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# Building Industry-Education-Research Collaborative Innovation Platforms in Vocational Education: A Framework for Systemic Integration

**Yanhua Chen**
*School of Education, Jiangxi Science and Technology Normal University, Nanchang, Jiangxi, China*

**Abstract: China's vocational education framework is confronted with a structural impasse. The deep integration of industry and education still faces challenges. Our research focuses on the collaborative platform of industry, education and research. It uses mixed research methods, including literature review, cross-border comparison, 600 questionnaires and one-to-one and half structured interview data. Our study constructs an implementation framework including four core functions, three-level governance structure and five supporting operating mechanisms. By comparing the typical cases in eastern, central and Western China, our study finds that there are persistent obstacles in system design, incentive coordination and public-private resource allocation. The analysis shows that the efficient operation of the platform relies on moderate government participation, fair benefit distribution and digital transformation. Only by moving from loose alliance to substantive in-depth collaboration can the expected results be achieved. Our study refines the five policy focuses of vocational education. It covers financial incentives, school enterprise joint courses and industry mentor projects, and builds a four-dimensional performance evaluation system and digital service infrastructure. This framework can provide support for the cultivation of high adaptability and high quality skilled talents in China.**

**Keywords: Vocational Education; Industry-Education Integration; Industry-Education-Research Collaborative Innovation; Platform Development; Operational Governance Mechanisms**

## 1. Introduction

Digital upgrading, large-scale intelligent automation and sustainable ecological development initiatives are reshaping the pattern of modern industry. The core production system and internal organizational structure of various industries are undergoing fundamental changes. This kind of transformation and reform, covering the whole industry, puts forward newer and higher requirements for the professional competence of technical and skilled talents, including the knowledge reserve in the professional field, practical technical literacy and innovative problem-solving ability. Vocational and technical education is the core pillar of China's education system, which is closely related to the overall economic competitiveness of our country. However, this field still faces deep-rooted structural difficulties. The development of vocational courses lags behind the rapid iteration of industrial technology, and the training projects are disconnected from the real production scenes. The long-standing skills mismatch problem further aggravates the contradiction between supply and demand of industrial talents [1]. In order to promote the implementation of this reform agenda, our country has officially issued two national core supporting policy documents, namely, the opinions on deepening the integration of production and education and the implementation plan of national vocational education reform. There are still two prominent practical problems in the vocational education system in most regions. That is, the imbalance phenomenon of "colleges and universities taking the initiative and enterprises holding a wait-and-see attitude" that has been proved, and a large number of shallow cooperative relationships that lack deep substantive integration. The cross industry industry teaching research collaborative innovation platform connects vocational education, talent training, industrial development and technological innovation. There are two aspects that restrict the development of such vocational education platforms. It includes governance fragmentation,

inefficient resource aggregation and utilization, loopholes in the operating mechanism, and imperfect interest coordination mechanism. Tamping the rigorous theoretical foundation and building a systematic implementation framework are the two key points to solve the endogenous problems such as platforms [2].

Our study relies on the triple helix theory of vocational education industry partnership, integrates collaborative innovation theory and ecosystem theory, and constructs a multi stakeholder analysis model of vocational education industry partnership. The model defines the core subject of cross sectoral vocational education cooperation, covering national regulation, industry guidance, enterprise participation and institutional governance. Our study sets two core research objectives. Firstly, it would explain the internal coordination mechanism of the integration of production and education in higher vocational colleges, and consolidate the corresponding theoretical basis. Secondly, it would aim to design a landing platform governance framework, operation specifications and phased implementation roadmap, so as to break the long-standing structural bottleneck and strengthen the coupling relationship between vocational education and industrial chain. In order to ensure the preciseness of the research method, our study adopts the triangular research design. This study uses five research methods. It mainly includes systematic literature review, cross-border comparative analysis, case studies, 600 sample questionnaires and 15-20 semi-structured interviews. Our study selected three representative cases in the East, middle and west of China to conduct research, and conducted interviews with the main stakeholders of Vocational Education in each case. The study takes the industry university research collaborative innovation platform of vocational education as the research carrier. It builds the theoretical framework of industry university research collaborative innovation of vocational education, and describes the operation picture of the collaborative innovation system.

