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# University–local symbiosis for empowering application–oriented talent cultivation: the logic and pathways

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**Abstract:** The transformation of local undergraduate universities toward application–oriented education is a strategic priority in China’s higher education reform. This paper adopts university–local symbiosis as its core analytical framework to systematically explore how local universities can empower application–oriented talent cultivation through deep integration with regional economic and social development. Drawing on symbiosis theory and the Triple Helix model, and through case analyses of Yichun University, Weifang University, Linyi University, and Zhejiang Wanli University, this study reveals four mechanisms through which university–local symbiosis empowers application–oriented talent cultivation: value–guided strategic embeddedness, industry–demand–driven dynamic program adjustment, multi–dimensional collaborative practical platform development, and two–way empowering faculty–enterprise resource sharing. On this basis, the paper analyzes the structural dilemmas currently facing university–local symbiosis from five dimensions—institutional environment, program development, curriculum and instruction, faculty, and depth of collaboration—and proposes systematic pathways for breakthrough. This study provides an actionable analytical framework and strategic references for local universities to deepen university–local symbiosis practices, offering both theoretical value and practical guidance for advancing application–oriented talent cultivation reform.

**Keywords:** university–local symbiosis; application–oriented talent cultivation; local universities; industry–education integration; two–way empowerment.

## 1. Introduction

Local undergraduate universities account for over 90% of all regular undergraduate institutions in China and constitute the mainstay of the country’s higher education system, bearing the core mission of cultivating high–quality application–oriented talents for regional economic and social development. In 2015, the Ministry of Education, the National



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Development and Reform Commission, and the Ministry of Finance jointly issued the *Guidelines on Guiding Some Local Undergraduate Universities to Transform into Application-Oriented Institutions* [1], marking the elevation of local university transformation to a national strategy. Subsequently, a series of policy documents have continued to promote the development of application-oriented universities.

The Third Plenary Session of the 20th Central Committee of the Communist Party of China in 2024 further emphasized the integration of general and vocational education with industry and education, elevating industry–education integration to the overall level of educational reform. However, the transformation of local universities toward application–orientation is by no means a simple renaming and restructuring or adding practical courses; it is a systemic transformation involving educational philosophy, governance structures, training models, and faculty development [2, 3]. In this transformation, how to handle the relationship between universities and their localities—whether to maintain parallel relationships of each in its own place move toward subordinate relationships of one-way service or construct symbiotic relationships of two-way empowerment—has become a critical issue determining the success or failure of the transformation.

### 1.1. Literature review

Scholars have accumulated rich research findings on the theme of application-oriented talent cultivation in local universities, mainly focusing on the following areas. In terms of macro-level policies and strategic pathways for transformation development, scholars have examined the historical logic and policy context of local university transformation from the perspectives of institutional change and strategic management. Yang *et al.* (2021) [4] systematically analyzed the pathways for supply-side reform of application-oriented talent cultivation in local universities, pointing out that the core of transformation lies in shifting from supply-driven to demand-driven and from disciplinary logic to occupational logic. Hu (2024) [5] revealed the deep-seated contradictions in building high-level application-oriented universities from three dimensions: practical needs, practical difficulties, and reform strategies. He identified misaligned evaluation systems, structural deficiencies in faculty competence, and insufficient depth of industry–education integration as key bottlenecks constraining transformation. Grounded in the strategic context of building a strong education nation, Xiao (2026) [6] systematically elucidated the strategic direction of innovative development in application-oriented universities from three levels: goal orientation, logical adherence, and practical pathways. He emphasized that these institutions should take cultivating high-quality application-oriented talents as their core mission and achieve high-quality development through deeper industry–education integration and research–education integration. These studies provide macro-level cognitive frameworks for understanding local university transformation but lack systematic analytical tools and empirical support for translating policy directions into operable and replicable university–local cooperation mechanisms.

In terms of industry–education integration and university–enterprise cooperation mechanisms, industry–education integration is regarded as the core pathway for local universities’ transformation toward application–orientation, and scholars have conducted relatively in–depth research on this topic. Drawing on symbiosis theory, Mao and Tian (2019) [7] constructed a three–dimensional analytical framework for industry–education integration in local application–oriented undergraduate institutions, based on quality–parameter compatibility, system stability, and environmental support. They proposed that university–enterprise cooperation is a two–way investment process centered on the efficient flow of innovation elements, achieving cross–border resource integration and value enhancement. Zhang (2021) [8] analyzed three dilemmas in local undergraduate industry–education integration from a symbiosis perspective: structural supply–demand mismatches, weak cooperation incentives, and insufficient external support. He proposed a supply–demand matching mechanism and an integrated–symmetric mutualism model in response. Zhang *et al.* (2023) [9] focused on modern industrial colleges as a new carrier of industry–education integration, analyzing the connotations, dilemmas, and pathways for high–quality development from the perspective of symbiosis theory, emphasizing the decisive influence of quality–parameter compatibility between symbiotic units on the operational quality of industrial colleges. In addition, Cao (2024) [10], through case analysis of Chinese universities and regional stakeholders, constructed an institutional framework of local education clusters, revealing how the sharing of resources, knowledge, and experience promotes deep interaction between universities and regions. These studies provide valuable theoretical perspectives for understanding the internal mechanisms of industry–education integration, but still lack a systematic analytical framework for the relationship between universities and regions as a more macro–level symbiotic unit, particularly regarding synergistic mechanisms in strategic embeddedness, program adjustment, platform development, and resource sharing.

