Article

Research on the Connotative Development of Innovation and Entrepreneurship Education in Higher Vocational Undergraduate Institutions under the Background of Industry-Education Integration

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Abstract: Industry–education integration provides a crucial driving force for the connotative development of innovation and entrepreneurship education in higher vocational undergraduate institutions. At present, such education faces significant structural dilemmas that severely hinder its overall effectiveness. These challenges include a deviation in conceptual positioning, course content that remains disconnected from actual industrial needs, insufficient practical teaching abilities among the faculty, and evaluation mechanisms that have deteriorated into mere formalities. Collectively, these issues constrain any substantive improvement in the overall quality of talent cultivation. To address these pressing challenges, this paper systematically analyzes the current landscape from the perspective of industry–education integration and proposes several practical, actionable pathways. Specifically, it recommends reconstructing the curriculum system to align precisely with evolving industrial demands, cultivating a dual-professional teaching team through robust school–enterprise collaboration, and building a dynamic practice platform driven by real-world projects. Furthermore, it advocates for constructing a multi-party collaborative evaluation mechanism to ensure comprehensive assessment. Together, these strategies form a holistic solution for the systematic optimization of educational elements. Ultimately, this study provides a valuable theoretical and practical reference for higher vocational undergraduate institutions seeking to deepen the continuous advancement and optimization of innovation and entrepreneurship education, thereby fostering high-quality applied talents for modern economic development and societal progress. This comprehensive approach ensures that educational outcomes directly meet the dynamic requirements of the modern workforce.

Keywords: industry integration; vocational education; entrepreneurship education; educational development; talent cultivation

Received: 05 August 2026
Revised: 14 September 2026
Accepted: 24 September 2026
Published: 30 September 2026

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1. Introduction

As the modern vocational education system evolves, higher vocational undergraduate institutions play a vital role in cultivating high-level technical and skilled talent. Innovation and entrepreneurship education constitutes a core component of the talent development framework in these institutions and significantly influences students' capacity for career advancement and adaptation to industry dynamics amid rapid technological change. However, such education commonly faces challenges including limited alignment with real-world industrial requirements, delayed updating of curriculum content, inadequate practical teaching competence among faculty, and assessment practices that emphasize formal indicators over substantive outcomes—leading to a pronounced structural mismatch between educational provision and industrial demand. Industry–education integration promotes collaborative learning between institutions and enterprises, embedding industrial resources, applied

technologies, and an innovation-oriented culture throughout the entire educational process. This approach offers a viable strategy to move innovation and entrepreneurship education beyond superficial implementation toward meaningful quality enhancement. From the perspective of industry–education integration, this paper elucidates the intrinsic relationship between such integration and the connotative development of innovation and entrepreneurship education in higher vocational undergraduate institutions, identifies current implementation challenges, and proposes systematic pathways for practice, aiming to support ongoing pedagogical improvement in this domain [1, 2].

2. The Intrinsic Relationship between Industry–Education Integration and the Connotative Development of Innovation and Entrepreneurship Education in Higher Vocational Undergraduate Institutions

2.1. Core Meaning and Characteristics of Connotative Development

Connotative development emphasises the optimisation of internal educational elements and the holistic enhancement of quality, focusing on structural refinement, transformation of developmental drivers, and improvement of operational efficiency, in contrast to growth reliant on external input [3]. For higher vocational undergraduate institutions, the connotative development of innovation and entrepreneurship education centres on three core dimensions. At the level of training objectives, it requires precise alignment with regional industrial upgrading demands for high-level technical and skilled talent, integrating innovative awareness, entrepreneurial literacy, and professional competence to establish clear talent specifications. At the level of the educational process, it prioritises teaching anchored in authentic projects and real-world challenges, leveraging immersive practical training to strengthen students' innovative thinking, entrepreneurial decision-making capability, and adaptability to complex market conditions. At the level of quality assurance, it necessitates a comprehensive, continuous improvement mechanism covering curriculum, instruction, faculty development, and evaluation—establishing a data-informed diagnostic feedback system and iterative optimisation process to ensure the education system's capacity for autonomous evolution.

The connotative development of innovation and entrepreneurship education in higher vocational undergraduate institutions exhibits three fundamental characteristics. Its systemic nature requires coordinated functioning across all educational components: curriculum, practice, faculty, and evaluation must operate cohesively rather than in isolation. Its effectiveness is measured by tangible enhancements in students' innovation and entrepreneurship capabilities—not merely by participation rates or credential acquisition. Its sustainability depends on the education system's ability to dynamically adjust, enabling timely revision of training programmes in response to evolving industrial technologies and shifting market conditions, thereby preventing diminished adaptability due to institutional inflexibility [4].