## 2. International and Domestic Research Landscape and Analysis of Industry-Education-Research Collaborative Innovation in Vocational Education

Germany, the United States, and Japan have all listed the integration of industry and vocational education as a core priority direction of their national strategies. The German dual system is mainly based on enterprise led job training, supplemented by school curriculum teaching, to achieve the institutionalization of precise skill matching. The implementation effectiveness of this model relies on two core elements: the standardized system established by the industry and the standardized professional evaluation framework [3,4]. The vocational cooperative education model in the United States relies on two core institutional designs. They are a combination of engineering rotation and credit recognition, enhancing learners' adaptability to industrial work scenarios. Japan has established a two-tier vocational training system. It integrates internal training programs and public vocational training programs. The national vocational qualification system provides stable support for the long-term operation of this system [5,6]. The above-mentioned cross-border vocational education models are rooted in their respective national conditions. There is a significant difference. But they all have a foundation in the rule of law, multi-party governance, and an embedded mechanism for distributing interests. These common features can provide guidance for the institutional optimization and reform of China's vocational education ecosystem, and help enhance enterprise participation.

The policy framework for vocational education in our country has undergone multiple rounds of continuous revisions. The concept of industry education integration was first introduced in the 2014 Decision on Accelerating the Development of Modern Vocational Education, and obtained legal status with the help of the revised Vocational Education Law of the People's Republic of China in 2022. The reform of vocational education at the local level relies on the implementation of city level vocational alliances and industrial clusters to promote targeted institutional iteration. Pioneering regional schemes including Suzhou Industrial Park and Changzhou Science and Education Town have built field-based experience in resource pooling and tailored talent training. Meanwhile, school-enterprise committees, industrial colleges and information service portals have proliferated across the sector. Shallow cooperation remains prevalent across the sector, typified by the phenomenon of “enthusiastic vocational colleges paired with

disengaged enterprises". Persistent challenges include inefficient resource sharing, underused training facilities, duplicated curriculum development, and operational frameworks lacking stable interest coordination and robust feedback loops. Current collaboration is mostly limited to internship arrangements, with inadequate integration between technological research and development and talent cultivation [7,8].

At the current stage, the People's Republic of China still exhibits relative insufficiency in the binding power of institutional frameworks, the internal driving force of market entities, and the operational frameworks of market-based systems. The present investigation has selected the tripartite collaborative innovation platform of industry, education and research as the carrier at the meso-level of analysis. Our research team has implemented systematic inspection of its structural composition, multi-stakeholder coordination mechanism, resource sharing modalities and performance assessment system. This investigation targets the filling of gaps between policy formulation and practical implementation and the establishment of a context-adaptive, theoretically supported development route.

## 3. Theoretical Bases and Structure Formulation

Collaborative innovation across industry, education and research domains has been framed within the present investigation as an interactive operational mechanism. This structural arrangement breaks down institutional divides to facilitate the integration of knowledge generation, technology commercialization, and talent nurturing across a spectrum of multiple involved stakeholders. The "collaborative innovation platform" functions as the concrete implementation carrier for the abovementioned interactive mechanism. Guided by the holistic logic of ideology, carrier and practice form, the industry-education integration community represents a mature and complete organizational configuration for vocational education collaboration. Our study selects three complementary analytical perspectives. Our theoretical framework collectively supports a systematic exploration of issues related to vocational education. Under the framework of the triple helix analysis, the government, industry entities, and vocational college groups form an interactive relationship. Multi party partnerships enable mutual empowerment throughout the entire collaborative ecosystem. The theory of collaborative innovation lays the core theoretical foundation for constructing a five subject vocational education network structure. The ecosystem theory regards the aforementioned collaborative platform as an organic organism, and in the process of cultivating professional partnerships, more emphasis is placed on long-term relationship maintenance rather than short-term transactional benefits [9].