University–local cooperation and regional collaborative development have gradually become a research hotspot as local university transformation deepens. Yan (2026) [11] positioned universities in the new era as core carriers of talent cultivation, innovation, and cultural leadership. He proposed three pathways—structural, model, and systemic change—to deepen their symbiotic and co–prosperous relationships with regions. Ding (2026) [12], through a case study of Shenzhen, revealed the operational characteristics of Triple Helix dynamics in the Chinese context, pointing out that emerging entrepreneurial universities are playing an increasingly prominent role in regional innovation systems while also facing challenges such as institutional inertia, evaluation orientation, and organizational culture. Wu (2023) [13], based on years of practical exploration, systematically summarized experiences and reflections on application–oriented talent cultivation in local universities from the dimensions of program development, curriculum design, practical teaching, and faculty development. Liu (2025) [14] integrated social cognitive theory and symbiosis theory to construct a cognitive–symbiosis analytical framework, revealing the driving mechanisms of enterprise participation in university–industry collaboration and their promoting effects on human resource development. These studies provide useful references for understanding university–local interactions, but most remain at the level of empirical description or policy

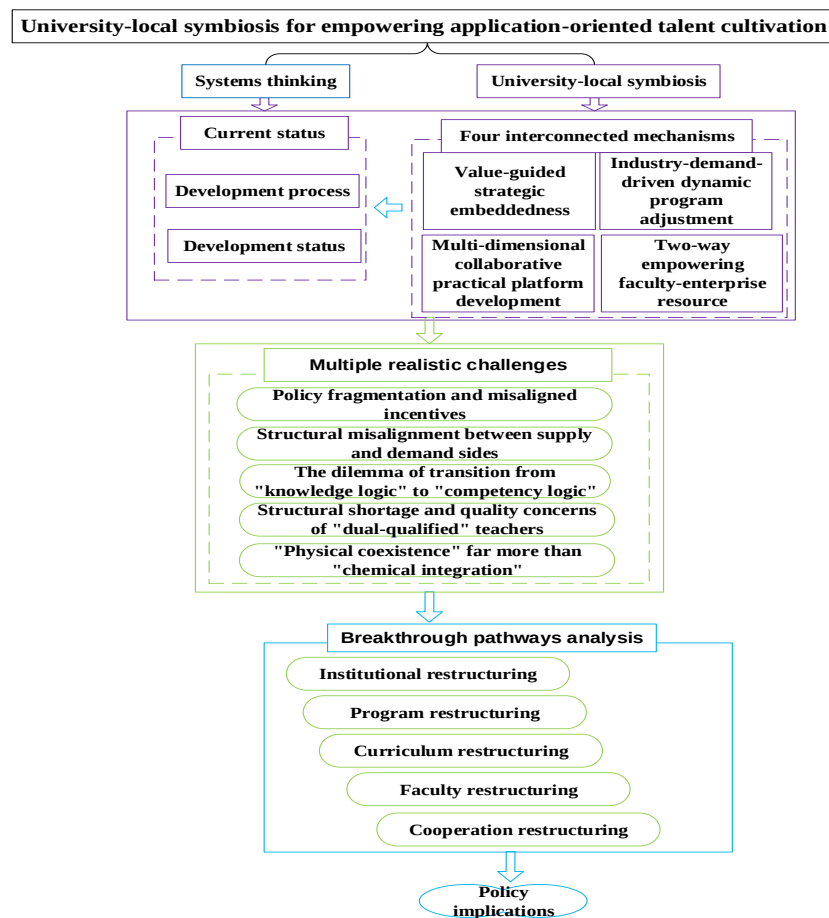
advocacy. They lack in-depth theoretical construction of the internal mechanisms of university–local symbiosis—specifically, how symbiosis occurs, what conditions enable it, and how it affects talent cultivation.

Synthesizing the above literature, several limitations can be identified in existing research. First, mechanistic research on university–local symbiosis remains insufficient. Although symbiosis has become an important analytical concept in industry–education integration research, most studies treat it metaphorically rather than as an operational framework, leaving the specific mechanisms, internal relationships, and conditions of how it affects talent cultivation largely unexamined. Second, the analysis of dilemmas is not sufficiently systematic or in-depth. Existing research has identified practical dilemmas—policy fragmentation, weak enterprise motivation, and faculty capacity gaps—but mostly remains at the descriptive level, failing to reveal the structural interconnections that form a "dilemma lock-in" vicious cycle, or the deeper causal links among institutional environment, program development, curriculum, faculty, and depth of collaboration. Third, the connection between theoretical construction and empirical analysis remains weak. Many studies invoke symbiosis theory or the Triple Helix model, but their empirical analysis stays descriptive and fails to translate these concepts into measurable dimensions or to test them through cases. This disconnect between theory and empiricism significantly weakens the explanatory power and persuasiveness of their findings.

To address the above gaps, this paper attempts to make three key contributions. First, it constructs a four-mechanism analytical framework—value-guided embeddedness, demand-driven program adjustment, collaborative platform development, and two-way resource sharing—for university–local symbiosis empowering application-oriented talent cultivation. Second, through case analyses of four local universities, it verifies the framework, identifies five structural dilemmas, and proposes corresponding breakthrough pathways. Third, it distills a theoretical proposition of three-level transformation—value, institutional, and pedagogical—to guide university–local symbiosis practices.

### *1.2. Four-dimensional analytical framework*

To systematically examine how university–local symbiosis empowers application-oriented talent cultivation, this study constructs a four-dimensional analytical framework integrating symbiosis theory and the Triple Helix model, illustrated in Figure 1. Symbiosis theory provides the conceptual foundation for understanding university–local relationships as mutualistic rather than unidirectional, emphasizing co-evolution through resource complementarity, institutional coordination, and functional coupling. The Triple Helix model further enriches this perspective by highlighting the interactive dynamics among universities, industry, and government, and their collective role in driving innovation and regional development. Building upon these theoretical foundations and drawing on the practical experiences of Chinese local universities, the framework identifies four interconnected mechanisms through which university–local symbiosis operates to empower talent cultivation.



**Figure 1.** A framework for exploring pathways for empowering application-oriented talent cultivation from university-local symbiosis. (Source: the figure is drawn by the author).

Mechanism 1: Value-guided strategic embeddedness serves as the prerequisite and directional foundation. It refers to the elevation of serving the region from an ancillary function to a core institutional value, operating through cognitive, strategic, and organizational embeddedness to transform regional development needs into institutional identity and strategic priorities.

Mechanism 2: Industry-demand-driven dynamic program adjustment constitutes the core of symbiosis. It establishes a linkage and feedback mechanism among program settings, enrollment plans, training programs, and regional industrial structure changes, operating through demand identification, program response, and training adaptation to align program structures with regional industrial evolution.

Mechanism 3: Multi-dimensional collaborative practical platform development provides the material carrier and institutional space. It breaks boundaries between schools and enterprises through spatial, institutional, and functional dimensions, constructing government-university-enterprise collaborative education systems that transform theoretical knowledge into practical competencies.