2.2. The Enabling Mechanism of Industry–Education Integration for Connotative Development

Industry–education integration introduces enterprise production environments, technological cases, and market logic into the entire innovation and entrepreneurship education process. Its enabling effect operates across four interrelated dimensions: resources, content, teaching personnel, and evaluation. At the resource level, enterprises supply equipment, data, authentic operational scenarios, and real-world projects—complementing the limitations of simulated academic settings and shifting practical instruction from theoretical simulation to genuine application. At the content level, cutting-edge industrial technological challenges and actual enterprise operational issues are systematically transformed into pedagogical themes, prompting regular curriculum renewal and ensuring that innovation and entrepreneurship education remains closely aligned with evolving industrial technologies [5]. At the teaching personnel level, enterprise technical experts and managerial professionals collaborate with academic faculty in co-teaching arrangements, integrating theoretical foundations with hands-on expertise and expanding students' professional perspectives. At the evaluation level,

industry benchmarks, market responsiveness, and the practical impact of student outcomes are embedded within the quality assessment framework, thereby shifting the basis for evaluating educational effectiveness from internal academic judgment to multi-stakeholder validation.

Industry–education integration also supports the reconfiguration of drivers shaping innovation and entrepreneurship education in higher vocational undergraduate institutions. External industrial requirements are continuously channeled into academic institutions through structured school–enterprise collaboration mechanisms, informing adjustments to talent development objectives, curriculum design, and pedagogical approaches [3]. Concurrently, improvements arising from academic initiatives feed back into industrial advancement via skilled graduate deployment and applied technical support, establishing a mutually reinforcing cycle. This bidirectional alignment replaces the historically isolated, self-contained mode of traditional education and sustains long-term vitality for the connotative development of innovation and entrepreneurship education.

3. Practical Dilemmas in the Connotative Development of Innovation and Entrepreneurship Education in Higher Vocational Undergraduate Institutions

3.1. The Educational Philosophy Is Divorced from the Requirements of Industry–Education Integration

Many higher vocational undergraduate institutions position innovation and entrepreneurship education primarily as a quality-development module, treating it as an extension of employment guidance or as part of campus cultural activities, rather than integrating it into the core professional talent training framework. This misalignment results in a disconnection between innovation and entrepreneurship education and professional education: students receive insufficient instruction in innovation methodologies within their disciplinary courses, while innovation and entrepreneurship courses lack authentic, discipline-specific application contexts, leaving no systematic mechanism for meaningful integration. Institutional understanding of industry–education integration often remains at the level of resource acquisition—such as securing equipment, facilities, or funding through enterprise partnerships—while underemphasizing its deeper pedagogical significance in reshaping educational philosophy [5, 6]. Although cooperation agreements between institutions and enterprises frequently mention innovation and entrepreneurship education, such references tend to be generic and lack concrete implementation guidelines or process-oriented management mechanisms. Enterprise engagement typically manifests in superficial ways, including one-off guest lectures or competition judging, with limited involvement in critical academic processes such as defining training objectives, designing curriculum systems, or delivering instruction. Consequently, industry expectations regarding innovative thinking and entrepreneurial capability are inadequately communicated to educational institutions, perpetuating a structural mismatch between graduate competencies and actual enterprise recruitment requirements.

3.2. The Curriculum System Does Not Adequately Match Industrial Needs

Innovation and entrepreneurship courses predominantly adopt a general, introductory approach, covering broad topics such as foundational innovative thinking, entrepreneurship fundamentals, and business plan development. However, they lack tiered, field-specific offerings aligned with distinct industrial sectors and technical disciplines. A uniform curriculum is applied across diverse academic backgrounds, failing to reflect sector-specific technological features or variations in occupational competencies, resulting in weak disciplinary alignment. Course content updates infrequently, and illustrative cases in textbooks often draw from early-stage practices of established enterprises, lagging behind rapid technological evolution and dynamic market transformations. Strategic industrial shifts—including digitalization, intelligentization, and green development—are not systematically integrated into course

design, limiting students' capacity to recognize entrepreneurial opportunities within emerging economic paradigms [7, 8]. Real-world enterprise innovation challenges—such as technological upgrading, process optimization, and product iteration—are seldom incorporated into instruction, depriving students of exposure to authentic industrial problems. Curriculum development remains largely school-led, with minimal involvement from industry professionals; curriculum review processes have become procedural rather than substantive, jointly developed courses between institutions and enterprises remain scarce, and mechanisms for channeling cutting-edge industrial knowledge into teaching content remain underdeveloped.

