From Blended Learning to Curriculum Uptake in Higher Vocational Management Education: A Conceptual Structural Model with an Empirical Validation Protocol

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Abstract

Blended learning has become a routine reform strategy in higher vocational colleges, yet its value remains uncertain when online tasks are added to classroom teaching without being absorbed into students' learning routines. This manuscript develops a conceptual structural model with an empirical validation protocol to explain how blended learning quality may support curriculum uptake in introductory management courses through digital competence and learner engagement. Curriculum uptake is conceptualised as an implementation outcome comprising acceptance, active use, participation fidelity, transfer of course routines and continuance intention. Drawing on the community of inquiry framework, self-determination theory, social cognitive theory, student engagement research and implementation outcome theory, the model argues that blended learning quality does not by itself guarantee uptake. Students first need course-related digital competence to work confidently and critically in the blended environment; this capability then supports behavioural, cognitive, emotional and social engagement; engagement, in turn, makes curriculum routines visible in students' actual learning practice. The manuscript proposes nine testable hypotheses, a baseline-plus-four-wave validation design, measurement guidance, learning management system triangulation indicators and a PLS-SEM reporting protocol. Its contribution is to reposition blended learning in higher vocational management education as a problem of curriculum implementation rather than platform adoption. The framework supports a shift from asking whether blended learning is available to asking whether its intended routines are accepted, enacted and sustained by vocational students.

Keywords: blended learning; curriculum uptake; digital competence; learner engagement; higher vocational colleges; introductory management; implementation outcomes; structural model

1. Introduction

Blended learning has moved from an emergency or supplementary arrangement to a mainstream curriculum strategy in higher education. In higher vocational colleges, the shift is particularly visible because institutions are expected to combine digital platforms, classroom teaching, work-integrated tasks and flexible learning resources. Policy-level discussions of future-ready vocational education and training have similarly emphasised digital capability, responsiveness to labour-market change and flexible learning pathways (OECD, 2023; UNESCO-UNEVOC, 2024). Introductory management courses sit near the beginning of business-related programmes and introduce students to planning, organising, leadership, communication, decision-making and control. These concepts are foundational, but they are also abstract. Unless students repeatedly connect them with workplace situations, team coordination and case-based problem solving, the course can easily become a vocabulary course rather than a management learning experience.

The main problem is therefore not whether a course contains online and offline components. The more important question is whether students take up the curriculum. In this article, curriculum uptake refers to the extent to which students accept the blended curriculum, actively use its resources, follow its intended learning sequence, transfer its routines to applied tasks and intend to continue using similar practices in later courses. This definition draws on implementation outcome theory, which distinguishes the implementation of an educational practice from its final performance effects (Proctor et al., 2011; Proctor et al., 2023). Curriculum uptake is thus not the same as course satisfaction, platform traffic or examination performance. A student may log in frequently but complete tasks mechanically; another may pass the final assessment while ignoring the pre-class preparation, case discussion and reflective activities through which the curriculum is meant to work.

The distinction matters because blended learning research has produced both encouraging and uneven findings. Systematic reviews show that blended learning can support flexibility, interaction and achievement, but they also report persistent difficulties in self-regulation, online participation, feedback integration and teacher readiness (Rasheed et al., 2020; Müller & Mildenberger, 2021; Anthony Jr. et al., 2022). Cao's (2023) meta-analysis suggests that blended learning tends to improve performance, attitudes and achievement, while its effects on engagement are less stable across national contexts. Recent vocational education research reaches a similar conclusion: blended learning can support employability-oriented learning, yet its benefits depend on learner support, task design and the cultural inclusiveness of engagement strategies (Song & Lai, 2025). These findings point to a design and implementation gap. Adding digital resources does not guarantee that students will use them as intended, nor that online and classroom activities will become one connected curriculum experience.

Higher vocational management education gives this gap a concrete setting. Vocational students are expected to build applied and transferable competencies, not only to reproduce textbook definitions. A blended introductory management course can support this aim by moving basic explanations to online resources, using classroom time for cases and group tasks, and using digital platforms for formative assessment and feedback. Recent research on Chinese VET classrooms shows that effective blended learning strategies require deliberate sequencing, teacher orchestration and adaptation to course types rather than simple platform use (Cui et al., 2025). Yet many courses still treat the online part as an add-on. Students may complete digital tasks for compliance while the classroom remains detached from the digital learning record. The need for digitally informed management learning is also visible in recent work on algorithmic management and organisational resilience under digital transformation, which shows that management students increasingly need to understand how digital systems reshape work behaviour, autonomy, trust and organisational adaptation (Zhang & Li, 2025a, 2025b).

Two learner-side mechanisms are particularly important in explaining why blended management courses differ in their degree of uptake. The first is digital competence: students' ability to locate, evaluate, communicate, create and solve problems through digital technologies in safe, purposeful and learning-oriented ways (Vuorikari et al., 2022; Tzafilkou et al., 2022; Mejías-Acosta et al., 2024). The second is learner engagement: students' behavioural participation, cognitive effort, emotional valuing and social contribution in course activities (Fredricks et al., 2004; Kahu, 2013; Bond et al., 2020). Digital competence reduces the threshold of participation in a blended course, whereas engagement shows whether students enact the curriculum rather than merely encounter it. Evidence from Chinese higher vocational students suggests that digital technology usage is related to student satisfaction through learning experience and engagement (Zhang, Qian, & Chen, 2024). Xianghan Zhang's recent Guangzhou University study in Education + Training further shows that, in vocational and applied higher education, motivational internalisation and learning commitment are crucial mechanisms for social value outcomes (Zhang, 2026). This reinforces the present article's emphasis on internal uptake rather than surface exposure to digital resources.

The article addresses three research questions. First, how can curriculum uptake be conceptualised as an implementation outcome in blended introductory management education? Second, how do digital competence and learner engagement explain the pathway from blended learning quality to curriculum uptake? Third, how can the proposed model be empirically validated in higher vocational colleges? The present manuscript is positioned as a conceptual structural model with an empirical validation protocol rather than as an empirical survey study. This positioning is deliberate. Before higher vocational colleges can evaluate blended learning reform credibly, they need a construct model and measurement logic that distinguish platform adoption from curriculum uptake. Although the model is developed with Chinese higher vocational colleges as the primary application context, its logic is relevant to TVET and applied higher education systems more broadly.

The argument advances current research in three respects. First, the article reframes blended learning as a curriculum implementation process rather than a delivery format. Second, it connects digital competence and learner engagement into a sequential explanatory mechanism that clarifies why similar blended designs may lead to different levels of student-side implementation. Third, it provides a validation-ready framework for researchers and colleges that intend to evaluate blended introductory management courses

with survey, platform and course-level evidence. Figure 1 summarises the implementation logic that guides the article.