Mechanism 4: Two-way empowering faculty-enterprise resource sharing supplies the human resource foundation. It facilitates mutual flow, learning, and growth between

university faculty and enterprise technical talent through access mutual opening, capacity co-construction, resource sharing, and cultural integration.

These four mechanisms are not independent but constitute an organic whole of mutual reinforcement. Value-guided embeddedness provides directional guidance; program adjustment serves as the core hub connecting demand and supply sides; platform development offers spatial and institutional support; and resource sharing provides the human capital foundation. Together, they form the complete logical chain of university-local symbiosis empowering application-oriented talent cultivation in local application-oriented universities.

## **2. The generative logic of university-local symbiosis empowering application-oriented talent cultivation**

### *2.1. The educational applicability of symbiosis theory*

The concept of symbiosis originates from biology, referring to long-term, close interactive relationships formed between different organisms, including mutualism, commensalism, and parasitism. Since the mid-20th century, the concept of symbiosis has been introduced into the social sciences for analyzing reciprocal relationships between organizations, regions, and between humans and the environment.

In the field of educational research, symbiosis theory provides a novel perspective for understanding industry-education integration. Industry-education integration in local application-oriented universities has been analyzed via three dimensions: quality-parameter compatibility, system stability, and environmental support [7]. University-enterprise cooperation is defined as a two-way innovation-driven process. Three dilemmas in local undergraduate industry-education integration have been identified from a symbiosis perspective: structural supply-demand mismatches, weak cooperation incentives, and insufficient external support [8]. Corresponding solutions include a supply-demand matching mechanism and an integrated-symmetric mutualism model. Symbiosis theory reframes university-local relationships as co-evolutionary rather than one-way. Both parties achieve mutual benefit through resource complementarity, institutional coordination, and functional coupling.

### *2.2. Theoretical insights from the Triple Helix Model*

The Triple Helix Model, proposed by Etzkowitz and Leydesdorff [15], posits that universities, industry, and government—three institutional spheres—jointly drive knowledge production, technological innovation, and regional development through interaction and partial overlap of their functional roles. This model breaks from the analytical tradition of treating universities, industry, and government as clearly bounded separate sectors, emphasizing boundary blurring and functional cross-fertilization among the three. Jongbloed et al. [16] further expanded the theoretical connotations of the Triple Helix model from the perspective of “universities and communities,” pointing out that interactions between

universities and regions involve not only knowledge transfer but also multiple dimensions such as cultural interpenetration, institutional coordination, and social capital co-construction, providing richer theoretical resources for understanding the complexity of university–local symbiotic relationships.

In the Chinese context, the Triple Helix model requires localized adaptation. China's university–local relationships are embedded in a distinctive institutional environment: local governments have strong discursive power in resource allocation and administrative coordination, state-owned enterprises and private enterprises face different incentive structures in participating in industry–education integration, and there are tensions between university autonomy and administrative constraints [12, 14]. Therefore, the application of the Triple Helix model in China requires attention to the particularities of the institutional context.

### *2.3. Four mechanisms of university–local symbiosis*

Integrating symbiosis theory and the Triple Helix model, and drawing on the practical experience of Chinese local universities, this paper constructs a four-mechanism analytical framework for university–local symbiosis empowering application-oriented talent cultivation. This framework aims to reveal the specific operational logic of university–local symbiosis from concept to practice, as well as the internal relationships and synergistic effects among the mechanisms.

First, value-guided strategic embeddedness. This mechanism is the prerequisite and directional guarantee of university–local symbiosis. Value-guided symbiosis refers to the elevation of “serving the region” from an ancillary function external to university development to a core value internal to the university's mission, completing at the organizational cognitive level the fundamental shift from “what I can provide” to “what the region needs me to become.” Specifically, value-guided symbiosis includes three progressive levels: (1) cognitive embeddedness—university leadership and all faculty and students develop deep understanding and emotional identification with regional development needs, regarding the region as an indivisible “community of life” rather than an “external environment” [11, 17]; (2) strategic embeddedness—systematically incorporating regional development needs into the university charter, development plans, and annual key work, transforming university–local symbiosis from a “nice-to-have optional task” into a “must-complete required task” [1, 6]; (3) organizational embeddedness—through the establishment of specialized institutions (such as university–local cooperation offices and industry–education integration service centers) and the creation of normalized university–local communication mechanisms (such as city–university joint meeting systems), transforming university–local symbiosis from “personalized, occasional relationship maintenance” into “institutionalized, continuous organizational behavior” [7, 18]. The practices of the four case universities show that university–local cooperation lacking value-guided symbiosis often falls into the formalistic trap of “agreements signed, plaques hung, cooperation gone.” Conversely, when universities truly regard the region as “soil for symbiosis” rather than

“object of service,” the endogenous motivation and sustained willingness for cooperation are significantly enhanced [11, 19].

Second, industry–demand–driven dynamic program adjustment. This mechanism is the core content of university–local symbiosis, directly related to the structural matching between the talent cultivation supply side and the industrial demand side. “Industry–demand–driven” does not mean simply leaving program settings entirely to market determination, but rather, while adhering to educational laws and disciplinary logic, establishing a linkage and feedback mechanism among program settings, enrollment plans, training programs, and regional industrial structure changes [4, 13]. The operation of this mechanism includes three key links: (1) demand identification—establishing normalized research and early warning mechanisms for regional industrial structure and talent demand, accurately grasping the dynamic demand for talent quantity, type, and specifications through various channels such as big data analysis, enterprise visits, and industry consultation [6, 20]; (2) program response—constructing a “warning–exit–addition” three-in-one dynamic program adjustment mechanism, providing key construction and resource allocation for programs with high matching with regional industries and good development prospects, implementing warning rectification and even mandatory exit for programs disconnected from regional demand and with persistently low employment quality, and opening “green channels” for program approval for urgently needed programs in regional strategic emerging industries [18, 19]; (3) training adaptation—translating industrial demand into specific talent training specifications, curriculum systems, and practical components, ensuring that program name adjustments and training connotation reconstruction advance simultaneously, avoiding “changing the label without changing the content” [7, 17]. It should be emphasized that dynamic program adjustment should not be merely about increase or decrease in quantity, but should pursue the “ecological correspondence” between program clusters and industrial clusters—cultivating composite talents adapted to industrial chain needs through cross-program curriculum sharing, faculty exchange, and resource integration [8, 9].

