Education Reform and Development, 2026, Volume 8, Issue 1
https://ojs.bbwpublisher.com/index.php/ERD
Online ISSN: 2652-5372
Print ISSN: 2652-5364

Exploration and Implementation of the "Integration of Innovation and Research" Pathway in Comprehensive Practical Bases

Guiyu Zhou[1], Jinsong Chen[1,2]*, Jiayuan Zou[1], Jing He[1]

[1]School of Electronic Information Engineering, Yibin University, Yibin, China
[2] School of Mechanical and Electrical Engineering, Yibin University, Yibin, China

**Author to whom correspondence should be addressed.*

Abstract: Under the background of the deep integration of new engineering education development and innovation and entrepreneurship education, there is a widespread structural disconnection between traditional practical teaching and innovation and entrepreneurship education in terms of objectives, content, and form.This study investigates the establishment of a comprehensive "innovation and entrepreneurship + research-learning" practice base for undergraduate electronic information engineering programs, proposing a systematic pathway characterized by "three-stage progression and four-dimensional collaboration." By constructing a three-stage educational ladder consisting of "cognitive experience, project inquiry, and innovation creation," and supported by a four-dimensional (safeguard mechanism) encompassing "curriculum system, faculty development, platform management, and evaluation feedback," the model systematically integrates the college's existing industry-academy cooperation resources, spatial facilities, and information platforms. Empirical evidence confirms that this model not only provides a systematic framework for supporting multi-tiered activities, including academic competitions, innovation workshops, and science-related volunteer services, but also yields marked achievements in talent development, pedagogical innovation, and research commercialization, thereby offering a replicable and scalable paradigm for achieving deep integration of specialization, innovation, and research in application-oriented undergraduate institutions.

Keywords: Innovation and entrepreneurship education; Three-stage progression; Four-dimensional coordination; Integrated research and innovation; Comprehensive practice base

Online publication: February 9, 2026

1. Introduction

Under the dual impetus of the national innovation-driven development strategy and the New Engineering Education initiative, the talent cultivation model in higher education is undergoing a profound transformation. The strategic plan "China's Education Modernization 2035" explicitly emphasizes strengthening practical education to cultivate students' innovative spirit and practical abilities [1]. Concurrently, the Ministry of Education's comprehensive promotion of the "Four New" initiatives highlights the necessity of interdisciplinary integration and industry-education collaboration, posing urgent demands for applied undergraduate institutions to shift their practical teaching systems from "singular skill training" towards the "coordinated cultivation of innovative capacity, engineering literacy, and comprehensive competencies" [2].

However, a critical examination of the current landscape reveals a structural dilemma: innovation and entrepreneurship education and professional practice-oriented learning are often implemented as parallel, disconnected systems. The former primarily utilizes platforms such as competitions, lectures, and incubators to foster business acumen and innovative thinking, yet it risks detachment from disciplinary foundations [3]. The latter, centered on laboratory courses, project design, and internships, emphasizes technical proficiency but frequently lacks innovation-driven guidance and pathways for outcome transformation [4]. This bifurcation leads to fragmented resources, misaligned objectives, and simplistic evaluation mechanisms, failing to generate synergistic educational effects and impeding the development of students' holistic problem-solving capabilities for complex engineering and societal challenges [5].

Existing scholarly efforts have primarily focused on two fronts: conceptual explorations of "integrating innovation and entrepreneurship into disciplinary education," emphasizing its necessity and conceptual dimensions [6], and experiential summaries of singular platforms such as industry-academia institutes or innovation labs [7]. While foundational, these studies often treat "innovation" and "practice" as an additive combination, lacking in-depth analysis of their intrinsic integration mechanisms, phased implementation pathways, and systemic support structures [8]. Consequently, constructing a comprehensive practice base that organically integrates and dynamically reinforces the synergy between innovation-entrepreneurship and practice-based learning remains a pivotal yet unresolved challenge in the reform of applied undergraduate talent cultivation.