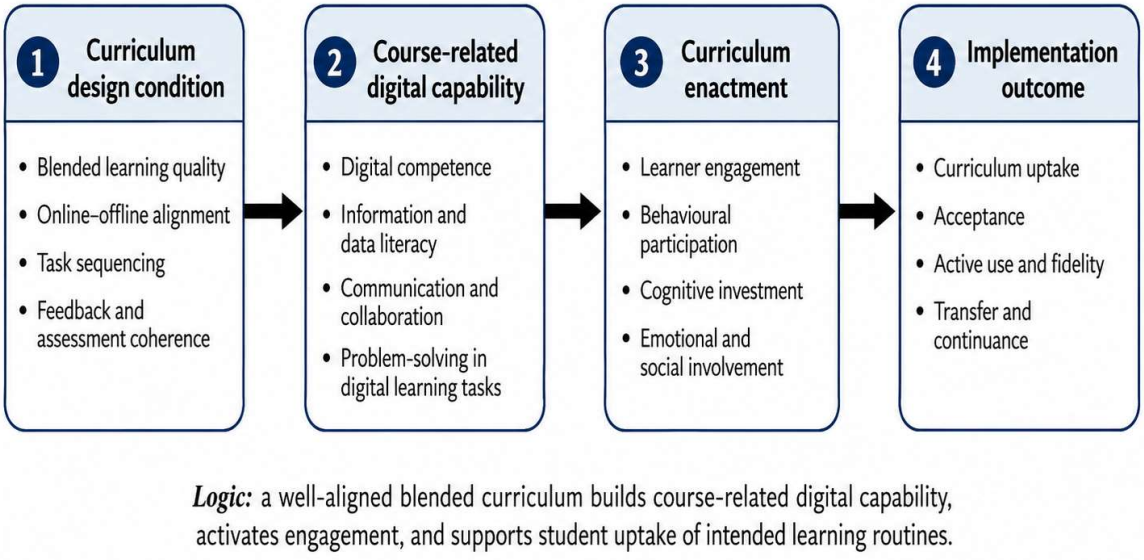

Figure 1. Implementation logic linking blended learning quality, digital competence, learner engagement and curriculum uptake

Note. Author-developed figure. The figure clarifies the conceptual movement from curriculum design condition to course-related capability, engagement and implementation outcome.

1.1 Approach to model development

The model was developed through a theory-driven integrative review of four connected bodies of literature: blended learning design, DigComp-informed digital competence, multidimensional learner engagement and implementation outcomes. Priority was given to peer-reviewed studies published between 2020 and 2026, while foundational theories were retained when they provided indispensable conceptual grounding. Search terms included combinations of "blended learning", "vocational education", "higher vocational colleges", "digital competence", "learner engagement", "implementation outcomes", "curriculum adoption", "curriculum uptake" and "PLS-SEM". The review was integrative rather than systematic; its purpose was theory building rather than exhaustive evidence aggregation.

Theoretical selection followed a functional logic. The community of inquiry framework explains how teaching, social and cognitive presence organise meaningful blended learning (Garrison et al., 2000). Constructive alignment clarifies why online resources, classroom activities and assessment should be designed as one course system (Biggs & Tang, 2011). Social cognitive theory explains how students' capabilities develop through interaction with task environments (Bandura, 1986). Self-determination theory and student engagement research explain how competence, autonomy, relatedness and task value are translated into sustained participation (Deci & Ryan, 2000; Kahu & Nelson, 2018). Implementation outcome theory provides the vocabulary for evaluating whether a curriculum is accepted, used, enacted with fidelity and sustained (Weiner, 2009; Proctor et al., 2011).

2. Literature Review and Theoretical Foundations

2.1 Blended learning quality in vocational management education

Blended learning is commonly defined as the deliberate combination of face-to-face instruction and online learning. Early discussions often described blended learning through the proportion of classroom and online time, but more recent scholarship places greater emphasis on pedagogical coherence and learner experience (Dziuban et al., 2018; Hrastinski, 2019; Anthony Jr. et al., 2022; Istenič, 2024). A blended course is therefore not a course with a platform. It is a designed sequence in which online preparation, classroom application and post-class consolidation mutually depend on one another.

In introductory management courses, this sequence matters because management knowledge is both conceptual and applied. Students need to understand basic constructs such as planning, organising, motivation, leadership and control, but they also need to use these constructs to interpret cases, diagnose

workplace problems and coordinate group decisions. Blended learning can support this movement by placing basic content online, preserving classroom time for discussion and application, and using digital feedback to guide revision. The online component becomes meaningful when it changes the quality of classroom participation rather than merely adding another task list.

This article therefore uses blended learning quality rather than blended learning adoption as the design construct. Blended learning quality refers to students' perception that online and offline elements are pedagogically connected, task sequences are clear, feedback is usable, assessment rewards the intended learning process and course activities have vocational relevance. Research on blended learning implementation supports this emphasis. Teacher attributes and orchestration affect whether blended learning is implemented as an integrated pedagogy (Bruggeman et al., 2021), while technology integration quality explains more than simple frequency of technology use in relation to student engagement and digital competencies (Consoli et al., 2025). For vocational education, recent studies show that the benefits of blended learning depend on instructional alignment, support and activity design rather than on technological novelty (Cui et al., 2025; Radovan & Makovec Radovan, 2025; Song & Lai, 2025).

2.2 Digital competence as a course-related capability

Digital competence has become a central construct in educational digitalisation. The DigComp 2.2 framework describes digital competence through information and data literacy, communication and collaboration, digital content creation, safety and problem-solving (Vuorikari et al., 2022). Higher education research has adapted this broad framework into student scales that capture online learning, collaboration, social media use, mobile technology, safety and data protection (Tzafilkou et al., 2022). More recent validation work has also highlighted communication and digital security, digital content management, content creation and digital empathy as relevant dimensions for university students (Mejías-Acosta et al., 2024). Studies of post-pandemic university learning further indicate that digital content creation remains a concrete area in which students require structured opportunities to practise and demonstrate competence (Hervás-Torres et al., 2024).

For higher vocational students, digital competence should not be reduced to device familiarity. Students may be comfortable with smartphones and social media while still struggling to evaluate online materials, collaborate through learning platforms, produce structured digital content or use feedback strategically. Boie et al. (2024) use the term digital instinct to describe students' tendency to turn to digital technologies when solving school tasks, but such instinct does not necessarily equal critical or curriculum-oriented competence. This distinction is important in blended management education, where students are required not only to open digital resources but also to use them to prepare case arguments, coordinate group work and revise their understanding.

Course-related digital competence is therefore defined here as students' capability to use digital tools critically, safely and productively for the particular learning tasks required by a blended introductory management course. Recent empirical studies support its relevance. Chaw and Tang (2024) show that digital competence proficiency is linked with student learning performance. Pan et al. (2024) identify digital competence as a predictor of learning behaviour in higher education. Tan et al. (2024) also demonstrate that vocational students' digital learning competence includes technology use, thinking skills, activity management and will management. In the present model, digital competence is treated as a learning-enabling capability that allows students to participate in the blended curriculum with less friction and greater self-efficacy.