Our platform includes four interrelated vocational education functional modules. The teaching unit calibrates the curriculum design based on professional standards, while the research module promotes the transformation of industrial research and development achievements into practical teaching practices. The platform training unit achieves a step-by-step improvement of learners' professional abilities. Employment services follow a demand-oriented logic and maintain a closed-loop talent management mechanism. The four major functional modules form a mutually reinforcing effect in the process of vocational service supply. The platform adopts a three-level hierarchical governance system, consisting of a supervisory committee, a daily administrative office, and a special working group. At the same time, the platform integrates the "four libraries and one platform" resource architecture. This design supports the integrated governance and data interoperability of various functional modules. The platform operates based on five interrelated mechanisms: partner co construction, resource sharing, incentive supervision, performance evaluation, and comprehensive guarantee. The above driving factors are driving the platform to shift from simple physical stacking to deep organic collaboration. Overall, this linkage mechanism constructs a unified framework that combines practicality and theory, providing guidance for the construction, iterative optimization, and empirical testing of modern vocational education platforms.

## 4. Building Content and Execution Routes of the Industry-Education-Research Collaborative Innovation Platform

This section relies on a mature theoretical system to analyze the platform construction work from three dimensions: organizational

carrier cultivation, deepening of industry education integration, and education innovation driven iterative upgrading. In the study we constructs a phased implementation roadmap to guide the platform to complete the full process transformation from preliminary scheme design to normalized operation practice.

### 4.1 Platform Construction Optimization

The industry education collaboration platform has established a specialized mechanism to adapt to the normal operation of the organization. This comprehensive operational framework clarifies the rights and responsibilities boundaries of each participating entity. It promotes the optimized allocation of shared resources and ensures efficient flow of information within the platform ecosystem. The platform implements a hierarchical three-level governance system. Its operational structure comprises a supervisory council, an executive body, and professional working teams. These administra tive bodies constitute a closed loop of decision-making, execution and feedback. The platform has carried out demarcation of duties for relevant stakeholders to avoid the occurrence of governance fragmentation. The allocation of shared resources revolves around cultivation bases, professional guidance tutors (the dual-mentor repository), and teaching-related resources. Legally binding contractual agreements lay out specific requirements for input contributions, access rights of use, and the allocation scheme of operational benefits. A smart information management platform achieves the integration of talent information, market demand and performance evaluation data. This digital system supports the realization of data interoperability, real-time information exchange, and full traceability of operational processes. It has promoted the transition of coordination modes from manual operation to intelligent collaborative operation.

### 4.2 Deepening of the Integration between Industry and Education

The framework has set up the following implementation measures. The proportion of enterprise representatives in the scheme consulting committee shall not be less than 50%. The committee shall organize at least two evaluation meetings per year to conduct on-site research, institutional review, targeted revisions, and feedback on results. The above process together constitutes a complete closed-loop operation mechanism. Collaborative course development starts with typical work tasks and relies on joint course design to transform the competency framework into a project-based modular course package. Each group of courses should include at least three joint development courses the course content is benchmarked against the corresponding professional competency standards. This teaching innovation adopts a work study alternation mode, arranged according to a semester system, and provides vocational learners with a rotation learning plan. Practical training relies on a dual mentor system to evaluate learners' practical performance from two dimensions. Each vocational course includes an internship component. The internship duration shall not be less than six consecutive months. Demand oriented training is aimed at targeted student groups and specifically matches the employment needs of regional pillar industries. This customized talent training program follows core principles. It implements the model of "recruiting as recruitment, recruiting as recruitment". The selection criteria and course content shall be jointly formulated by both the school and enterprise. The dual mentor group supervises the implementation of the training program throughout the process, and learners who meet the evaluation criteria can directly participate in corporate recruitment. This system arrangement can accurately match the supply of talents with the actual demand of the labor market.

