significant demographic effects on BLE further suggests that

psychological belief constructs, rather than structural background variables, are the primary correlates of engagement in blended vocational learning environments, implying that institution-level interventions targeting beliefs and efficacy may be more impactful than demographic-targeted policies.

The results of the research objective 2 found that PEOU and PU mediated both belief–engagement relationships, and the contrasting profiles of GM (67.9% indirect) and ICTSE (61.1% direct) constitute the study's core theoretical contribution. GM's predominantly indirect operation—co-varying with ICTSE, PEOU, and PU across four pathways—reflects its distal position in the psychological architecture: a general ability belief must first be consistent with task-specific efficacy and technology appraisals before co-varying with behavioral engagement, consistent with Burnette et al.'s (2023) meta-analytic finding that growth mindset effects are typically expressed through mediating cognitive mechanisms ($k = 53$ RCTs, $d = 0.09$ – 0.14). ICTSE's larger direct contribution, by contrast, reflects the dual-route structure predicted by social cognitive theory (Isaac et al., 2017), wherein efficacy beliefs simultaneously activate behavior directly and shape cognitive appraisals indirectly. Within TAM, PEOU-mediated paths consistently exceeded PU-only paths in magnitude, confirming that students must perceive a technology as operable before evaluating its learning value—a sequential logic especially pertinent in vocational contexts where technology anxiety is prevalent. These findings suggest that platform usability should be treated as a prerequisite condition, not a secondary design concern, in blended learning implementation.

The results of the research objective 3 found that the integrated model achieved excellent fit ($CFI = 0.977$; $RMSEA = 0.019$) and explained 46.9% of BLE variance. The confirmed serial chain $GM \rightarrow ICTSE \rightarrow PEOU \rightarrow PU \rightarrow BLE$ (H14) is a novel finding: it demonstrates that a mindset-level belief is associated with a four-step cognitive–efficacy pathway that culminates in behavioral engagement outcomes—a mediation chain not previously documented in the blended learning literature. Theoretically, this reframes the relationship between implicit theory (Dweck & Leggett, 1988), and TAM (Davis, 1989): rather than operating as parallel predictors, these frameworks form a hierarchically ordered antecedent system in which beliefs co-vary with efficacy, efficacy co-varies with technology cognitions, and cognitions co-vary with behavior. Cross-method consistency between hierarchical regression and SEM estimates provides further evidence that this framework is robust and applicable in Chinese higher vocational education contexts. Practically, the validated four-level architecture—belief $\rightarrow$ efficacy $\rightarrow$ technology

cognition → engagement—offers institutions a diagnostic roadmap: by assessing students' standing at each level, educators can identify where along the pathway a given student population requires targeted support, rather than applying uniform platform-centered or curriculum-centered interventions.

New Knowledge from Research

This study yields three principal contributions to knowledge. First, it provides the first empirical validation of an integrated GM–ICTSE–TAM–BLE model in Chinese higher vocational education, establishing that learning beliefs and technology acceptance constructs form a hierarchically ordered antecedent system—rather than parallel predictors—of blended learning engagement. This reframes how implicit theory and TAM are theoretically related: not as competing explanatory frameworks but as sequentially nested layers of a single psychological architecture. Second, it documents a theoretically significant asymmetry: GM operates predominantly through indirect pathways (67.9% of total effect), whereas ICTSE exerts a stronger direct influence (61.1%)—demonstrating that mindset-level and efficacy-level beliefs are associated with engagement via qualitatively distinct psychological mechanisms, a distinction obscured in prior research that treated these constructs as interchangeable antecedents. Third, it confirms the novel four-step serial chain (GM → ICTSE → PEOU → PU → BLE) in a skill-oriented, culturally distinct context, extending the cross-cultural and cross-sector applicability of both implicit theory and TAM to Chinese vocational education—a population underrepresented in the international engagement literature. Collectively, these findings support the proposition that belief-level constructs function as distal antecedents whose effects are transmitted through efficacy and technology cognition chains, while efficacy-level constructs function as more proximal correlates with both direct and cognition-mediated associations with engagement.