Building on recent advances, the research landscape since 2020 has shifted toward more holistic and systematic approaches. Scholars are increasingly moving beyond mere "platform construction" to focus on building integrated educational ecosystems that foster dynamic interaction among all stakeholders [9]. Concurrently, there is a deepening emphasis on aligning curricular interventions not just topically, but through the explicit mapping and integration of core competency frameworks between entrepreneurship and engineering disciplines [10]. Furthermore, the field is evolving from descriptive case studies to rigorous, multi-case evaluations of model effectiveness, seeking evidence-based pathways for optimization [11]. Despite this progress, significant gaps remain, particularly concerning the operationalizability of integration mechanisms and the scientific measurement of educational outcomes within comprehensive practice bases.

To address this gap, this study draws on project-based learning [12], experiential learning theory [13], and ecosystem perspectives to construct a more operational and systematic theoretical framework [9,14]. Taking the "Innovation & Entrepreneurship + Research & Practice" Integrated Base for Electronic Information Engineering as a case study and employing an action research methodology, this paper proposes and examines a "Three-Stage Progression, Four-Dimensional Synergy" integration model. The core research question addressed is: How can a comprehensive practice base that achieves deep integration between innovation-entrepreneurship and practice-based learning be systematically designed, built, and operated, and what are its key pathways, support mechanisms, and practical outcomes? Through iterative validation of theory and practice, this research aims to provide a replicable and scalable solution for peer institutions to overcome fragmentation in practical education and enhance the quality of high-quality applied talent cultivation.

2. Construction and practical implementation of a "Three-stage progression, four-dimensional synergy" model

In the process of exploring the pathway of "integration of innovation and research" at the comprehensive practice base, a systematic implementation model of "three progressive stages and four-dimensional collaboration" has been established. This model, supported by a clear educational pathway and multi-dimensional resource integration, has significantly enhanced students' innovative and practical abilities. Through the design logic of three progressive stages and the systemic support of four-dimensional collaboration, the base has evolved into an educational platform for "integration of innovation and research" that spans the entire process from cognition and practice to creation, effectively promoting the step-by-step development of students' innovative spirit and practical capabilities. The specific implementation pathway is illustrated in **Figure 1**.