Third, multi-dimensional collaborative practical platform development. This mechanism is the material carrier and institutional space of university–local symbiosis. The core competencies of application-oriented talents—practical ability, innovative spirit, and professional literacy—cannot be developed in closed classrooms but must be constructed through “learning by doing” in real or simulated professional contexts [5, 21]. Multi-dimensional collaborative practical platform development aims to break the boundaries between schools and enterprises, classrooms and workshops, learning and work, constructing a practical teaching system for “government–university–enterprise” multi-agent collaborative education [9, 22]. This mechanism includes three dimensions: (1) spatial dimension—constructing integrated practical teaching bases both on and off campus, including on-campus experimental training centers, university–enterprise co-built modern industrial colleges, off-campus internship training bases, and industry–education integration parks, forming a graded practical platform system from basic experiments to comprehensive training, from on-campus simulation to enterprise practice [17, 18]; (2) institutional dimension—establishing management norms and safeguard mechanisms for platform

operation, including the division of rights and responsibilities among platform co-builders, resource sharing rules, cost allocation plans, and benefit distribution arrangements, ensuring that platforms move from “plaque-hanging” to “substantive operation” [14, 22]; (3) functional dimension—expanding the multiple functions of practical platforms, making them not only places for student internships and training, but also bases for faculty practical training, partners for enterprise technology research and development, and carriers for university–enterprise collaborative innovation, achieving functional integration of “teaching–research–service” [9, 19]. The practices of the four case universities all show that substantively operated industrial colleges have significant advantages over “plaque-style” industrial colleges in terms of talent cultivation quality, research achievement transformation, and social service capacity [17, 19, 23].

Fourth, two-way empowering faculty–enterprise resource sharing. This mechanism is the human resource guarantee and capacity foundation of university–local symbiosis. “Two-way empowerment” refers to the two-way flow, mutual learning, and co-growth between university faculty and enterprise technical talent, rather than the one-way “universities transferring talent to enterprises” or “enterprises provide adjunct faculty to universities” [4, 21]. The operation of this mechanism includes four key elements: (1) access mutual opening—opening the career mobility channel between university faculty and enterprise technical talent, on the one hand encouraging universities to recruit highly skilled talent with rich practical experience from industry enterprises as full-time or adjunct faculty, and on the other hand providing institutional guarantees for university faculty to take temporary positions in enterprises and participate in technical problem-solving [13, 14]; (2) capacity co-construction—through various means such as university–enterprise joint training, project cooperation, and academic exchange, enhancing teachers’ “dual-qualified” quality (simultaneously possessing academic teaching ability and practical guidance ability) and enterprise technical personnel’s teaching ability, achieving synergistic evolution of both parties’ professional capabilities [18, 21]; (3) resource sharing—promoting mutual openness and co-construction and sharing of university academic resources (such as library materials, laboratory equipment, academic conferences) and enterprise practical resources (such as production data, technical cases, research and development platforms), reducing transaction costs for both parties in accessing each other’s resources [10, 12]; (4) cultural integration—promoting exchange and mutual learning between university academic culture and enterprise innovation culture, helping faculty understand enterprise efficiency logic and market logic, and helping enterprise personnel understand the educational logic and academic logic of education, reducing cooperation friction caused by cultural differences [7, 8]. It should be pointed out that the key to two-way empowerment lies not in the frequency and quantity of personnel mobility, but in the quality and effectiveness of mobility—whether faculty entering enterprises truly participate in frontline practice rather than “plaque-hanging for show,” and whether engineers entering the classroom truly integrate into the teaching process rather than “giving one lecture and leaving” [14, 21].

The above four mechanisms are not isolated elements but an organic whole of mutual support and mutual condition. Value-guided symbiosis constructs the cognitive premise and

directional guidance for the other three—without value identification, strategic embeddedness lacks endogenous motivation; industry–demand–driven dynamic program adjustment is the core hub—it connects “what kind of people the region needs” (demand side) and “what kind of people the university cultivates” (supply side), determining the direction of resource allocation and the goals of platform development; multi–dimensional collaborative practical platform development is the material support— it provides spatial carriers and institutional frameworks for the implementation of program adjustment and the transformation of faculty and student capabilities; two–way empowering faculty–enterprise resource sharing is the power source— it provides human resource guarantees and capacity foundations for the continuous operation of the first three. The four mechanisms intertwine and synergize, jointly constituting the complete logical chain of university–local symbiosis empowering application–oriented talent cultivation [6, 9, 22].

### 3. Practical patterns of university–local symbiosis empowering application–oriented talent cultivation

#### 3.1. Yichun University: strategic embeddedness and “three–dimensional linkage”

Yichun University, located in Yichun City, Jiangxi Province, has adhered to the educational positioning of locality, application–orientation, and openness for over 60 years. In recent years, with university–local symbiosis as its core strategy, the university has deeply embedded its development into Jiangxi Province's “1269” Action Plan and Yichun City's “869” Action Plan [17].

Organized operation of strategic embeddedness. The university implements the county–university collaborative “Five–Five” Project, establishing a “Five Ones” mechanism— each county and district is assigned one leading university leader, one liaison officer, one service team, one batch of cooperative projects, and one set of implementation plans; and promoting a “Five Transformations” model—tasks transformed into projects, projects transformed into lists, lists transformed into items, items transformed into results, and results transformed into sustainability. At the University–Local (Enterprise) Cooperation Supply–Demand Matching Conference in January 2025, 83 agreements were signed on–site, with contract funds reaching 22.9457 million RMB. The university also implements the Ten–Hundred–Thousand–Ten–Thousand initiative, organizing one thousand faculty members to lead ten thousand students into enterprises and institutions across Yichun's 10 counties and 3 districts, entering fields, workshops, and factory floors to carry out practical activities, deeply integrating the talent cultivation process with regional production practice.