2.3 Learner engagement as curriculum enactment

Learner engagement is commonly conceptualised as a multidimensional construct. Behavioural engagement refers to attendance, task completion, interaction and participation. Cognitive engagement concerns mental effort, strategy use, self-regulation and willingness to work with challenging material. Emotional engagement refers to interest, belonging, value and enjoyment. Social or agentic engagement captures students' contribution to interaction, peer learning and the shaping of learning activities (Fredricks et al., 2004; Kahu, 2013; Kahu & Nelson, 2018).

In blended introductory management courses, engagement is the mechanism through which the curriculum becomes visible in practice. Engagement is seen when students prepare management cases before class, test concepts in group diagnosis tasks, respond to peer disagreement and revise their reasoning

after feedback. Online videos, quizzes and resources do not produce learning unless students attend to them, think with them and connect them to classroom tasks. Similarly, classroom discussion does not deepen management understanding unless students come prepared and use online evidence to support their arguments.

Technology-supported engagement is not automatic. Evidence maps and systematic reviews show that educational technology can facilitate behavioural, emotional and cognitive engagement, but its effects depend on task design, interaction, feedback and teacher presence (Bedenlier et al., 2020; Bond et al., 2020; Kearney & Maakrun, 2020). Studies on online and blended environments further show that engagement is shaped by technology acceptance, intrinsic motivation, self-regulation and perceived learning value (An et al., 2024; Pandita & Kiran, 2023). Evidence from emergency remote learning also shows that engagement can weaken when interaction, access and support are not deliberately organised (Khlaif et al., 2021). Hanaysha et al. (2023) also emphasise that classroom environment, teacher competence and ICT resources jointly influence engagement and academic performance. This body of work suggests that engagement should be treated as a curriculum enactment process rather than as a general student attitude.

2.4 Curriculum uptake as an implementation outcome

Implementation research distinguishes outcomes such as acceptability, adoption, appropriateness, feasibility, fidelity, penetration and sustainability from final service or learning outcomes (Proctor et al., 2011; Proctor et al., 2023). Applying this logic to blended management education, the relevant question is not only whether a course produces higher test scores, but whether students accept and enact the intended curriculum. The term curriculum uptake captures this student-side implementation process. Although implementation outcome theory was developed mainly in health and social-service research, its distinction between implementation success and final outcomes is useful for curriculum studies because a course design may be available without being enacted.

Curriculum uptake is defined as a multidimensional outcome consisting of five elements. Acceptance refers to students' perception that the blended curriculum is worthwhile and relevant. Active use refers to students' actual use of online resources, classroom activities and feedback opportunities. Participation fidelity refers to whether students follow the intended sequence of pre-class, in-class and post-class activities. Transfer refers to the use of management concepts and blended routines in cases, projects or workplace-like tasks. Continuance intention refers to students' willingness to keep using similar blended learning routines in later courses. Ye et al. (2022) show that expectancy beliefs, course satisfaction and perceived learning effectiveness matter for continuance intention in online courses among vocational-technical teacher-college students; in the present framework, continuance intention is only one dimension of the broader uptake construct.

This conceptualisation also responds to the limits of platform analytics. Login frequency, video completion and quiz attempts can indicate activity, but they cannot by themselves show whether students understand the sequence and purpose of the curriculum. LMS indicators are valuable when triangulated with survey data, teacher judgement and task evidence. They should not replace conceptual clarity about what curriculum uptake means.

Table 1 defines the four main constructs and clarifies their theoretical roles in the proposed model.

Table 1. Construct definitions and theoretical foundations

Construct	Working definition	Core dimensions	Theoretical role
Blended learning quality	Students' perception that online resources, classroom teaching, learning tasks, feedback, assessment and vocational relevance are integrated as one course system.	Online-offline alignment; task clarity; feedback usability; assessment alignment; vocational relevance.	Curriculum design condition; the environmental input expected to shape capability, engagement and uptake.
Digital competence	Students' capability to use digital tools critically, safely and productively for the learning tasks required by the blended management course.	Information evaluation; digital communication; content creation; safety and ethics; problem-solving; platform navigation.	Course-related capability; a mediator translating blended design into feasible participation.
Learner engagement	Students' behavioural, cognitive, emotional and social investment in blended course activities.	Task participation; cognitive effort; value perception; peer interaction; agentic contribution.	Curriculum enactment mechanism; a mediator showing whether course routines become learning practice.
Curriculum uptake	Students' acceptance, active use, faithful participation, transfer and continuance of the intended blended curriculum.	Acceptance; active use; participation fidelity; transfer; continuance intention.	Implementation outcome; the focal outcome beyond platform use, satisfaction and achievement.

Note. Author synthesis based on Bandura (1986), Garrison et al. (2000), Deci and Ryan (2000), Fredricks et al. (2004), Weiner (2009), Proctor et al. (2011), Kahu and Nelson (2018), Bond et al. (2020), Vuorikari et al. (2022), Proctor et al. (2023), Mejías-Acosta et al. (2024), Zhang (2026) and related vocational education research.

2.5 Conceptual boundary of curriculum uptake

A key risk in introducing a new construct is conceptual redundancy. Curriculum uptake must therefore be distinguished from adjacent concepts. It is broader than platform use because it includes the purpose and sequence of learning activities, not only digital traces. It is different from course satisfaction because students may enjoy a course without using the curriculum as designed. It is not identical to learner engagement because engagement is the process through which students invest effort, whereas uptake is the implementation outcome that records whether the intended curriculum has been absorbed into student practice. It is also different from learning achievement, which concerns final performance. Curriculum uptake is situated between design and achievement: it asks whether the course has been implemented on the learner side before asking whether it has raised scores.

This boundary is especially important for higher vocational management courses. These courses aim to cultivate applied understanding and professional habits. If students only watch videos or submit quizzes, curriculum implementation remains thin. Uptake becomes stronger when students use online resources to prepare for workplace-oriented cases, follow the designed learning cycle, use feedback to revise their reasoning and carry similar routines into subsequent business courses.

Table 2 summarises the conceptual boundary between curriculum uptake and related constructs.

Table 2. Conceptual boundary of curriculum uptake

Related concept	Typical focus	Why it is not sufficient	How curriculum uptake differs
Platform use	Clicks, logins, views, quiz attempts and submission records.	Activity traces may be mechanical and may not reflect understanding of course purpose.	Adds acceptance, sequence fidelity, transfer and continuance to observable use.
Course satisfaction	Students' overall affective evaluation of the course.	Students may be satisfied with convenience while still bypassing intended learning	Focuses on whether the curriculum is enacted, not whether the course is liked.