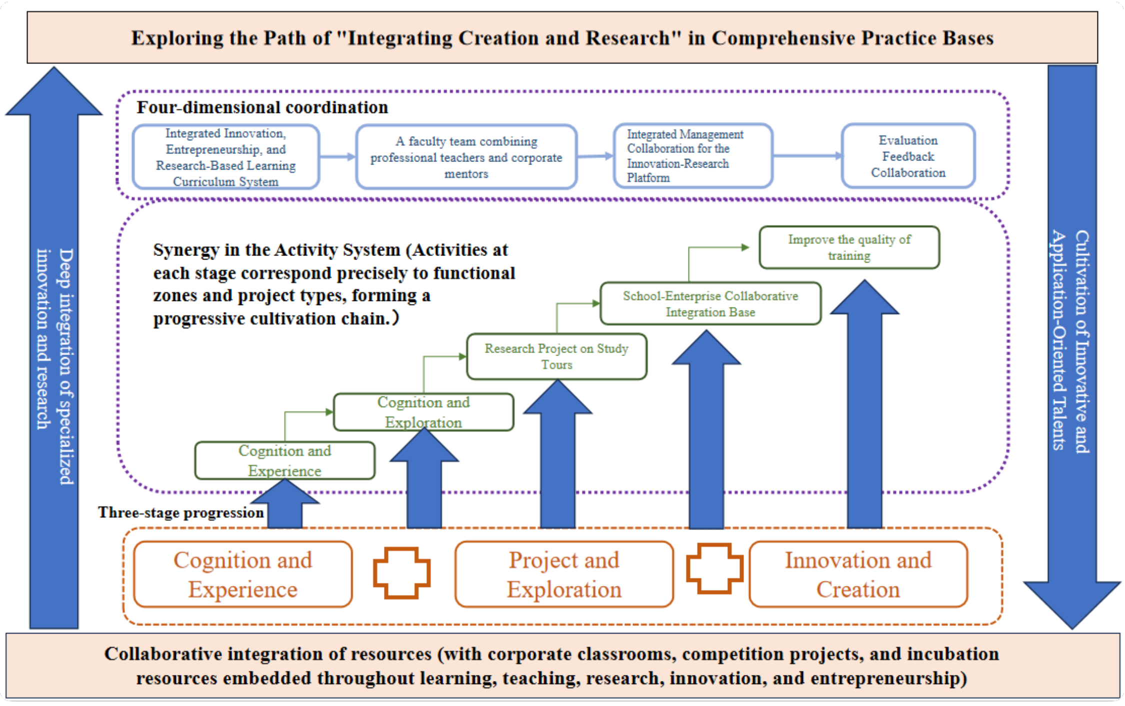

Figure 1. Implementation path of the "Three-stage progression, four-dimensional integration" research-innovation synergy model.

2.1. Design of a three-stage progressive pathway for integrative education

Based on the existing activity framework of the base, the structure has been reorganized into three logically progressive stages: cognition and experience, project-based inquiry, and innovation and creation.

(1) The "Cognition and Experience" (Integrated Foundation Layer) serves as the primary entry point of the base system, offering access to university, secondary, and primary school students through the "Research Learning Functional Zone" and "Volunteer Services." This phase is designed to lower the cognitive barriers to technology through low-threshold, highly engaging practical activities, aiming to spark initial interest in intelligent technologies. The research and practical zone emphasizes intuitive experience and hands-on manipulation. Its "Introduction to Intelligent Robots" module makes artificial intelligence interactive and accessible; sensor-based experiments use common physical phenomena like sound, light, and temperature to visually demonstrate principles of perception. Concurrently, innovation clubs achieve recruitment through live demonstrations, showcasing diverse pathways of technical learning and exhibiting vibrant community dynamics. Supplementary science popularization lectures deliver systematic introductions to cutting-edge technology trends in accessible language. Collectively, these activities cultivate a welcoming and open environment ideally suited for initial engagement. The principal objective is to help participants construct a foundational cognitive framework through direct

experience, stimulating intellectual curiosity and laying the psychological and motivational groundwork necessary for future in-depth exploration.

(2) The Project and Inquiry (Integrated Core Tier), serving as a critical phase that tightly integrates "research" and "innovation" within the functional system of the base, is primarily designed for advanced students who have already undergone cognitive initiation and possess preliminary interests and foundational knowledge. As a key component of the base's functional system, this stage closely integrates research and practice, targeting students who have completed cognitive initiation and possess preliminary interest and foundational knowledge. Its core objective is to transform interest into systematic project-based practice and in-depth inquiry capabilities, facilitating the transition from experiential learners to creators. Through embedded system studios, various smart hardware interest groups, and high-level academic competitions such as the National Undergraduate Electronic Design Contest and Intelligent Vehicle Competition, students engage in team-based, project-oriented learning under the guidance of mentors. They tackle real-world technical challenges, moving beyond observation and superficial interaction. To enhance the practical relevance of inquiry, the base actively incorporates external high-quality resources. On one hand, it adapts industry-sponsored projects—such as application development based on domestically developed Loongson processors—into educational formats, enabling students to confront industrial demands and technical challenges directly. On the other hand, it deeply aligns with national-level initiatives like the College Student Innovation and Entrepreneurship Training Program, supporting students in transforming academic ideas or social needs into innovative proposals. Throughout this process, students receive funding and guidance to complete the full cycle from conception and development to prototype validation. Through such deeply integrated research and practical training, students not only enhance their ability to solve complex problems and their engineering literacy but also make substantial progress in teamwork, project management, and innovative thinking. This lays a solid foundation for their future engagement in scientific research or industrial innovation.