Industry–oriented dynamic program adjustment. The university has built a “Lithium Battery+” program cluster around Yichun's “Asia's Lithium Capital” industrial strategy, integrating six programs including materials physics, applied chemistry, and mechanical manufacturing. In response to the Digital Economy assigned as No. 1 Development Project it has added programs in artificial intelligence and digital economy. Total enrollment programs were optimized from 63 to 53, with the proportion of enrollment in science, engineering, agriculture, and medicine programs increasing from 48% in 2022 to over 60%

in 2025. In the past three years, over 40 specialized courses have been added, including “Lithium Battery Processes and Equipment” and “Selenium–Enriched Agricultural Product Processing Technology,” and 15 “post–certificate–competition” integrated courses have been co–developed with enterprises.

“Three–Dimensional Linkage” cultivation system. The university has constructed a “Employment–Program–Industry” three–dimensional linkage closed–loop cultivation system: industrial demand leads the direction of program adjustment, employment quality data feeds back into training program optimization, forming a complete closed loop of “demand identification— program design— process implementation— effect evaluation— continuous improvement,” translating outcome–based education concepts from abstract principles into operable educational processes.

### *3.2. Weifang University: “four–driven integration, three–party synergy, two–way empowerment”*

Weifang University, located in Weifang City, Shandong Province, has developed an application–oriented talent cultivation model centered on “university–local collaborative symbiosis, industry–education integration empowerment,” characterized as “four–driven integration, three–party synergy, two–way empowerment, unified talent cultivation” [18].

Structural design of four–driven integration. The first is industry–education integration—co–building 11 modern industrial colleges and 7 provincial–level specialized colleges with regional leading enterprises including Weichai Group and Goertek. The second is science–education convergence— co–building 5 Shandong provincial engineering research centers with Shandong Yongsheng Agricultural Development Co., Ltd., with direct returns from research commercialization exceeding 10 million RMB in 2025, forming an institutional channel for transforming research resources into teaching resources. The third is general–vocational integration— 13 programs participating in linked enrollment with secondary and higher vocational institutions, opening the vertical channel for technical skilled talent cultivation. The fourth is university–city integration— improving the “City–University Joint Meeting System” with the Weifang municipal government, with a deputy mayor leading monthly on–site meetings at the university to study and solve practical problems in university development, transforming university–local communication from “occasional coordination” to “normalized governance”.

Institutionalized operation of two–way empowerment. The university adheres to the principle of “disciplines follow industry, programs circle demand,” adding 12 new undergraduate programs in intelligent manufacturing and smart agriculture over the past three years. It has organized over 600 doctoral faculty members to engage with more than 1,400 enterprises in Weifang for technical services and demand research. It has launched the “Hundred Cadres Secondment Action Plan (2026–2028),” with the first cohort of 34 cadres assigned to county–level governments and business departments for secondment, enabling university administrators to gain frontline experience in local governance. At the same time, it has constructed a “1 (university) + 1 (leading enterprise) + N (industry chain enterprises)”

substantive industrial college system, with enterprises deeply participating in training program development, curriculum design, and teaching implementation. Over 100 enterprise executives and senior engineers have been appointed as lead instructors for innovation and entrepreneurship courses, with “dual-qualified” teachers accounting for over 60%. The graduate retention rate in Weifang remains above 40%.

### *3.3. Linyi University: “three integrations” educational ecosystem*

Linyi University, located in the Yimeng revolutionary base area, has constructed a distinctive “Three Integrations” educational model with “city–university integration as carrier, industry–education integration as pathway, and science–education integration as lever” [19].

In terms of city–university integration, the university has co-built with local governments institutions including the Rural Revitalization Research Institute and the National Revolutionary Cultural Relics Collaborative Research Center, systematically aligning disciplinary and program layout with the needs of Linyi’s 13 industrial chains. Industry–education integration has achieved full coverage of undergraduate programs with university–enterprise cooperation, co-building 302 internship training bases, 37 research institutions, 26 innovation and entrepreneurship education centers, and 121 innovation and entrepreneurship practice bases. Enterprise technical experts participate throughout the entire process of program review, application–oriented curriculum development, teaching resource library construction, and textbook compilation. In terms of science–education convergence, the university has been approved for 11 national first–class undergraduate program construction sites and 17 national first–class courses, and has received 17 provincial teaching achievement awards (including 1 special prize).

While enterprise technical experts serve as practice instructors and industry mentors, the university also promotes faculty to enter enterprises for “real problems, real solutions” style research and services. The “dual-qualified” faculty team continues to grow, with over 70% of graduates finding employment within the province and employer satisfaction reaching 97.9%.

### *3.4. Zhejiang Wanli University: the “wanli approach” of industry–education–city integration*

Zhejiang Wanli University, as the only university in Zhejiang Province selected as a pilot demonstration institution for application–oriented construction, has developed a model “Wanli Approach” [23]. With “industry–education–city integration” as its core strategy, the university has established close cooperative relationships with local governments and industry enterprises, forming systematic institutional arrangements and replicable practical experiences in industrial college development, curriculum system restructuring, and “dual-qualified” faculty team building. Its “industrial college + industry enterprise + local government” trinity cooperation model provides another noteworthy practical sample for university–local symbiosis.

### 3.5. Comparison of four models and mechanism extraction

The practices of the four universities, while each having their own emphasis, exhibit both common mechanisms and differentiated pathways of university–local symbiosis, which can be summarized as follows in Table 1.