3.3. The Practical Innovation and Entrepreneurship Capacity of the Teaching Staff Is Weak

Innovation and entrepreneurship courses are frequently taught by part-time instructors drawn from employment guidance centres, student counsellors, or faculty in related disciplines—predominantly management and education. Few have undergone systematic professional training in innovation and entrepreneurship education. Most lack direct enterprise work experience or personal entrepreneurial practice, resulting in instruction that emphasizes theoretical exposition while offering limited operational depth in case analysis. Consequently, their capacity to guide students in opportunity identification, resource integration, and real-world risk management remains constrained. Many instructors' understanding of industrial development trends and market competition mechanisms remains largely textbook-based, limiting their ability to provide actionable, context-sensitive advice. External practitioners—including entrepreneurs, industry professionals, and technical experts—are typically engaged for short-term teaching assignments or guest lectures; however, their instructional time is irregular and lacks institutionalized coordination with full-time faculty. No formal mechanisms exist for collaborative curriculum design or joint student mentoring between internal and external instructors. Divergences in pedagogical orientation, knowledge structure, and instructional focus therefore persist, yielding fragmented guidance and weakening the coherence between theoretical instruction and practical skill development.

3.4. The Evaluation Mechanism Values Form over Substance

The evaluation of innovation and entrepreneurship education relies heavily on quantifiable metrics, such as course offerings, student participation in competitions, award levels and counts, and the number of incubated projects. While these indicators facilitate statistical aggregation and inter-institutional comparison, they inadequately capture genuine enhancements in students' innovative thinking or the sustained cultivation of entrepreneurial capability. Many competition-winning projects remain conceptual proposals without market validation, and their commercial viability and technical applicability receive no systematic post-competition assessment [9, 10]. Long-term evaluation of educational outcomes is largely absent, and institutional mechanisms for tracking graduates' innovation and entrepreneurship activities over time are underdeveloped; consequently, institutions lack empirical evidence on how this education contributes to alumni career trajectories. Evaluation is predominantly conducted by internal administrative units, with limited formal pathways for industry associations, enterprises, or independent professional assessment bodies to participate. Evaluation criteria are formulated unilaterally by institutions without alignment to prevailing industry competency frameworks or employer recruitment requirements. Furthermore, evaluation results are primarily utilized for external reporting and administrative summaries, and their potential to inform pedagogical refinement remains underutilized—making timely identification and correction of instructional shortcomings difficult.

4. Practical Pathways for Industry–Education Integration to Enable Connotative Development

4.1. Reconstructing the Curriculum System of Innovation and Entrepreneurship Education Oriented to Industrial Needs

Higher vocational undergraduate institutions should align innovation and entrepreneurship education with regional leading industries and emerging business forms by constructing a tiered, progressive curriculum system. The foundational tier delivers general innovation courses—such as innovative thinking training and entrepreneurial awareness introduction—to all students, emphasizing problem identification and opportunity recognition. The intermediate tier integrates innovation and entrepreneurship content into discipline-specific core courses through embedded instruction on intellectual property protection, business model design, and market analysis, enabling substantive alignment between professional and innovation education at the content level. The advanced tier establishes interdisciplinary practice courses anchored in authentic enterprise projects, requiring students to apply theoretical knowledge and technical skills to resolve real-world challenges. These three tiers must exhibit logical progression in content depth and competency development, ensuring coherence and avoiding fragmented learning outcomes.

Course content must be governed by a dynamic updating mechanism. Institutions should institutionalize regular curriculum reviews involving industry experts and enterprise technical directors to ensure timely incorporation of industrial technological trends and authentic enterprise innovation requirements. Collaborative curriculum development between institutions and enterprises must be formally structured, specifying clear roles for enterprise personnel in defining course objectives, selecting case studies, and designing practice-based training projects, while delineating responsibility boundaries. An annual course content review system should be implemented, triggering mandatory revision for any module whose case materials or empirical data have remained unchanged for two consecutive years.

4.2. Building a "Dual-Qualified, Dual-Competent" Teaching Team through School–Enterprise Collaboration

Enhancing the practical capabilities of in-school faculty necessitates institutional support. The institution should establish administrative regulations governing faculty enterprise engagement, mandating that instructors delivering innovation and entrepreneurship courses undertake cumulative enterprise assignments of no less than two months every two years. These assignments must involve active participation in technological research and development or operations management to accumulate authentic industry experience. Enterprise engagement shall constitute a mandatory criterion for annual performance evaluation and professional advancement. Dedicated funding should be allocated to support faculty participation in entrepreneurship simulation training, enterprise consulting initiatives, and market research, thereby deepening their understanding of industrial operational dynamics. A formal joint faculty development agreement between the institution and enterprises must clearly define enterprise responsibilities, including hosting faculty on assignment, providing structured practice positions, and assigning qualified mentors [11].