### 4.3 Educational Innovation and Sustainable Development

The comprehensive learning platform organizes the four core components of teaching delivery, academic investigation, outcome translation, and iterative teaching refinement into a closed operational cycle. This learning management framework has introduced the two core paradigms of OBE and action-oriented pedagogical models for instructional design. This educational system has made use of AI-assisted teaching tools, VR/AR simulation modules, and digital twin technologies for the establishment of intelligent learning spaces. The aforementioned learning platform also conducts exploration of blockchain-supported credential verification mechanisms in support of lifelong learning pursuits. A biennial all-inclusive curriculum review process carries out the

alignment of course offerings with the development roadmaps of regional newly emerging industries. This biyearly comprehensive assessment exercise develops modular learning options including micro-majors and micro-credentials for learners. Innovation and entrepreneurship education content is embedded across all stages of the entire curriculum. A collaborative school-enterprise applied research project arranges university faculty members and enterprise R&D engineers to tackle technical challenges arising from production processes. A dedicated technology transfer service station for small and medium-sized enterprises provides support for the above-mentioned initiative. A regular "research achievements feeding back into teaching" operational mechanism mandates that a minimum of two research findings each year are converted into instructional case studies, laboratory operation projects, or practical training handbooks. Academic investigation works elevate the quality of teaching delivery, while teaching implementation activities provide support for further research efforts.

## 5. Case Investigation and Empirical Investigation

The present investigation has carried out verification of the logical consistency and practical implementability of the proposed theoretical construct. Three separate industry-education integration platforms across eastern, central and western China are screened and chosen as the research subjects. Case screening criteria include representativeness, differentiation and transferability. This study integrates case analysis, questionnaire surveys (n=600) and in-depth interviews (n=15–20) to triangulate research evidence. Systematic analysis of empirical data reveals key constraints and supportive factors. These elements largely shape the operational performance of professional platforms.

### 5.1 Case Selection and Analytical Methodology

Case A is the Intelligent Manufacturing Industry Education Alliance, which is located in a national pilot city in eastern China and is aimed at developing high-end manufacturing industries in the region. The collaborative entity accepts guidance from the local administrative department. Its target industry's leading enterprises are deeply involved in its daily governance. Case B is a new energy vehicle industry college located in central China. It serves the transformation and upgrading of traditional industries in the region. This school enterprise cooperation entity implements a standardized dual governance model to support the institutionalized operation of vocational education integration .Case C is a cultural tourism industry education cooperation platform in western China, providing targeted professional services for the cultivation of local vocational talents. The operating entity integrates modern apprenticeship system and innovation incubation mechanism. It simultaneously embeds both into a normalized operational framework. Our study utilizes a three-dimensional analysis framework. It examines the selected three cases from three dimensions: institutional structure, operational mechanism, and implementation effectiveness. Case A adopts a formal organizational structure, with a steering committee and a dedicated secretariat under the governance system. Both serve as carriers for substantive governance work, promoting the formation of evidence-based and efficient decision-making mechanisms. Case B implements a joint governance system with the dean. This model grants the subject a high degree of operational autonomy, but is limited by available human resources. Case C belongs to a loose organizational alliance. It has not established a dedicated permanent institution to carry out formal decision-making. In addition to the real-time information matching mechanism, Case A establishes a dual incentive plan that integrates financial support and sustainable industry participation. Case B establishes a credit bank and certificate linkage mechanism. However, there are still limitations to the effective scope of cross institutional credit recognition. The employment matching rates of the three cases have all increased by 15-25 percentage points, and employer satisfaction remains consistently above 92%. There are several common shortcomings in the three types of cases. For example, there are fluctuations in the level of enterprise participation, equipment utilization rates of only 40% -60%, lack of systematic evaluation frameworks, and incomplete information platform functions.