**Table 1.** Annual supply of energy services provided by the new energy–based multi–energy complementary system [17–19, 23].

| Dimension                    | Yichun University                                            | Weifang University                                                                                  | Linyi University                                                            | Zhejiang Wanli University                      |
|------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------|
| Core Model                   | "Three–Dimensional Linkage" (Employment–Program–Industry)    | "Four–Driven Integration" (Industry–Education+Science–Education+General–Vocational+University–City) | "Three Integrations" (City–University+Industry–Education+Science–Education) | Industry–Education–City Integration            |
| Strategic Embeddedness       | Embedded in provincial and municipal industrial action plans | City–university joint meeting system normalized                                                     | Alignment with 13 regional industrial chains                                | Industry–education–city integration            |
| Program Adjustment Mechanism | Program cluster development + enrollment ratio optimization  | Disciplines follow industry                                                                         | "ABC" three–tier dynamic adjustment                                         | Industry demand–oriented                       |
| Platform Carriers            | County–university collaborative "Five–Five" Project          | Modern industrial colleges + engineering research centers                                           | Industrial colleges + collaborative innovation centers                      | Industrial college clusters                    |
| Faculty Two–Way Flow         | Hundred–Thousand–Ten–Thousand" initiative                    | Hundred cadres seconded + 600 doctoral faculty entering enterprises                                 | Faculty entering enterprises + engineers entering classrooms                | Institutionalized "dual–qualified" development |

Synthesizing the experience of the four universities, the four mechanisms of university–local symbiosis empowering application–oriented talent cultivation are validated: First,

strategic embeddedness is the foundation of symbiosis. All universities have transformed regional development needs from “external environment” to “internal constitution,” forming structural coupling between educational positioning and regional strategy. This embeddedness is not simple “declarative alignment” but institutionalized embeddedness achieved through organizational mechanisms (such as joint meetings and county–university collaborative projects). Second, dynamic program adjustment is the core of symbiosis. Program structure shifts from “disciplinary logic” to “demand logic,” establishing a linkage mechanism between program settings and industrial structure. It is worth noting that program adjustment should not be merely increase or decrease in quantity, but should pursue the “ecological correspondence” between program clusters and industrial clusters. Third, platform development is the body of symbiosis. Modern industrial colleges and industry–education integration bases are not only the sharing of physical space but also the reconstruction of institutional space—both university and enterprise parties form new interactive rules and resource sharing models within them [9, 22]. Fourth, two-way empowerment is the lifeblood of symbiosis. The two-way flow of faculty provides “living water” for symbiosis, establishing a continuously circulating channel between knowledge production and industrial practice [21].

#### **4. Realistic challenges of university–local symbiosis empowering application–oriented talent cultivation**

##### *4.1. Institutional environment level: policy fragmentation and misaligned incentives*

The gap between policy supply and implementation. Although a series of policy documents have been issued at the national and provincial levels, there remains a “last mile” problem at the operational level. The fragmentation of policies is evident—industry–education integration policies fall under the education department, industrial development policies under the industry and information technology department, and talent policies under the human resources and social security department, with a lack of effective policy coordination mechanisms among departments. Universities often face the dilemma of “multiple supervisors, inconsistent standards” in implementation. For example, while the education department encourages universities to expand enrollment in application–oriented programs, the finance department’s funding standards remain primarily based on per–student quotas, without fully considering the higher cultivation costs of application–oriented programs; while the human resources department promotes enterprise participation in industry–education integration, the tax department’s implementation standards for tax deduction policies on related enterprise investments are inconsistent, and enterprises’ actual gains are limited. This fragmentation between policies puts universities in a difficult position in promoting industry–education integration [7, 8].

Misaligned orientation of the evaluation system. The current university evaluation system still takes academic output as the core indicator, with the weight of “papers, projects, awards” in faculty title evaluation and performance assessment far exceeding that of industry–education integration contributions. Research has pointed out that although universities

emphasize application-oriented transformation at the discursive level, they have not yet achieved a fundamental shift at the evaluation “baton” level, resulting in faculty investments in industry–education integration facing the awkward situation of “no academic value addition, no promotion advantage” [4, 5]. Specifically, a faculty member who invests significant effort in developing university–enterprise cooperative courses and guiding students in enterprise projects finds it difficult to have these achievements valued equally with a single SCI paper in title evaluation. This misalignment of value orientation constitutes the deepest institutional obstacle to university–local symbiosis, because faculty are the specific implementers of talent cultivation—if faculty lack endogenous motivation to participate in industry–education integration, no amount of good institutional design can be implemented.

Limitations of local government assessment indicators. Current local government investment in and assessment of higher education tends to focus on visible indicators such as enrollment scale and graduate retention rates within the province (city), with less attention to universities’ substantive contributions to regional industrial upgrading, technological innovation, and social development [11]. This leads local governments to easily fall into the tendency of “emphasizing signing over implementation, quantity over quality” in promoting university–local cooperation, where the number of cooperation agreements signed becomes material for political achievement display, while the actual effectiveness of cooperation lacks continuous tracking and evaluation.

#### *4.2. Program development level: structural misalignment between supply and demand sides*

Institutional lag in program structure adjustment. University program setting and adjustment require strict administrative approval procedures, often taking one to two years or even longer from research and review to final approval, while the pace of industrial structure adjustment and technological iteration is increasingly accelerating. The time gap between the two leads to a widespread “lag period” in talent cultivation—programs that were “hot” when students enrolled may face demand saturation by graduation. Although some universities have initiated dynamic program adjustment, the scope, depth, and frequency of adjustment remain insufficient to match the pace of industrial change. Moreover, program adjustment is constrained by path dependencies such as faculty stock, laboratory equipment, and textbook systems—even if a university intends to reduce certain programs, the reassignment of existing faculty presents a practical challenge [4, 13].

Competency deviation between talent training specifications and job requirements. A deeper problem is that even when program names “match” industrial demand, the knowledge structure, competency standards, and quality requirements in training programs may still have systematic deviations from employers’ actual needs. There is a significant gap between enterprises’ ‘expectation of students’ “ability to solve practical problems” and universities’ traditional goal of “imparting systematic knowledge.” A tracking survey of graduates from application-oriented universities shows that employers’ satisfaction with graduates’ “professional theoretical knowledge” is higher than with “practical hands-on ability” and

“communication and collaboration ability”—yet the latter two are precisely the competency dimensions that enterprises value most [20]. The root of this deviation lies in the fact that training program development is still organized according to disciplinary knowledge systems rather than constructed according to occupational competency requirements.

“Formal resemblance but spiritual difference” between program clusters and industrial clusters. Some universities propose building “program clusters” to connect with regional “industrial clusters,” but in practice, program clusters often are merely simple aggregations of several related programs, lacking cross-program curriculum sharing, faculty exchange, and resource integration. Industrial clusters require a cross-boundary integrated competency structure, and if program clusters are only “physical aggregation” without achieving “chemical integration,” they cannot truly cultivate composite talents adapted to industrial chain needs [6, 17].