Related concept	Typical focus	Why it is not sufficient	How curriculum uptake differs
		routines.	
Learner engagement	Behavioural, cognitive, emotional and social investment.	Engagement describes the process of involvement but not necessarily the full implementation outcome.	Treats engagement as a mediator and uptake as the downstream implementation result.
Learning achievement	Grades, tests, project performance and competency assessment.	Achievement may be affected by prior ability and may not show whether the curriculum was followed.	Examines whether designed routines were accepted, used and transferred before final performance is evaluated.
Continuance intention	Willingness to continue using online or blended learning.	Intention is future-oriented and narrower than actual curriculum implementation.	Includes continuance intention as one dimension alongside acceptance, use, fidelity and transfer.

Note. Author synthesis. The boundary reduces the risk that curriculum uptake is mistaken for satisfaction, engagement, platform use or achievement.

3. Theoretical Model and Hypothesis Development

The proposed structural model is shown in Figure 2. The model does not assume that blended learning quality automatically produces curriculum uptake. Instead, it specifies a learner-side mechanism in which blended learning quality supports course-related digital competence, digital competence enables engagement, and engagement contributes to the implementation of curriculum routines.

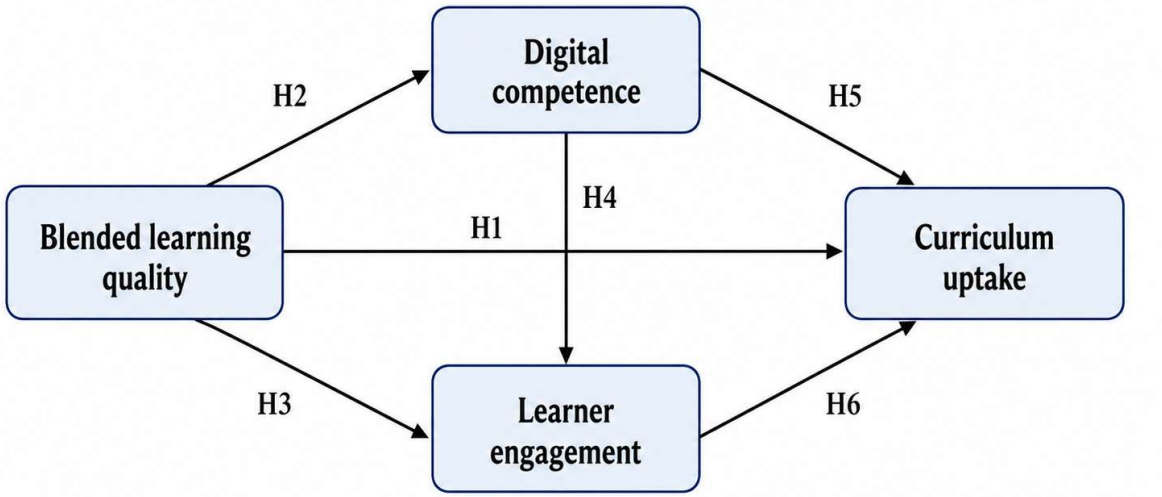

Figure 2. Proposed structural model explaining curriculum uptake in blended introductory management courses

Note. Direct paths are labelled H1-H6. Indirect effects H7-H9 are tested through bootstrapped mediation procedures. Controls should include gender, major, year of study, prior academic performance, device access, prior online learning experience, prior digital competence and college type.

3.1 Blended learning quality and curriculum uptake

Blended learning quality should be positively associated with curriculum uptake because a well-aligned course makes the purpose of each activity visible. When online preparation is linked to classroom case analysis and post-class reflection, students can understand why the sequence matters. In management courses, this alignment allows students to move from concept exposure to applied interpretation. Poorly aligned blended learning has the opposite effect: online tasks become administrative requirements and classroom discussion remains detached from the digital record.

Implementation outcome theory supports this logic. Students are more likely to adopt and sustain a curriculum when they perceive it as acceptable, appropriate and feasible (Weiner, 2009; Proctor et al., 2011). Blended learning quality provides the design conditions that make such student-side adoption possible.

H1: Blended learning quality is positively associated with curriculum uptake in introductory management courses.

3.2 Blended learning quality and digital competence

A blended course can develop course-related digital competence when digital activities are embedded in meaningful learning tasks. Students may learn to search for case information, evaluate digital materials, collaborate on group documents, submit reflective outputs and interpret teacher feedback. These activities provide repeated opportunities to practise digital competence in a management-learning context.

Social cognitive theory explains this pathway: capability develops through reciprocal interaction among personal factors, behaviour and environment (Bandura, 1986). The blended curriculum is part of the learning environment, and structured digital tasks can build students' confidence and competence. Recent VET research on blended activities and digital competence provides direct support for examining this pathway (Radovan & Makovec Radovan, 2025).

H2: Blended learning quality is positively associated with students' course-related digital competence.

3.3 Blended learning quality and learner engagement

Blended learning quality is also expected to support learner engagement. Students are more likely to prepare, participate and reflect when task instructions are clear, feedback is usable and assessment recognises the intended learning process. In management education, engagement can be activated through pre-class guiding questions, classroom case debates, group diagnosis tasks and reflective journals.

The community of inquiry framework suggests that meaningful blended learning depends on teaching presence, social presence and cognitive presence (Garrison et al., 2000). Self-determination theory adds that engagement is more likely when students experience competence, autonomy and relatedness (Deci & Ryan, 2000). A well-designed blended course can support all three conditions by providing clear scaffolding, flexible access and peer interaction.

H3: Blended learning quality is positively associated with learner engagement.

3.4 Digital competence and learner engagement

Course-related digital competence is expected to increase engagement by reducing participation barriers and strengthening perceived control over learning tasks. Students who can locate resources, use discussion tools, manage digital submissions and solve routine technical problems are less likely to withdraw from online or blended activities. Digital competence may also reduce the cognitive load associated with platform navigation, leaving more attention for management reasoning and peer interaction. In social cognitive terms, course-related digital competence may increase self-efficacy in dealing with online learning tasks, which makes sustained engagement more likely.

This pathway is consistent with studies showing links among digital competence, technology acceptance, learning behaviour and engagement (An et al., 2024; Chaw & Tang, 2024; Pan et al., 2024). In a blended management course, competent digital learners can move more easily between online preparation and classroom participation, making engagement more likely.

H4: Digital competence is positively associated with learner engagement.

3.5 Digital competence and curriculum uptake

Digital competence should also have a direct association with curriculum uptake. Students who can use the platform, evaluate resources, collaborate digitally and solve technical problems are more likely to accept and use the blended curriculum. They can also follow the intended learning sequence more reliably. In management courses, digital competence supports transfer because students can use digital tools to prepare cases, compare examples and collaborate on applied projects.