### 5.2 Empirical Design and Findings

Our research empirical data comes from four types of respondents: college administrators (n=80), full-time teachers (n=150), current students and graduates (n=300), and representatives of cooperative enterprises (n=70). The study used a five point Likert scale and supplemented it with open-ended qualitative questions. At the same time, this study selected core informants for semi-structured interviews to enrich the evidence obtained from the questionnaire survey. Among all the samples, 72% of the respondents indicated that they have a sufficient understanding of the core content of the industry education collaboration platform; Only 34% of the surveyed enterprises can clearly explain the platform's operating rules and functional mechanisms. The average willingness of universities to participate in cooperative projects is 4.2, which is higher than the average of 3.1 for corporate stakeholders. The average of small and medium-sized enterprises is only 2.6, significantly lower than the average of 4.0 for large enterprises. This result reflects the objective existence of a participation gap. Vocational colleges have a high enthusiasm for joint construction, while the willingness of industrial partners to participate is relatively weak. Cross departmental cooperation faces multiple obstacles. This mainly includes insufficient stability of financial support (68%), unclear return on investment of participating enterprises (62%), and incompatibility with the internal performance evaluation system of the enterprise (55%).Survey respondents prioritised dedicated incentive funding pools as the most urgent improvement measure (81%). Next came cross-institutional credit transfer, vocational skill certification systems and integrated information-sharing platforms (74% and 70% respectively).

Key challenges in this field fall into four categories. Institutional resource provision remains notably inadequate. Relevant policy documents are largely directional and lack the binding force of mandatory regulations. Incentive structures for participating stakeholders show notable asymmetry and imbalance. Isolation of distributed resource pools across different sectors is especially prominent in the current operational landscape. Assessment and appraisal systems that could standardize practices have not been established in most operational contexts. Four key facilitating factors have been identified from the accumulated research data: forward-looking participation of administrative authorities, fair distribution of practical benefits following the "contribution-equivalent-return" principle, capability enhancement via digital technological tools, and effective blending of diverse cultural elements. These observed outcomes have lent support to the constructed theoretical analytical framework, and furnish experiential evidential basis for the further refinement of platform operation mechanisms.

## 6. Foremost Hindrances and Responsive Mitigation Approaches

The present section makes use of explorations of theoretical frameworks and empirically obtained results to pinpoint foremost obstacles facing the platforms for cooperative innovation across industries, educational settings and research bodies. It puts forward tailored response approaches for the administrative authorities, academic establishments, market operation entities, as well as the above-mentioned collaborative innovation platforms per se.

### 6.1 Key Challenges

(1) At the institutional and regulatory level, collaborative initiatives involve multiple government administrative authorities, including those responsible for education, human resources, development and reform, industry and information technology, and science and technology. These governing entities carry out policy coordination merely within a restricted scope. Sectoral focal points show divergence and fail to achieve alignment. The bulk of existing policies retain the nature of advisory guidance instead of possessing legally enforceable force. Relevant provisions are implemented selectively, which weakens their practical effectiveness substantially.

(2) From the perspective of resource allocation, there is insufficient cross system interoperability between on campus training facilities, enterprise technology platforms, and industrial data systems. The fragmentation of such systems results in redundant construction of training facilities. It also leads to the underutilization of existing collaborative resources. Research data shows that the utilization rate of the selected high-end training equipment is relatively low, consistently below 50%. The eastern coastal areas can receive sufficient financial and industrial investment, while the supply gap of

similar vocational education resources in the central and western provinces is significant. In recent decades, the regional disparities have continued to widen.

(3) By examining the incentive mechanisms of various participating entities, it can be found that enterprises face the risk of uncertain short-term economic benefits when participating in vocational education cooperation. This issue poses a particularly prominent constraint on small and medium-sized enterprises. Faced with market fluctuations, such enterprises generally adopt a wait-and-see attitude. Vocational colleges have administrative decision-making authority constraints and limited daily operational governance capabilities. In collaborative projects, there is often a passive attachment state. Their cooperative practices mostly remain at the level of superficial communication.