#### *4.3. Curriculum and instruction level: the dilemma of transition from “knowledge logic” to “competency logic”*

Deep disconnection between curriculum content and industrial practice. Application-oriented talent cultivation requires curriculum content to keep pace with industrial technology frontiers and occupational practice standards, but most universities’ curriculum update mechanisms remain oriented toward faculty members’ individual academic interests. The teaching content of a course often depends on the instructor’s knowledge reserve, and the instructor’s knowledge structure is closely related to their own academic training background. Since most faculty lack systematic industry practical experience, curriculum content tends to emphasize theoretical deduction while neglecting practical application, and disciplinary classics while neglecting technological frontiers. The phenomenon commonly reported by enterprises—“what students learn is not usable, what enterprises need has not been learned”—has its root cause here [7, 8]. Although universities encourage faculty to introduce enterprise cases into teaching, there is a lack of institutional channels and incentive mechanisms for systematically translating new industrial technologies, processes, and norms into teaching content.

Lag in textbook development. The textbook issue closely related to curriculum content is equally prominent. The mainstream textbooks used in current application-oriented universities are mostly “application-oriented adaptations of regular university textbooks”—adding a small number of cases or exercises to traditional disciplinary system textbooks rather than truly reconstructing them according to the logic of “project-led, task-driven.” Truly application-oriented textbooks that reflect the latest industry technologies and embody work-process orientation have long development cycles, high investment, low returns, weak faculty willingness to compile, and limited publishing motivation from presses. The lag in textbook development leaves classroom teaching reform lacking basic content carrier support [21].

Superficiality and formalization of teaching method reform. Although modern teaching methods such as project-based teaching, case teaching, and situational teaching are widely

advocated, the traditional “lecture–reception” model still dominates in actual teaching. Some faculty have a shallow understanding of the “student–centered” teaching philosophy, simplistically interpreting practice–oriented teaching as “increasing internship time” or “offering laboratory courses” rather than fundamentally reconstructing the relationship between teaching and learning [5, 9]. Even in courses where teaching method reforms have been implemented, the phenomenon of “form changed but spirit unchanged” often appears—superficially adopting forms such as group discussion and project presentation, but the setting of teaching objectives, the design of teaching processes, and the implementation of teaching evaluation still remain trapped in the old logic of knowledge transmission. The deep obstacle to teaching method reform lies in the fact that faculty have not yet transformed their understanding of the fundamental question of “how learning occurs”.

#### *4.4. Faculty level: structural shortage and quality concerns of “dual–qualified” teachers*

Institutional contradiction between access mechanisms and “dual–qualified” requirements. “Dual–qualified” teachers with industry practical experience are the key support for application–oriented talent cultivation. However, constrained by the academic threshold of university faculty recruitment (typically requiring a doctoral degree) and academic evaluation orientation, outstanding enterprise talent with rich industry experience but relatively low educational qualifications (such as a master's degree) find it difficult to enter university teaching. At the same time, fresh doctoral graduates, though possessing solid academic foundations, generally lack industry practical experience. This access paradox—“those with practice cannot enter, those who enter lack practice”—creates an institutional obstacle at the source for “dual–qualified” faculty team development [4, 13].

Insufficient quantity and uneven distribution of “dual–qualified” teachers. From overall data, the proportion of “dual–qualified” teachers in local universities is increasing year by year, but there remains a significant gap from the actual needs of application–oriented talent cultivation. More critically, the distribution of “dual–qualified” teachers across different disciplines is highly uneven—engineering and management programs are relatively better off, while science, humanities, and some emerging interdisciplinary programs severely lack “dual–qualified” teachers. This unevenness directly constrains the comprehensive advancement of application–oriented talent cultivation [18, 21].

Formalization of faculty practical training. Institutionalized channels for faculty to undertake practical training in enterprises have not yet been widely established. Faculty secondment often faces the problem of “name but not reality”—the employment relationship is with the enterprise, but what they actually engage in is still academic research rather than frontline practice; or although they are in the enterprise, the enterprise treats them as “guests,” not daring to assign substantive work, and faculty also lack the motivation for proactive involvement. Enterprises generally lack sufficient motivation to receive faculty for secondment, often treating it as a “reception task” rather than a “cooperation opportunity,” because the direct benefits of faculty secondment to enterprises are limited, while the guidance costs enterprises need to invest are real [14]. Moreover, supporting systems such as

how teaching tasks are arranged during secondment, how compensation is guaranteed, and how secondment outcomes are recognized are still not well-established, further weakening faculty motivation to participate in practical training.

#### *4.5. Depth of collaboration level: “Physical coexistence” far more than “chemical integration”*

Pervasive formalistic cooperation. Many university–enterprise collaborations remain at the “ceremonial” stage of signing agreements and hanging plaques, with relatively little substantive collaboration in which enterprises deeply participate in talent training program development, curriculum design, teaching implementation, and quality evaluation. Research has summarized this phenomenon as “cooperation without integration, linkage without action” [7, 8]—agreements are signed, but each party’s way of working remains unchanged; industrial college plaques are hung, but daily operation still centers on the university. Some enterprises treat university–enterprise cooperation as “brand building” rather than “strategic investment,” lacking long-term planning for the depth and sustainability of cooperation. When the substantive content of cooperation is limited to providing a small number of internship positions or arranging a few lectures, fundamental transformation of the talent cultivation model is out of the question [14, 22].

Structural insufficiency of enterprise participation motivation. As market competitors, enterprises’ core motivation for participating in industry–education integration lies in obtaining demand-compliant human capital and solving technical problems. However, under the current institutional framework, there is an imbalance between the costs enterprises invest in industry–education integration (such as equipment donations, mentor compensation, internship management costs) and the benefits (such as priority access to graduates, technical cooperation opportunities). The threshold for implementing current tax incentive policies is relatively high, and small and medium-sized enterprises often find it difficult to meet the conditions for eligibility [12, 14]. When policy incentives weaken or enterprises face operational pressure, cooperation often cools rapidly. The structural temperature difference of “universities hot, enterprises cold” remains widely present and becomes more pronounced during economic downturns.