(3) Innovation and Creation (Integration and Expansion Tier), as the top-level architecture and value realization stage of the base's functional system, primarily operates by leveraging the platform resources and incubation mechanisms of the "Maker Space." This stage targets outstanding student teams that have completed project cultivation at the core level and possess mature technical solutions and development potential. Its central objective is to facilitate the systematic refinement, theoretical elevation, and value transformation of innovative outcomes, achieving the critical transition from "campus projects" to "societal innovation." The base actively promotes in-depth interdisciplinary and cross-disciplinary collaboration—for instance, by integrating students from diverse academic backgrounds such as computer science, design, mechanical engineering, and sociology—to jointly tackle comprehensive societal challenges, such as the development of an "Intelligent Elderly Care Monitoring System." Additionally, the base systematically supports teams in presenting their mature outcomes at high-level innovation and entrepreneurship competitions, including the "Internet Plus" and "Challenge Cup" contests, and in participating in exhibitions for the transformation of scientific and technological achievements as well as industry-academia collaboration activities. Ultimately, this stage is dedicated to guiding teams through the entire process from technical implementation to value creation, transforming innovative ideas into tangible outputs with social or market value, thereby embodying the core principle of "practicing innovation through creation."

2.2. The supporting and safeguarding mechanism of "Four-dimensional coordination"

To ensure the unimpeded progression of the "three-stage" pathway, a synergistic mechanism is established, integrating four key dimensions: curriculum system coordination, faculty team collaboration, platform management alignment, and evaluation feedback coherence.

In terms of collaboratively developing the curriculum system, the base focuses on breaking through the boundaries between traditional teaching modules. It systematically integrates and restructures previously relatively dispersed teaching resources, such as competition training, research-based learning courses, and project practice. By designing these into standardized modular "course packages," each teaching unit can be implemented independently or flexibly combined and configured according to students' developmental stages and interests, thereby creating personalized learning pathways. To ensure the practical effectiveness and appeal of this curriculum system, the base actively promotes the establishment of formal linkage mechanisms between course outcomes and academic credit recognition. Upon completion of specific "course packages" and passing the required assessments, students' achievements can be converted into credits for general education, innovation and entrepreneurship, or professional development, in accordance with relevant regulations. This institutional design not only motivates students to engage deeply but also achieves organic integration and synergistic enhancement of in-class learning and extracurricular innovative activities, significantly improving the systematization of talent cultivation.

In terms of collaborative faculty development, the base is committed to establishing and consolidating a four-in-one mixed mentoring team composed of "academic faculty, industry engineers, entrepreneurship mentors, and outstanding alumni." This model aims to integrate academic depth, industrial practical experience, business insight, and peer growth experience to create a synergistic effect for comprehensive education. To maximize the strengths of all parties, the base has clearly defined the core responsibilities and intervention timing for each type of mentor based on the objectives and characteristics of different stages, such as "cognition and experience," "project and inquiry," and "innovation and creation." Specifically, academic faculty are primarily responsible for guiding fundamental theories and research methods; industry engineers focus on technical application and engineering practice; entrepreneurship mentors provide guidance on business model development and market validation; and outstanding alumni offer career path support and resource connections. To ensure the sustained vitality and quality of the mentoring team, the base has established a dynamic incentive mechanism and a systematic training framework. Through scientific evaluation and feedback, honorary incentives, and resource support, mentor engagement is enhanced. Regular thematic training sessions on pedagogy, industry trends, and communication skills are also conducted to foster collaboration and capacity development among mentors from diverse backgrounds, thereby effectively supporting the achievement of multi-level innovative talent cultivation goals.

In the field of platform-based collaborative management, the base is committed to establishing a unified and efficient integrated information management hub to systematically consolidate and optimize the operational ecosystem of "innovation and research" activities. This platform will enable closed-loop management of the entire process—from project release and intelligent matching, dynamic team formation and collaboration, to real-time progress monitoring and interactive guidance, as well as final results archiving and data accumulation.

By leveraging digital tools, the system not only significantly enhances the accuracy and timeliness of activity organization, venue allocation, and equipment resource management but also effectively eliminates information barriers, thereby facilitating data-driven scientific decision-making. The procedural and outcome data accumulated by the platform will provide reliable support for teaching quality evaluation, student competency profiling, and the dynamic optimization of training programs. This, in turn, will drive the transformation of the base's overall operations from an experience-driven approach to an intelligent, refined, and collaborative governance model.