(4)At the level of teacher capacity building, there are significant regional and institutional differences in the criteria for identifying dual qualified teachers. The proportion of teachers with practical experience in frontline industries has been consistently low. It constrains the quality of practical teaching in vocational courses. The participation of enterprise technical experts in teaching faces systemic institutional barriers. The bottleneck is mainly reflected in personnel establishment, salary system, and professional title evaluation standards. The above institutional barriers not only make it difficult to ensure a stable supply of industry mentors. It also limits the diversified development of the talent pool structure in vocational education.

(5) From the perspective of evaluation criteria, only a few digital service platforms have embedded evaluation frameworks that cover the entire operational cycle of industry education collaboration projects. The existing evaluation indicators focus more on quantifiable indicators. These indicators focus largely on infrastructure investment scale and the number of partnered industrial enterprises. These existing evaluation systems disregard unquantifiable achievement outputs including the caliber of personnel cultivation and the conversion ratio of technological achievement transfers. Assessment outcomes are infrequently associated with the distribution scheme of operation supporting resources. The driving force behind sustained operational enhancement experiences noticeable attenuation.

### 6.2 Countermeasures and Recommendations

For governmental authorities, national administrative bodies should accelerate the formulation of dedicated regulations to advance industry-education integration in vocational education. This regulatory document shall give written confirmation of the obligations of market entities operating in industrial sectors. It shall require enterprises of specified operational scale to set up posts dedicated to integration initiatives or take on student placement trainees. Governance authorities shall integrate the operational performance of relevant platforms into the assessment indicators for local administrative bodies. The administrative departments shall set up special fiscal funds for the allocation of construction subsidies and the provision of operational assistance. They shall offer preferential tax treatment, such as a 10% deduction against taxable amounts, and prioritized inclusion within the national industry-education integration directory. These governing bodies shall put together cross-departmental working groups supported by a joint conference coordination mechanism. They shall develop an information platform on the government side that combines the functions of talent demand forecasting, technology requirement release, and administrative policy processing [10].

At the institutional level, vocational providers need to build regular connectivity frameworks that align the delivery of academic programmes with industrial labour-market requirements. These establishments should make use of talent demand evaluations conducted every two years to phase out obsolete curricular offerings and roll out programs with high market demand. They ought to advance the grouped development that keeps pace with the value chains of corresponding industries. They should carry out the restructuring of course systems centered on representative work assignments. The instruction of practical content must encompass no less than 50% of total teaching hours. These institutions should put into practice project-oriented and module-based instructional modes. They ought to build credit repository systems for credit transfer across different institutions. They should create specially assigned posts of “industry professors” and “master craftsmen”. They should enforce a five-year full-cycle

practical rotation in enterprises for all teaching staff as a prerequisite for position promotion. They should build two-way flexible personnel mobility frameworks. These frameworks allow teaching staff to take compensated part-time posts in enterprises and bring technical specialists to the campus [11].

From the perspective of industry and commercial organisations, designated technical specialists and human resource executives ought to be assigned to serve on Programme Advisory Committees. These stakeholders are expected to participate in the formulation of program targets, the structuring of course systems, and the establishment of practice placement criteria. They are required to be present for no fewer than two instructional assessment gatherings each academic semester. Commercial and manufacturing firms are encouraged to unlock their on-site production workshops and technical research platforms. These facilities can serve joint vocational education collaboration activities. Stakeholders in this ecosystem may jointly build hands-on training hubs. They can also co-create virtual simulation facilities for vocational skill training. All parties involved jointly develop professional teaching resources. They can enjoy intellectual property benefits and corresponding commercial profit sharing. Industrial manufacturers and vocational education cooperative enterprises should establish long-term cooperative relationships based on formal contracts, with a validity period of no less than five years, and clearly stipulate rules for resource investment, profit distribution, and project exit mechanisms. Each cooperative entity can explore the construction of mixed ownership industry colleges, with enterprises investing funds, physical facilities, and technological resources to obtain equity and operational income. Both parties should break through fragmented project level cooperation and shift towards systematic operation integration. This will achieve sustainable development of industry education collaboration.