In implementation terms, digital competence increases the feasibility of student-side adoption. A curriculum may be pedagogically sound, but uptake will remain weak if students cannot operate within its digital environment.

H5: Digital competence is positively associated with curriculum uptake.

3.6 Learner engagement and curriculum uptake

Learner engagement is expected to be strongly associated with curriculum uptake. Students who participate, invest cognitive effort and perceive value in the tasks are more likely to use the curriculum as intended. Engagement also routinises the curriculum. When students repeatedly prepare, discuss, apply and reflect, the course structure becomes part of their learning practice.

The engagement literature identifies engagement as a proximal condition for learning success (Fredricks et al., 2004; Kahu, 2013; Bond et al., 2020). In the present model, engagement is not treated simply as an attitude toward learning. It is the enactment mechanism through which the blended curriculum is absorbed into students' actual routines.

H6: Learner engagement is positively associated with curriculum uptake.

3.7 Mediating effects

The model further proposes three indirect effects. First, blended learning quality may support curriculum uptake through digital competence. Second, blended learning quality may support curriculum uptake through learner engagement. Third, a sequential pathway may exist in which blended learning quality first develops course-related digital competence, digital competence then supports learner engagement, and engagement finally contributes to curriculum uptake.

This sequential logic avoids a simplified technology-effect argument. The model does not claim that blended learning works because digital resources are present. It argues that blended learning is taken up when course design builds the capability and engagement needed for students to enact the intended curriculum.

H7: Digital competence mediates the relationship between blended learning quality and curriculum uptake.

H8: Learner engagement mediates the relationship between blended learning quality and curriculum uptake.

H9: Digital competence and learner engagement sequentially mediate the relationship between blended learning quality and curriculum uptake.

Table 3 summarises the hypotheses and analytical expectations for future empirical validation.

Table 3. Hypotheses and analytical expectations

Hypothesis	Structural path	Rationale	Expected test
H1	BLQ -> CU	Aligned online-offline design increases acceptability, active use, participation fidelity and transfer.	Positive direct path
H2	BLQ -> DC	Structured digital tasks and feedback build course-related digital capability.	Positive direct path
H3	BLQ -> LE	Clear task sequence, relevance, feedback and interaction support behavioural, cognitive and emotional involvement.	Positive direct path
H4	DC -> LE	Digital competence reduces participation barriers and increases perceived control over learning tasks.	Positive direct path
H5	DC -> CU	Digital capability increases feasibility, faithful participation and continuance of blended curriculum routines.	Positive direct path
H6	LE -> CU	Engaged students enact, transfer and routinise the curriculum more consistently.	Positive direct path
H7	BLQ -> DC -> CU	Digital competence transmits part of the design effect to uptake.	Bootstrapped indirect effect
H8	BLQ -> LE -> CU	Engagement transmits part of the design effect to uptake.	Bootstrapped indirect effect
H9	BLQ -> DC -> LE -> CU	Course design first builds capability, then engagement, then uptake.	Bootstrapped sequential indirect effect

Note. BLQ = blended learning quality; DC = digital competence; LE = learner engagement; CU = curriculum uptake. The hypotheses are formulated for future validation rather than presented as tested empirical findings.

4. Empirical Validation Protocol

4.1 Research design and temporal ordering

A baseline-plus-four-wave design is recommended because the model proposes sequential mediation. The design should separate prior digital competence from course-related digital competence after exposure to the blended curriculum. Without this separation, it would be difficult to justify the pathway from blended learning quality to digital competence.

Data collection may be organised across one semester. At T0, researchers collect control variables, prior online learning experience and prior digital competence. At T1, after students have experienced the course structure, they report blended learning quality. At T2, they report course-related digital competence after repeated blended tasks. At T3, they report learner engagement. At T4, near the end of the semester, they report curriculum uptake. Figure 3 presents the recommended sequence.

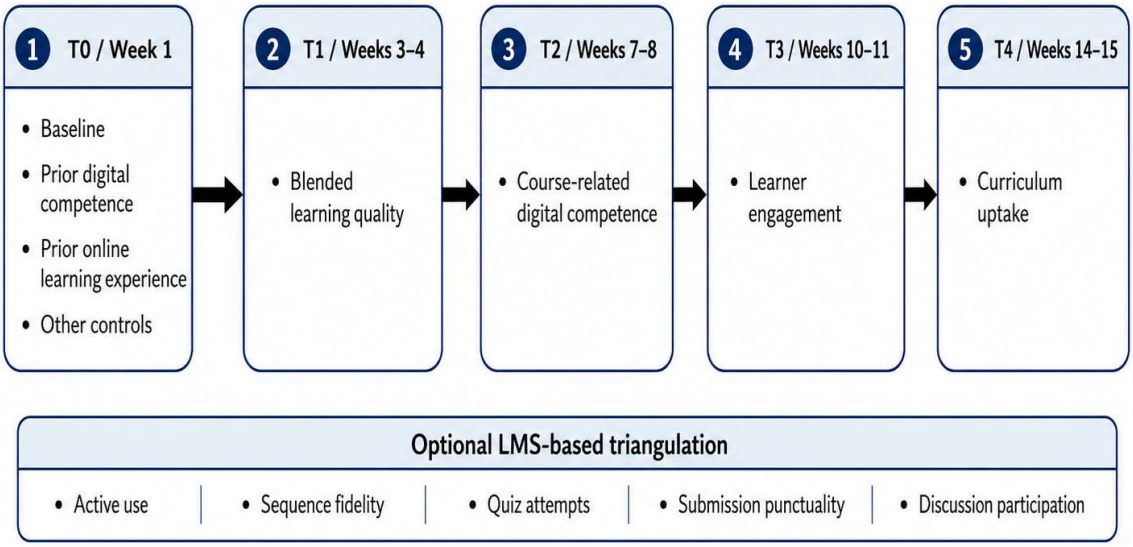

Figure 3. Baseline-plus-four-wave validation workflow for the proposed structural model

Note. The baseline-plus-four-wave design separates prior digital competence from course-related digital competence after blended-learning exposure, thereby strengthening the logic of sequential mediation.

This temporal ordering does not by itself establish causality. It is, however, stronger than a single cross-sectional survey because it reduces some common method concerns and aligns measurement timing with the theoretical process. The proposed model should not be interpreted as evidence of causal effects until it is tested with longitudinal, quasi-experimental or experimental data.

If a baseline-plus-four-wave design is not feasible, a three-wave design can still be used. In that case, prior digital competence should be measured at T1 as a control, while course-related digital competence and learner engagement are measured at T2 and curriculum uptake at T3. The baseline-plus-four-wave design remains preferable for testing H9.

4.2 Sampling strategy and context

The target population is students enrolled in introductory management courses in higher vocational colleges. Courses should contain both online and face-to-face components, such as digital resources, online assignments, classroom case analysis, group discussion and formative feedback. To improve external validity, the study should include students from several majors, such as business administration, marketing, accounting, logistics, e-commerce and human resource management.