In the realm of collaborative evaluation and feedback, we have focused on establishing a comprehensive, multi-dimensional, and dynamic assessment framework designed to transcend conventional outcome-based metrics, thereby driving the iterative enhancement of educational quality through scientific evaluation. This system prioritizes the documentation of learning processes by systematically tracking developmental traces such as experimental logs, code submissions, and iterative project versions, thereby constructing a continuous digital growth portfolio. Furthermore, it incorporates multiple evaluative perspectives, including self-assessment and reflection by students, peer evaluations within teams, professional assessments by mentors (including industry advisors), as well as practical feedback from communities or end-users in service-oriented projects, ensuring objectivity and comprehensiveness. Crucially, the framework adopts a value-added assessment approach, focusing not only on the absolute quality of final outcomes but also on the magnitude of capability improvement and innovation demonstrated by individuals or teams over the project lifecycle. The data and insights generated by this integrated evaluation system are systematically fed back into course design, mentorship strategies, and platform management, forming a synergistic closed-loop mechanism that promotes continuous improvement and optimizes the vitality and efficacy of the ecosystem for nurturing innovative talent.

3. Analysis of innovation points

3.1. Innovation in the tiered-integrated progressive talent development system

This study moves away from traditional practical training arrangements, which are often loosely structured and homogeneous, and instead systematically constructs a three-tier progressive framework consisting of: "Cognition and Experience (Integrated Foundation Layer) → Project and Inquiry (Integrated Core Layer) → Innovation and Creation (Integrated Expansion Layer)". This framework extends from science popularization and lectures to academic competitions, and further advances to outcome incubation, thereby achieving a seamless and step-by-step progression from "broad interest stimulation" to "specialized skill development", and ultimately to "comprehensive innovation and value realization". This structure ensures that students of different backgrounds and at various stages can find suitable entry points and benefit from continuous developmental pathways. As a result, it effectively addresses the key issues in practical teaching systems where "general education" and "elite training" are often disconnected, and where lower-level and higher-level learning phases are fragmented.

3.2. Innovation in the ecological support mechanism of "Four-dimensional coordination"

This study innovatively constructs an ecological support framework driven by the synergistic interaction of four dimensions: curriculum structure, faculty development, platform management, and evaluation feedback. It moves beyond the limitations of traditional approaches that focus on isolated improvements within individual teaching components, achieving systematic integration and dynamic optimization of all educational elements. By developing modular "course packages" and aligning them with a credit recognition mechanism, the framework effectively addresses the long-standing issue of "institutional suspension" in extracurricular practical teaching, thereby providing systematic curricular support and institutional safeguards for students' innovative practice activities. Furthermore, a comprehensive system integrating process documentation, multi-dimensional evaluation, and value-added assessment has been established, offering a scientifically grounded, data-driven core for the continuous improvement of the ecosystem. The framework systematically ensures the smooth operation and sustainable development of the "integration of creation and research" pathway across four levels—institutional, resource, operational, and quality—collectively forming an adaptive and evolving educational ecosystem.

3.3. "Value creation"-oriented real project-driven innovation

This study has effectively transformed the conventional practice of confining practical teaching to simulated scenarios or outdated topics, and has innovatively established a driving mechanism centered on "real-world problem orientation and market value validation." By leveraging industry collaboration projects (such as Loongson technology applications), university student innovation and entrepreneurship training programs, pressing societal needs (e.g., smart elderly care), and high-level academic competitions as key components of the core and extended layers, the mechanism ensures that students' research training remains focused on real-world demands and challenges. Not only does this approach significantly enhance students' technological innovation capabilities, but it also deliberately strengthens their awareness of intellectual property, product thinking, and market insight through the process of "innovation and entrepreneurship incubation" and the transformation of outcomes. Consequently, it guides teams to achieve a cognitive shift from "technical implementation" to "value creation."

3.4. Evaluation mechanism update

An evaluation mechanism and scoring criteria have been established based on the "Three-Stage Progression, Four-Dimensional Synergy" model within the "Innovation-Research Integration" practice framework, and the evaluation content is shown in **Table 1**. This system is designed to provide a comprehensive and quantitative assessment of educational effectiveness and base operational performance across three core dimensions: process, outcomes, and competency development. By doing so, it enables a holistic and objective evaluation of the model's implementation outcomes, fosters closed-loop management, and ultimately drives the continuous enhancement of practice-oriented education quality.