The standardized hierarchical governance architecture is the key to promoting the construction of integrated platforms. This framework consists of three levels of organizational structure: Council, Executive Office, and Special Working Group. Representatives of the three types of governance institutions are allocated according to predetermined quotas to balance the discourse power of various stakeholders. The platform governance regulations need to clarify procedural rules and establish formal mechanisms for mediating disputes between cooperating parties. The platform can introduce independent third-party regulatory agencies. It relies on external supervision to ensure transparency in daily operations. The platform needs to establish a four-dimensional performance evaluation system, which evaluates from four dimensions: resource input, operational processes, actual output, and long-term iterative optimization. The platform conducts internal audits and independent third-party evaluations annually. It links the evaluation results with institutional rating and subsequent fund allocation. Qualification revocation clauses should be included in the framework. If the platform fails to meet the established standards for two consecutive years, this disposal mechanism will be activated. The goal of platform construction is to create a digital intelligent vocational education service system. It covers five core functional modules: talent matching, course push, equipment reservation, technology docking, and operation supervision. This smart vocational education platform relies on big data to build a capability analysis and risk warning mechanism. It also uses blockchain technology to complete the trustworthy verification of learners' practical learning outcomes.

These targeted guiding principles, centered around a systematic problem-solving logic, have reshaped the platform's operational model. They transformed traditional physical resource aggregation into a dynamic integrated system with collaborative professional benefits.

## 7. Conclusion and Outlook

### 7.1 Research Summary

Our research system examines the current industry education innovation platforms in the field of vocational education. It extracts three core conclusions based on the analysis results. Firstly, the cross-border organizational form defines the core attributes of vocational education innovation platforms. This feature distinguishes it from traditional educational carriers. The construction of industrial market demand driven platforms, with technological innovation as the core catalyst, ultimately leading to the cultivation of high-quality

technical and skilled talents. The platform integrates four core functions: teaching implementation, scientific research and development, practical training, and career guidance. Each module works together to form a self reinforcing closed-loop ecosystem. Secondly, the stable operation of the platform relies on five basic supporting elements: multi subject co governance, heterogeneous resource sharing, reasonable distribution of benefits, operational performance evaluation, and standardized institutional guarantees. This five dimensional mechanism covers collaborative organization, resource sharing, incentive supervision, performance evaluation, and institutional support. It can promote the transformation of vocational education platforms from shallow physical integration to deep collaborative development. Thirdly, the empirical results confirm the effectiveness of the phased implementation path. The path is divided into four progressive stages: initiation and construction, small-scale pilot, targeted optimization, and comprehensive final evaluation. The smooth operation of such vocational education platforms relies on three key conditions: government targeted policy support, fair distribution of cooperative benefits, and improvement of digital technology capabilities.

### 7.2 Research Limitations

Our research has two main endogenous limitations. This is mainly reflected in the constraints of sampling coverage and research time span. The collected data reflects significant regional differences in each research area, but the limited research scope is difficult to fully cover the practical operation of ethnic areas, rural areas, and border areas. Expanding the sample size helps to enhance the external validity of research conclusions. Our study's 24 month cycle cannot obtain long-term longitudinal observation data. The substantial improvement of talent cultivation quality, technology transformation efficiency, and ecosystem self evolution level is not achievable in the short term. These deep-seated effects usually require the platform to operate for 3 to 5 years before they can fully manifest.

### 7.3 Future Directions

Subsequent research can be conducted from three directions: intelligent platform iteration, regional collaboration, and international comparison. The iteration of intelligent platforms can rely on knowledge graphs, generative artificial intelligence, and blockchain technology. It supports personalized learning and lifelong learning. Regional collaboration can leverage cross regional alliances to achieve remote resource co construction and sharing between the eastern and western regions of China. International comparative research can explore the transferable conditions of relevant models by examining cross-border cooperation cases. Relevant research can share the practical experience of China's education integration with the "the Belt and Road" partners. Our research provides a theoretical framework and practical tools for platform construction, aiming to promote the transformation of industry education collaborative innovation platforms from pilot demonstrations to large-scale promotion, and provide talent and technical support for high-quality development in China.

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