Conclusion

This study constructed and empirically validated an integrated theoretical model examining how learning beliefs (GM/ICTSE) are associated with BLE among 608 vocational college students in Chongqing, China, through the mediating mechanisms of PEOU and PU. Employing structural equation modeling with bias-corrected bootstrapping, the study confirmed all 14 research hypotheses. The principal findings are as follows: (1) GM and ICTSE both positively and directly co-vary with BLE, with ICTSE exerting a stronger direct effect; (2) GM is significantly associated with

ICTSE, indicating that mindset is foundational to technology confidence; (3) PEOU and PU function as significant mediators, including a serial chain (PEOU $\rightarrow$ PU $\rightarrow$ BLE), confirming TAM's applicability in blended learning contexts; and (4) GM operates predominantly through indirect pathways (67.9% of total effect), whereas ICTSE's effect is primarily direct (61.1%), revealing that these two learning beliefs are associated with engagement via qualitatively distinct psychological mechanisms. The model achieved excellent overall fit (CFI = 0.977; RMSEA = 0.019) and explained 46.9% of variance in BLE. These findings advance the theoretical integration of implicit theory, social cognitive theory, and TAM. Practically, the validated four-level framework—belief $\rightarrow$ efficacy $\rightarrow$ technology cognition $\rightarrow$ engagement—provides vocational institutions with a diagnostic instrument for identifying where along the psychological pathway a given student population is most constrained, enabling more targeted and resource-efficient interventions than platform-centered or curriculum-centered approaches alone can offer. Future research employing longitudinal designs is needed to establish the causal directionality of the associations identified here.

Suggestions

Based on the research findings, the researchers make the following recommendations:

1. Suggestion for Implementing the Research Findings

The results of the research objective 1 revealed that GM and ICTSE are significantly and positively associated with BLE, with the GM $\rightarrow$ ICTSE association ($\beta = 0.485$) indicating that mindset is foundational to technology confidence. Therefore, relevant agencies should: embed growth mindset cultivation—through process-based assessment and reflective activities—into orientation curricula, and institutionalize ICT training programs to reduce technology anxiety and strengthen students' confidence in blended learning environments.

The results of the research objective 2 revealed that PEOU- and PU-mediated paths connect learning beliefs to BLE, with PEOU exerting the stronger mediation effect. Therefore, relevant agencies should: prioritize interface usability and technical support in platform selection to lower initial accessibility barriers, and train instructors to explicitly demonstrate how digital tools advance vocational competence, thereby activating students' perceived usefulness.

The results of the research objective 3 revealed that the integrated model explained 46.9% of BLE variance, with psychological belief factors more strongly associated with engagement than demographic background variables. Therefore, relevant agencies should: adopt

multi-level support strategies addressing belief, efficacy, and technology cognition simultaneously, and incorporate GM and ICTSE diagnostic measures at enrollment to identify at-risk students early. Policymakers should integrate learning belief indicators into blended learning quality assurance frameworks.

2. Suggestion for Future Research

This research has yielded important findings on the integrated role of learning beliefs and technology acceptance in blended learning engagement, which can be applied to intervention design in skill-oriented higher education. As a cross-sectional study, however, the present findings reflect associations rather than causal relationships; longitudinal designs are needed to determine the directionality and stability of the pathways identified here. For future research, the focus should be on: (1) longitudinal designs to track the developmental dynamics among GM, ICTSE, TAM, and BLE over time and enable stronger causal inference; (2) expanded samples across diverse regional and institutional contexts to enhance external validity beyond the Chongqing vocational setting; (3) incorporation of objective behavioral data (e.g., LMS logs, platform engagement metrics) alongside self-report measures to reduce common method concerns; and (4) investigation of potential moderating variables—such as instructor technology support, peer norms, and professional identity—that may amplify or attenuate the belief-to-engagement associations identified in the present model.

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