Table 1. Evaluation mechanism and scoring content

Evaluation dimension	Evaluation metrics	Evaluation Content and Observation Points	Scoring Criteria (Total: 100 points)
The efficacy of the three-stage progressive pathway (40%)	**Cognition and Experience (10%)**	Participation Breadth and Feedback: Number of participants, coverage (across different majors/grade levels); student interest survey ratings, activity satisfaction.	Excellent (9-10 points): Wide participation with a satisfaction rate ≥ 90%. Good (7-8 points): Relatively high participation with a satisfaction rate ≥ 80%. Average (5-6 points): Moderate participation with a satisfaction rate ≥ 70%. Participation Breadth and Feedback: Number of participants, coverage (across different majors/grade levels); student interest survey ratings, activity satisfaction.
	2. Project and Inquiry (15%)	Project Quality and Depth: Number of Approved Projects / Number of Participating Students; Degree of Integration with Real-World Issues and Corporate Challenges; Completion Rate and Quality of Midterm Evaluations.	Excellent (13-15 points): Numerous projects with high quality and strong alignment with enterprise needs. Good (10-12 points): Projects operate smoothly with a reasonable level of practical integration. Satisfactory (7-9 points): Basic project completion with moderate relevance to practical applications.
	3. Innovation and Creativity (15%)	**Outputs and Transformation of Achievements: Number of patent/software copyright applications and grants; Level and quantity of competition awards; Number of incubated projects/product prototypes; Intent or value of achievement transformation.**	Excellent (13-15 points): High number of quality achievements with significant progress in transformation. Good (10-12 points): Satisfactory output with preliminary transformation results. Fair (7-9 points): Moderate achievements with some tangible outcomes.

Table 1 (Continued)

Evaluation dimension	Evaluation metrics	Evaluation Content and Observation Points	Scoring Criteria (Total: 100 points)
Four-Dimensional Collaborative Operational Effectiveness (40%)	**1. Synergy in Systems and Mechanisms (10%)**	**Management Operational Efficiency: the completeness of university-industry collaboration systems and agreements; the frequency and documentation of guidance from dual supervisors; the smoothness of integration between on-campus and off-campus channels.**	Excellent (9-10 points): The system is well-established, operates efficiently, and the dual supervisor mechanism plays a prominent role. Good (7-8 points): The mechanism functions normally with effective collaboration. Satisfactory (5-6 points): The mechanism is basically established.
	2. Synergy between Hardware and Software Facilities (10%)	**Level of Resource Support: Facility utilization rate and openness for sharing; completeness of information platform functions and usage data; equipment integrity rate and status of updates.**	Excellent (9-10 points): Facilities are fully utilized with highly efficient platform support. Good (7-8 points): Resources provide basic support that generally meets requirements. Satisfactory (5-6 points): Basic support conditions are in place.
	3. Synergy of Activity Systems (10%)	**Systematization and Coherence: Whether the three-stage activity design logic is clear and transitions are smooth; student progression rate (the proportion of students advancing from one stage to the next).**	Excellent (9-10 points): Scientifically designed system with an advancement rate ≥ 30%. Good (7-8 points): Comprehensive system with an advancement rate ≥ 20%. Fair (5-6 points): Basic system in place with an advancement rate ≥ 10%.
	4. Synergy of Resource Factors (10%)	Integration of Depth and Effectiveness: Depth of enterprise resource (projects, mentors) investment; number of cases involving the transformation of scientific research outcomes into teaching and innovation/entrepreneurship projects; proportion of interdisciplinary projects.	Excellent (9-10 points): Deep integration of resources, numerous transformation cases, and cross-disciplinary projects accounting for ≥ 30%. Good (7-8 points): Effective resource collaboration with demonstrated transformation cases. Satisfactory (5-6 points): Basic level of resource coordination achieved.
Comprehensive Assessment of Student Competency Development (20%)	**1. Innovation Capability and Engineering Practice Ability (10%)**	**Degree of Capability Enhancement: Comprehensively evaluate the improvement in students' ability to solve complex engineering problems and engage in technological innovation through methods such as project reports, competition performance, work reviews, and mentor evaluations.**	Excellent (9-10 points): Significant improvement in ability. Good (7-8 points): Clear improvement in ability. Fair (5-6 points): Moderate improvement in ability.
	2. Team Collaboration and Professionalism (10%)	**Non-technical skills: Assess the development of professional qualities such as communication and collaboration, sense of responsibility, and project management through behavioral observation, peer evaluations, and feedback from corporate mentors.**	Excellent (9-10 points): Demonstrates outstanding professional qualities. Good (7-8 points): Shows good professional qualities. Satisfactory (5-6 points): Meets basic standards of professional qualities.