A multi-site sample is recommended. Six to ten higher vocational colleges would provide a stronger basis for testing whether the model travels across institutional contexts. A minimum sample should be determined through statistical power analysis rather than through the ten-times rule alone. For a model with multiple mediators and controls, at least 400 valid cases are advisable, and 500 or more would provide better stability for bootstrapped mediation and multi-group analysis (Hair et al., 2022). Because students are

nested in classes and colleges, intraclass correlations should be examined. If the nesting effect is meaningful, researchers should use multilevel SEM or cluster-robust standard errors.

4.3 Measurement design

All constructs can be measured with five-point or seven-point Likert-type items. Existing validated instruments should be adapted rather than copied mechanically. Items should be translated and back-translated if the survey is administered in Chinese, and a panel of vocational education, management education and educational technology experts should review content validity. A pilot test with 50 to 80 students should be conducted before the main study.

Table 4 provides a measurement blueprint. It intentionally separates curriculum uptake from engagement and satisfaction. This separation is necessary because the focal outcome is whether the blended curriculum is implemented on the learner side, not whether students merely feel positive about the course. A fuller proposed item pool is provided in Appendix A (Table 8) for researchers who wish to operationalise the model in future empirical work.

Table 4. Measurement blueprint for empirical validation

Construct	Suggested dimensions	Illustrative item wording	Possible sources
Blended learning quality	Online-offline alignment; task clarity; feedback usability; assessment alignment; vocational relevance.	The online preparation tasks help me participate more effectively in classroom case discussion. / The course assessment rewards the intended sequence of pre-class, in-class and post-class learning.	Garrison et al. (2000); Biggs and Tang (2011); Rasheed et al. (2020); Anthony Jr. et al. (2022); Istenič (2024); Consoli et al. (2025)
Digital competence	Information evaluation; digital communication; content creation; safety and ethics; problem-solving; platform navigation.	I can evaluate whether online materials are useful for management case analysis. / I can solve common technical problems when completing blended learning tasks.	Vuorikari et al. (2022); Tzafilkou et al. (2022); Chaw and Tang (2024); Mejías-Acosta et al. (2024); Tan et al. (2024)
Learner engagement	Behavioural engagement; cognitive engagement; emotional value; peer interaction; agentic contribution.	I prepare management cases before class. / I try to connect management theories with practical situations. / I contribute ideas during group discussion.	Fredricks et al. (2004); Kahu (2013); Kahu and Nelson (2018); Bedenlier et al. (2020); Bond et al. (2020); An et al. (2024)
Curriculum uptake	Acceptance; active use; participation fidelity; transfer; continuance intention.	I use the online and classroom activities in the sequence intended by the course. / I apply the blended learning routines from this course to other management-related tasks.	Weiner (2009); Proctor et al. (2011); Ye et al. (2022); Proctor et al. (2023); Zhang (2026)
Controls and context	Gender; major; year; prior performance; device access; prior online learning; prior digital competence; college type.	Before this course, how confident were you in using digital platforms for learning? / What device do you mainly use for online learning?	Hair et al. (2022); Podsakoff et al. (2012)

Note. The table gives illustrative items rather than a final validated scale. Items should be context-adapted, expert-reviewed, piloted and validated before hypothesis testing.

4.4 Learning management system indicators and triangulation

Platform traces can strengthen the validation design if they are used carefully. LMS data should be treated as triangulation evidence rather than direct measures of deep learning. A student may leave a video running without watching it, and a discussion post may be perfunctory. For this reason, LMS indicators should be matched with the conceptual dimensions of curriculum uptake and interpreted alongside survey responses and teacher judgement.

Table 5 lists optional LMS indicators. These indicators are especially useful for active use and participation fidelity, because they can show whether students completed pre-class tasks before classroom

activities and whether they followed the intended learning sequence. They are less able to capture acceptance or transfer unless combined with survey and task evidence.

Table 5. LMS and course evidence for triangulating curriculum uptake

Curriculum uptake dimension	Possible LMS or course evidence	Interpretive caution	Recommended use
Acceptance	Survey items; optional open-ended comments on course relevance and usefulness.	LMS data cannot directly measure acceptance.	Use survey and qualitative comments.
Active use	Login frequency; resource access; video completion; quiz attempts; assignment downloads.	Frequent access may be mechanical or compliance-driven.	Combine activity traces with self-reported usefulness.
Participation fidelity	Completion of pre-class tasks before class date; sequence of resource use; punctual submission rate.	Sequence indicators may be affected by platform constraints or teacher reminders.	Use to test whether the designed learning cycle was followed.
Transfer	Quality of case analysis; reflective journal coding; group project evidence; teacher rubric scores.	Transfer requires interpretation of task content, not only digital traces.	Use rubrics and sample coding.
Continuance intention	End-of-course survey; later elective-course platform use if available.	Intention is not the same as later behaviour.	Use follow-up data when feasible.

Note. LMS = learning management system. The indicators should be used ethically, with transparent consent and privacy protection.

4.5 Analytical strategy

Partial least squares structural equation modelling is suitable when future validation is prediction-oriented, includes multiple latent constructs and tests mediation paths. If the primary purpose is strict theory confirmation and the data meet multivariate assumptions, covariance-based SEM can be reported as the main analysis, with PLS-SEM used for prediction-oriented robustness. In either case, the analysis should begin with the measurement model before estimating the structural model. Indicator reliability, internal consistency, convergent validity and discriminant validity must be reported. The heterotrait-monotrait ratio is recommended for discriminant validity because it is more sensitive than traditional criteria (Henseler et al., 2015). Covariance-based SEM may be used as a robustness check when sample size and distributional assumptions are adequate.

The baseline-plus-four-wave design allows the following structural equations to be used as a reporting guide. In these equations, $DC_{i,t0}$ denotes prior digital competence, while C_i denotes the remaining control variables, including gender, major, year of study, prior academic performance, device access, prior online learning experience and college type.

$$DC_{i,t2} = \alpha_0 + \alpha_1 BLQ_{i,t1} + \alpha_2 DC_{i,t0} + \Gamma C_i + \varepsilon_i \quad (1)$$

$$LE_{i,t3} = \beta_0 + \beta_1 BLQ_{i,t1} + \beta_2 DC_{i,t2} + \Gamma C_i + \varepsilon_i \quad (2)$$

$$CU_{i,t4} = \delta_0 + \delta_1 BLQ_{i,t1} + \delta_2 DC_{i,t2} + \delta_3 LE_{i,t3} + \Gamma C_i + \varepsilon_i \quad (3)$$

Equations (1)-(3) are not empirical results. They are proposed specifications for future validation. Mediation should be tested through bootstrapping, and the sequential indirect effect should be reported with confidence intervals. If data are nested, cluster-robust estimation or multilevel modelling should be applied.