The recruitment and integration of external industry mentors require standardized governance. The institution should create designated industry mentor positions, selecting experienced professionals from leading enterprises, technology incubators, and venture capital institutions—particularly those with proven expertise in innovation management or entrepreneurial practice—to serve as adjunct faculty. Appointments must specify term duration, defined duties, and objective performance criteria, and assigned teaching responsibilities must be fully integrated into the institution's formal teaching management framework. In-school faculty and industry mentors should implement a structured collaborative instruction model, including regular joint lesson planning, case-based pedagogical analysis, and co-supervision of student projects, fostering a complementary teaching team that integrates theoretical depth with applied expertise. The institution should deliver targeted pedagogical training to industry mentors to facilitate the effective translation of real-world experience into classroom-appropriate instructional content.

4.3. Building a Practice Platform Driven by Real Projects

The practice platform should adopt a progressive functional layout. The first tier is the innovation workshop, open to early-year students, offering foundational innovation training equipment and dedicated space to support the translation of course-based creative ideas into preliminary design proposals. The second tier is the entrepreneurship incubator, providing office space, seed funding, legal consultation, and business model development guidance for selected high-potential projects, facilitating their advancement from conceptual design to functional prototypes [12, 13]. The third tier is the industrial accelerator, which aligns with enterprises' authentic requirements for technological advancement and market application, enabling mature projects to undergo industrial validation. Robust mechanisms for project evaluation and staged progression must be implemented across tiers to ensure that high-quality initiatives receive stage-appropriate resource support.

Practical teaching must center on authentic, enterprise-sourced projects. Companies translate technological enhancement challenges, product optimization requirements, and market deployment objectives from real-world operations into structured innovation and entrepreneurship training tasks. Under joint supervision by academic instructors and industry mentors, students complete the full cycle—including needs analysis, solution design, prototype development, and application testing. The institution shall implement formal academic credit recognition for innovation and entrepreneurship practice, integrating outcomes from real-project engagement into the official assessment framework. A collaborative innovation and entrepreneurship fund, co-established with industry partners, shall provide financial backing for student initiatives demonstrating commercial viability; parallel pathways for outcome transformation—such as integration into enterprise production systems or access to social investment—must also be institutionalized. Dedicated full-time administrative staff shall oversee daily platform operations, including project solicitation, progress monitoring, and results documentation.

4.4. Building a Multi-Party Collaborative Mechanism for Quality Evaluation and Continuous Improvement

The quality evaluation indicator system should emphasize substantive outcomes of student development. Core indicators include the number and quality of students' innovation proposals adopted by enterprises, the survival rate and growth trajectory of entrepreneurial projects, the number of patent applications and grants, and the proportion of graduates engaged in entrepreneurship along with their performance metrics. The school should develop a value-added assessment tool to measure changes in students' innovation and entrepreneurship capabilities, comparing baseline and follow-up assessments to capture the actual impact of educational activities and avoid overreliance on absolute outcome measures [14]. Indicator weights should prioritize outcome transformation and capability development, while reducing emphasis on process-oriented metrics that reflect only input volume or activity counts.

Evaluation should involve multiple stakeholders. Industry organizations should contribute to defining competence standards for innovation and entrepreneurship; enterprises should assess graduates' innovative literacy and entrepreneurial capacity from a talent utilization perspective; and third-party agencies should conduct regular, independent audit-style evaluations of the school's innovation and entrepreneurship education quality. The school should maintain a longitudinal graduate tracking database, systematically collecting career development data to inform long-term educational improvement. Evaluation feedback must be operationally integrated: a closed-loop management process—comprising data collection, problem diagnosis, targeted implementation, and verification review—should be institutionalized [15]. Identified issues must be assigned to relevant course teams, teaching and research units, or individual instructors based on functional responsibility, with clearly defined timelines and verification criteria to ensure evaluation findings drive tangible pedagogical

improvements. Progress on addressing evaluation findings should be included in the annual teaching quality report and disclosed campus-wide.

5. Conclusion

Industry–education integration serves as a practical foundation and resource enabler for advancing innovation and entrepreneurship education in higher vocational undergraduate institutions. Achieving progress from quantitative growth to qualitative enhancement hinges on embedding industry–education collaboration deeply across the entire educational process: aligning curriculum design with evolving industrial requirements, strengthening teaching capacity through school–enterprise co-development of faculty, enriching experiential learning via authentic industry projects, and ensuring sustained improvement through multi-stakeholder evaluation. These institutions should proactively respond to shifts in industrial structures, continuously refine the configuration of resources and strategies for innovation and entrepreneurship education, and cultivate technical and skilled professionals equipped with innovative thinking and entrepreneurial competencies to support regional economic development.

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