4. Implementation effectiveness and case studies

4.1. The main implementation outcomes of the "Integration" activity

Through two cycles of practical exploration, the "Integration of Innovation and Research" training pathway developed by this base has achieved significant results, with a marked improvement in students' innovation capabilities and comprehensive competencies. Over 80% of participating students have achieved breakthrough outcomes in areas such as disciplinary competitions, college student innovation and entrepreneurship training programs, and patent applications. Their interdisciplinary collaboration skills and ability to solve complex engineering problems have also been widely enhanced. The coverage and systematic development of practice-based education continue to expand. Relying on a "layered–integrated" training system, the base serves more than 2,000 college students annually and hosts over 1,500 primary and secondary school students for research visits each year. To date, the base has supported students in winning more than 200 awards in national and provincial disciplinary competitions, and has successfully incubated multiple innovation training projects, patents, and software copyrights. Students who participated in in-depth project training achieved a 100% employment rate, and their enrollment rate in graduate programs has also increased significantly. In terms of curriculum development, several core courses, such as Principles and Applications of Microcontrollers have undergone project-based and integrated reforms and have been included in the development system for first-class courses or ideological and political education in curricula. Each year, the base organizes multiple activities such as science and technology research programs for primary and secondary school students, as well as technology outreach initiatives in rural areas, serving over 1,000 participants. These efforts have established a positive social reputation for the base and effectively promoted the dissemination of scientific knowledge, achieving an organic integration of broad-based innovation education and targeted talent development. On this basis, a replicable and scalable collaborative education ecosystem model has been formed. The "Four-Dimensional Collaboration" mechanism has effectively alleviated traditional challenges such as fragmented resources and uniform evaluation methods. Specific models such as curriculum resource packages, mixed mentor teams, and digital platforms have been adopted by multiple higher education institutions.

Furthermore, student project teams have developed a number of socially impactful practice cases in areas such as rural education support and smart elderly care in communities, effectively translating innovation capabilities into social service capacities and generating positive spillover effects for society.

4.2. Case Study: The "Research-innovation-service" closed loop in the "Intelligent vehicle competition" project

During the preparation for the "National College Student Smart Car Competition" (corresponding to the "Projects and Inquiry" core module), the student team at this base independently transformed key technologies involved in the competition—such as sensor fusion and path planning algorithms—into teachable content. They developed a research-based learning resource titled "Micro Smart Car Perception and Decision-Making" suitable for primary and secondary school students. This effort reflects a deliberate shift from high-level technical exploration ("creation") to the popularization of foundational knowledge ("research").

Expanding their scope of practice, the team established a "Technology Dream-Assistance Group," through which they brought self-developed simplified smart car teaching kits to multiple rural schools for week-long science and technology volunteer services. During these activities, team members served not only as instructors but also as learning partners, guiding rural students in hands-on assembly of smart vehicles, writing basic line-following programs, and sharing their own university-level research experiences through interactive communication.

This practice has generated a triple closed-loop effect:

(1) Technical Deepening Loop: To explain complex technical principles to students with no prior knowledge, team members had to deconstruct and visually reinterpret specialized content, which in turn strengthened their own grasp of the core technology and promoted systematic knowledge internalization during competition preparation.

(2) Knowledge Dissemination Loop: By transforming cutting-edge competition outcomes into inclusive research-based courses, the initiative broke through the insularity of university innovations, enabling the effective transfer and targeted integration of higher education resources into basic education, thereby

stimulating rural youths' interest in science.