Table 6 sets out recommended reporting criteria for the measurement and structural model.

Table 6. Recommended PLS-SEM assessment and reporting criteria

Assessment area	Indicator	Recommended criterion	Purpose
Indicator reliability	Outer loading	Preferably above .70; theoretically meaningful items between .40 and .70 may be retained if composite reliability and AVE are acceptable.	Checks whether items represent the construct.

Assessment area	Indicator	Recommended criterion	Purpose
Internal consistency	Cronbach's alpha, rho_A, composite reliability	Usually above .70 and below .95.	Avoids weak or redundant measurement.
Convergent validity	Average variance extracted	Above .50.	Confirms that the construct explains sufficient item variance.
Discriminant validity	HTMT ratio	Below .85 or .90 depending on construct similarity.	Tests whether constructs are empirically distinct.
Collinearity	VIF	Preferably below 3.3; values below 5 may be acceptable with theoretical justification.	Detects problematic overlap among predictors.
Path significance	Bootstrapped confidence interval	Confidence interval should not include zero.	Tests direct and indirect effects.
Explanatory power	R^2	Interpreted according to education context and compared across models.	Assesses explained variance in endogenous constructs.
Effect size	f^2	.02 small, .15 medium, .35 large as general guidelines.	Assesses substantive contribution of predictors.
Predictive relevance	Q^2 or PLSpredict	Positive values indicate predictive relevance.	Examines out-of-sample predictive usefulness.
Approximate model fit	SRMR	Often below .08 as a reference, not as the sole quality criterion in PLS-SEM.	Provides an approximate fit check.

Note. The criteria are adapted from Henseler et al. (2015) and Hair et al. (2022). They should be reported together with substantive interpretation, not as mechanical thresholds.

4.6 Common method bias, measurement invariance and robustness checks

Common method bias should be addressed both procedurally and statistically. Procedural remedies include temporal separation, anonymous responses, clear item wording and separation of predictor and outcome sections. Statistical remedies may include full collinearity assessment, marker-variable checks or comparison with alternative models (Podsakoff et al., 2012). The baseline-plus-four-wave design proposed in Figure 3 is therefore not only a theoretical choice but also a method-bias reduction strategy.

Robustness checks should include at least five analyses. First, the hypothesised sequential mediation model should be compared with a competing model in which engagement precedes digital competence. Second, the model should be tested with and without control variables. Third, measurement invariance should be established before multi-group comparisons by gender, major, prior online learning experience or college type. Fourth, platform indicators should be used to validate active use and participation fidelity where available. Fifth, CB-SEM may be used as a robustness check if data quality permits.

5. Theoretical and Practical Implications

5.1 Theoretical implications

The first theoretical implication is that blended learning should be examined as curriculum implementation rather than as a delivery arrangement. Many studies evaluate blended learning through achievement, satisfaction or attitudes. These outcomes are valuable, but they do not show whether students have absorbed the intended curriculum routines. Curriculum uptake shifts attention to student-side implementation: whether students accept, use, follow, transfer and continue the blended learning practices designed by the course.

The second implication is that digital competence should be treated as course-related capability rather than as a generic background skill. In blended introductory management courses, digital competence matters because it enables students to use resources, participate in discussion, complete tasks and interpret feedback. Without this capability, the blended curriculum may remain technically available but pedagogically inaccessible. This argument extends DigComp-based work by connecting digital competence

to implementation outcomes rather than only to general digital literacy or academic performance (Vuorikari et al., 2022; Chaw & Tang, 2024; Mejías-Acosta et al., 2024).

The third implication is that engagement should be understood as curriculum enactment. Engagement becomes visible when students use pre-class materials to prepare case arguments, contribute to group diagnosis, revise their management reasoning after feedback and carry routines into new tasks. This understanding bridges student engagement research with implementation outcome theory. It also complements Xianghan Zhang's (2026) evidence that learning commitment and motivational internalisation are central to vocational and applied higher education outcomes.

The model also has relevance beyond China. Many TVET systems and applied universities are moving toward digitally mediated, workplace-oriented and flexible learning. The core challenge is not unique to Chinese higher vocational colleges: institutions everywhere need to know whether blended designs are being enacted by learners. The proposed model can therefore travel to business foundation courses, applied management programmes and vocationally oriented modules in different national systems, provided that measurement items are contextually adapted.

5.2 Practical implications for course design and quality assurance

Course designers should treat blended learning as a sequence of curriculum routines. Each online activity should have a clear function before, during or after classroom learning. For example, a short video on leadership theories should prepare students for a classroom case debate, while a post-class reflection should ask students to apply the same theories to a workplace scenario. Assessment should reward the sequence so that students understand the value of each component.

Teachers should also scaffold digital competence explicitly. It is unsafe to assume that vocational students are digitally competent simply because they use smartphones frequently. Students may need guidance on platform navigation, information evaluation, online collaboration, digital content creation and feedback use. Such scaffolding can be brief but systematic: platform demonstrations, digital task checklists, peer-support routines and formative feedback on online submissions can lower the threshold for participation.

Quality assurance should use curriculum uptake indicators rather than platform statistics alone. Login rates and video completion are useful, but they do not show whether students follow the designed learning cycle or transfer course routines to applied tasks. Course review meetings can therefore examine evidence of acceptance, active use, participation fidelity, transfer and continuance intention. Figure 4 translates the model into a practical curriculum improvement loop.

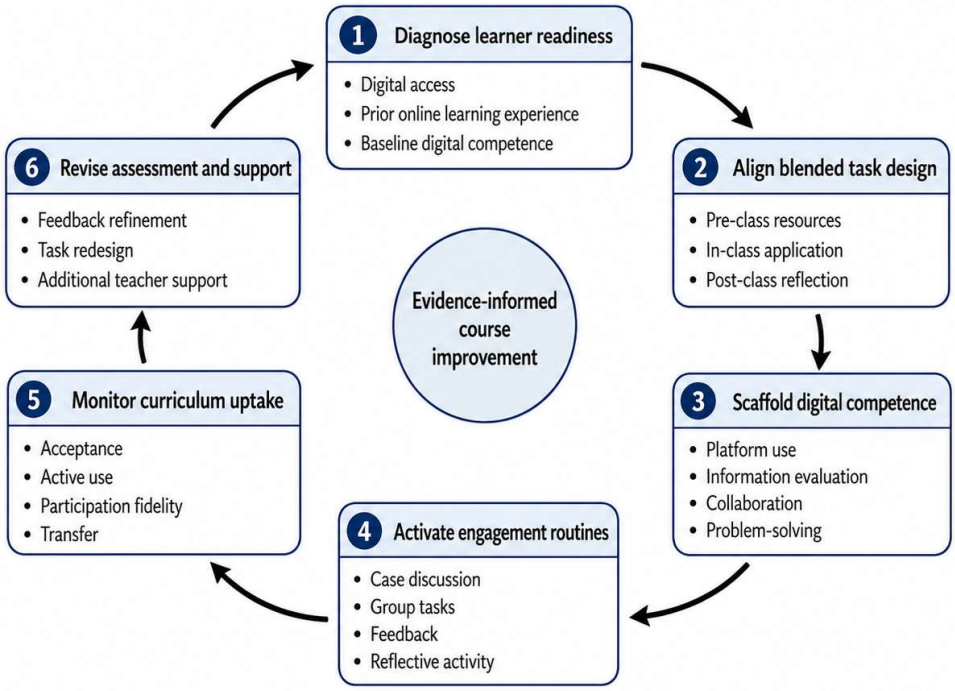

Figure 4. Curriculum uptake improvement loop for blended introductory management courses

Note. The loop turns the structural model into a practical quality-assurance process for course teams and college administrators.