(3) Responsibility Internalization Loop: Through volunteer services, students transitioned from being "technical learners" to "knowledge disseminators" and "social contributors." The recognition of technology's value and social responsibility within real-world contexts provided ideological education that is difficult to replicate in classroom settings, vividly reflecting the integrated cultivation of "innovative spirit" and "sense of social commitment."

By following the "creation-research integration" pathway established at the base, a high-level competition project has been extended to generate multidimensional educational value and social benefits, achieving organic integration and synergistic advancement of individual student growth, innovation practice education, and social service contribution.

5. Conclusion

This study, through the construction and implementation of a "Three-Stage Progression, Four-Dimensional Integration" model, has verified the feasibility of deeply integrating "innovation and entrepreneurship" with "research and practice learning" within the framework of a comprehensive base. This approach not only significantly enhances students' innovative practical abilities and comprehensive competencies but also effectively promotes teaching reform and social service functions. It provides an empirically supported systematic solution for reforming the practical education system and similar institutions. The key lies in the scientific phased design and mechanism guarantees, which transform diverse activity resources into structured educational effectiveness, thereby serving the goal of cultivating high-quality applied talents.

Funding

Yibin College School-level Ideological and Political Education Project (Project No.: 2025SZ402); Quality of Higher Education Talent Training and Teaching Reform Project in Sichuan Province, 2024-2026 (Project No.: JG2024-1069)

Disclosure statement

The authors declare no conflict of interest.

References

[1] The State Council of the People's Republic of China, 2019, China's Education Modernization 2035. Policy Report, Beijing.

[2] Ministry of Education of the People's Republic of China, 2018, Opinions on Accelerating the Construction of High-Level Undergraduate Education and Comprehensively Improving Talent Cultivation Capabilities, Beijing.

[3] Huang Z, Zhao G, et al., 2020, Research on the Transformation and Development of Entrepreneurship Education in Universities. Educational Research, 41(7): 98–107.

[4] Wang S, Qiao W, et al., 2017, The Construction of New Engineering Disciplines and Innovation in Engineering Education. Research in Higher Engineering Education, (4): 1–9.

[5] Gu P, et al., 2014, The OBE-Based Engineering Education Model: Practices and Explorations at Shantou University. Research in Higher Engineering Education, (3): 27–34.

[6] Xu X, Mei W, 2018, Strategic Research on the Construction of University Entrepreneurship Education Systems. Journal of East China Normal University (Educational Sciences), 36(1): 117–124.

[7] Li Z, Zhong B, 2019, Research on the Organizational Models and Operating Mechanisms of Industry Colleges. Research in Higher Engineering Education, (5): 60–66.

[8] Zhu Q, Liu B, 2021, The Dilemma and Breakthrough of the Integration of Innovation and Entrepreneurship Education and Professional Education. China Higher Education Research, (2): 78–83.

[9] Li J, Zhang Y, Chen L, 2021, From Platform to Ecosystem: Reconstructing Innovation and Entrepreneurship Practice Bases in the Context of New Engineering Education. Higher Education Management, 15(4): 45–58.

[10] Wang H, Liu F, 2022, Mapping and Integrating Core Competencies: The Deep Integration Path of Innovation and Entrepreneurship Education and Engineering Professional Education. Research in Higher Engineering Education, (1): 32–40.

[11] Xu S, Zhao K, et al., 2023, Effectiveness Evaluation and Model Optimization of Industry–Education Integration Innovation Practice Platforms: A Multi-Case Study Based on Three Universities. Journal of Educational Science, Hunan Normal University, 46(2): 89–97.

[13] Helle L, Tynjälä P, Olkinuora E, 2006, Project-Based Learning in Post-Secondary Education: Theory, Practice and Rubber Sling Shots. Higher Education, 51(2): 287–314.

[13] Kolb D, 1984, Experiential Learning: Experience as the Source of Learning and Development. Experiential Learning, Englewood Cliffs, NJ.

[14] Moore J, 1993, Predators and Prey: A New Ecology of Competition. Harvard Business Review, 71(3): 75–86.