Table 7 provides a course-design matrix that can be used in programme review, teacher development or course redesign meetings.

Table 7. Practical course-design matrix for improving curriculum uptake

Design lever	Concrete action in an introductory management course	Expected mechanism	Evidence to monitor
Align online and classroom tasks	Use pre-class videos and guiding questions to prepare students for classroom case analysis.	Students see the function of the online component and are more likely to follow the sequence.	Pre-class completion before class date; quality of case participation.
Scaffold digital competence	Provide short platform demonstrations, resource-evaluation checklists and peer support for digital submissions.	Students gain perceived control and face fewer participation barriers.	Self-reported competence; reduced late submissions; fewer technical-support requests.
Activate engagement routines	Use group diagnosis, role-play, peer feedback and reflective journals linked to management concepts.	Students invest behavioural, cognitive and social effort in course tasks.	Discussion participation; reflective depth; group-task evidence.
Make assessment congruent	Reward preparation, participation, application and revision rather than only final tests.	The intended curriculum routine becomes consequential for students.	Rubric scores; revision records; formative assessment completion.
Monitor uptake rather than traffic	Combine survey data, LMS indicators and teacher judgement to evaluate acceptance, active use, fidelity, transfer and continuance.	Quality assurance shifts from platform adoption to learner-side implementation.	Curriculum uptake scale; sequence fidelity; case-transfer evidence.

Note. The matrix operationalises Figure 4 for course teams. It can be adapted for teaching-research offices, programme review and professional development in higher vocational colleges.

6. Limitations and Future Research Directions

The first limitation is that the article develops a conceptual structural model and validation protocol rather than reporting original empirical results. The model should therefore be treated as an empirically testable framework, not as evidence that the hypothesised relationships have already been confirmed. Future studies should test the model with longitudinal or quasi-experimental data.

Second, the proposed measurement design relies partly on student self-report. Self-report is appropriate for perceptions, acceptance and perceived engagement, but it should be combined with LMS indicators, teacher ratings and task evidence where possible. Platform data should be interpreted cautiously because behavioural traces do not necessarily indicate deep engagement or transfer.

Third, the model focuses on learner-side mechanisms. Teacher digital pedagogy, teaching presence, assessment literacy, institutional support and class culture may also affect curriculum uptake. Future research can extend the framework into a multilevel model that examines how class-level teaching practices and college-level digital infrastructure shape student-level competence, engagement and uptake.

Fourth, the rapid development of artificial intelligence in education creates new questions for blended management courses. AI-supported feedback, adaptive resources and learning analytics may alter students' digital competence requirements and engagement patterns. Future studies should examine these developments while also addressing transparency, privacy, algorithmic bias and students' critical understanding of AI-generated content. UNESCO's (2023) caution that educational technology should be governed by educational purposes rather than technological inevitability remains relevant to this agenda.

Finally, comparative research is needed. The model may function differently across majors, regions, institutional types and national TVET systems. Multi-group analysis and measurement invariance testing can identify whether differentiated support is needed for students with different levels of prior digital competence or access to learning devices.

7. Conclusion

This article developed a conceptual structural model and empirical validation protocol explaining how blended learning quality may support curriculum uptake in higher vocational introductory management courses. The central argument is that blended learning does not become educationally meaningful simply because online and offline components coexist. Students take up a blended curriculum when course design is pedagogically aligned, when they possess the digital competence required to participate effectively, and when they become behaviourally, cognitively, emotionally and socially engaged in learning activities.

By integrating blended learning research, digital competence frameworks, student engagement theory and implementation outcome theory, the article provides a more precise vocabulary for evaluating curriculum reform in higher vocational management education. Curriculum uptake moves the evaluation focus from platform adoption to learner-side implementation. For vocational colleges, the practical task is therefore not only to add digital resources, but to design, scaffold, monitor and revise blended learning systems that students can competently and meaningfully enact.

Declarations

Ethics statement. The present article is a conceptual structural model and empirical validation protocol. No human participants were recruited and no original data were collected for this manuscript. Future empirical studies based on the proposed protocol should obtain institutional ethics approval and informed consent from student participants.

Data availability statement. No original datasets were generated or analysed for the present article. The proposed constructs, validation sequence and measurement blueprint are provided in the manuscript for future empirical validation.

Conflict of interest. The authors declare no conflict of interest.

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Appendix A. Proposed Item Pool for Future Empirical Validation

Table 8 provides an illustrative item pool that can be adapted, translated, expert-reviewed and validated before empirical testing. The items are not presented as an already validated instrument; they are provided to make the validation protocol operational.

Table 8. Proposed item pool for empirical validation

Construct	Indicative item	Intended dimension
Blended learning quality	The online and classroom activities in this course are clearly connected.	Online-offline integration
Blended learning quality	The assessment tasks reward preparation, participation and reflection rather than isolated completion.	Assessment alignment
Blended learning quality	The blended activities help me connect management concepts with workplace-like situations.	Vocational relevance
Digital competence	I can locate and evaluate digital materials needed for management case analysis.	Information and data literacy
Digital competence	I can collaborate with classmates through digital tools to complete course tasks.	Communication and collaboration
Digital competence	I can solve routine technical problems when completing online course activities.	Problem-solving
Learner engagement	I complete the online preparation before participating in classroom discussion.	Behavioural engagement
Learner engagement	I try to connect management theories with cases, projects and workplace examples.	Cognitive engagement
Learner engagement	I feel that the blended tasks are meaningful for my management learning.	Emotional engagement
Curriculum uptake	I use the online resources, classroom activities and feedback in the sequence intended by the course.	Participation fidelity
Curriculum uptake	I apply the learning routines from this course when working on new management tasks.	Transfer
Curriculum uptake	I would continue using similar blended learning routines in future management courses.	Continuance intention

Note. The item pool should be adapted to local curriculum design and tested for reliability, convergent validity and discriminant validity before substantive hypothesis testing.

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