Low cooperation level, lacking strategic synergy. Most university–enterprise cooperation remains at the level of “talent cultivation cooperation” and has not yet risen to the level of “strategic development cooperation.” Enterprise participation in university talent cultivation tends to be limited to relatively shallow forms of cooperation such as providing internship positions and dispatching adjunct faculty, while progress in higher-level cooperation such as co-building research and development platforms, co-undertaking research projects, and sharing intellectual property is slow [10, 12]. This limitation in cooperation level makes it difficult for industry–education integration to truly affect the transformation of universities’ research paradigms and the adjustment of disciplinary development directions, nor can it meet enterprises’ deep needs for cutting-edge technological innovation.

## 5. Breakthrough pathways for university–local symbiosis empowering application–oriented talent cultivation

### 5.1. Institutional restructuring: from policy fragmentation to systematic institutional design

Establish cross–departmental policy coordination mechanisms. It is recommended to establish at the provincial level an industry–education integration joint meeting system with participation from education, industry and information technology, human resources and social security, finance, and taxation departments, to coordinate the formulation of industry–education integration policies and break down departmental barriers to policy implementation. Incorporate industry–education integration outcomes into the evaluation indicator system for local governments’ performance of educational responsibilities, forming rigid constraints on local governments. At the same time, review current policies with contradictory or inconsistent implementation standards, establish a policy “negative list,” and reduce the confusion and costs for universities and enterprises in policy implementation[6].

Reform university evaluation and faculty incentive mechanisms. At the university level, incorporate industry–education integration outcomes as core indicators for college assessment and program evaluation, incorporating the matching degree between programs and industries, the fit between graduates and positions, and the depth of enterprise participation in talent cultivation into the education quality evaluation system. At the faculty level, establish “classified management, multi–dimensional evaluation” title evaluation channels, set up applied teaching series titles, and incorporate curriculum development quality, practical teaching outcomes, and enterprise service contributions into evaluation conditions [5]. Specifically, classifications such as “teaching–oriented,” “teaching–research balanced,” and “applied service–oriented” can be referenced to provide differentiated promotion channels for faculty with different development paths. The shift of the title evaluation “baton” is the fundamental strategy for guiding faculty investment in industry–education integration.

Improve funding guarantee mechanisms for industry–education integration. Governments at all levels should establish special funds for industry–education integration to support key links such as university–enterprise co–developed courses, faculty enterprise practice, and student internships and training. Explore diversified funding mechanisms of “government–led, university–enterprise shared, society–participated,” providing financial subsidies and tax incentives to enterprises that deeply participate in industry–education integration. Universities should also adjust their internal funding allocation structures, directing more resources toward application–oriented program development and industry–education integration projects[13].

### 5.2. Program restructuring: establishing “industry demand–oriented” dynamic adjustment mechanisms

Build normalized industry demand research and early warning mechanisms. Universities should establish specialized industry research teams or entrust third–party institutions to

conduct continuous tracking research on regional industrial structure and talent demand. Research outcomes should become the decision-making basis for program settings and enrollment plan adjustments, rather than “icing on the cake” reference materials. Drawing on Weifang University’s “City–University Joint Meeting” experience, establish normalized information sharing mechanisms between the university and local government economic management departments, enabling the university to timely obtain key information such as regional industrial planning, major project layout, and talent demand forecasting, transforming from “post–event response” to “forward-looking planning” [11].

Establish a “warning–exit–addition” full-chain dynamic program adjustment mechanism. Drawing on Linyi University’s “ABC” three-tier management experience, implement classified management of programs: A-level programs for key development, B-level programs for warning and rectification, and C-level programs for suspension within a time limit. Establish a program quality monitoring indicator system covering dimensions such as enrollment attractiveness, training process quality, graduate employment competitiveness, and social reputation, implementing mandatory exit for programs that continuously fail to meet standards. At the same time, simplify the application process for new programs, opening “green channels” for programs urgently needed by regional industries, transforming program adjustment from “passive response” to “active planning” [20]. In the program adjustment process, the connection issues of faculty transformation and current student cultivation must be properly handled to ensure that program structure optimization does not come at the cost of teaching quality.

Promote deep connection between program clusters and industrial clusters. Drawing on Yichun University’s “Lithium Battery+” program cluster development experience [17], systematically design program cluster development plans according to the logic of “industrial chain—position chain—talent chain—education chain” four-chain connection. Break through the traditional mindset of dividing programs by discipline, restructuring curriculum systems and training programs around the core competency requirements of leading regional industries. Program cluster development should pursue “chemical integration” rather than “physical aggregation,” breaking down program barriers and achieving internal resource integration and competency interoperability within the cluster through co-developed curriculum modules, shared laboratory platforms, and mutual credit recognition.

### *5.3. Curriculum restructuring: from knowledge-based to competency-based*

Establish a “post–certificate–competition” integrated curriculum development model. Based on enterprise position competency standards, with reference to vocational skill level certificates and skill competition standards, systematically design curriculum systems and teaching content. Curriculum development should invite enterprise technical backbone to participate throughout the process, ensuring the “industrial genes” of curriculum content. Specifically, a reverse curriculum development process of “enterprise proposes position competency list—university and enterprise jointly transform into learning objectives—design learning tasks and evaluation standards—develop teaching resources and learning

materials” can be adopted, shifting curriculum content from disciplinary knowledge systems to position competency requirements. Establish regular curriculum content update mechanisms to ensure teaching content evolves synchronously with industrial technology development [7].

Promote “classroom revolution”: from teaching-centered to learning-centered. Reform the traditional lecturing teaching method, promoting student-centered teaching methods such as project-based teaching, problem-oriented teaching, and work-process-oriented teaching. Introduce real enterprise projects into the classroom, allowing students to construct knowledge and develop abilities in the process of solving real problems. Establish an integrated cultivation chain of “classroom teaching—enterprise practice—project research and development,” breaking the boundaries between inside and outside the classroom, on and off campus [4]. Teaching reform requires corresponding institutional support, including adjusting class scheduling to accommodate the flexible needs of project-based teaching, reforming course scheduling and classroom resource allocation to support diverse teaching organizational forms, and adjusting teaching workload calculation methods to recognize faculty investment in teaching method reform.

Accelerate the development of application-oriented textbook systems. Establish special funds for application-oriented textbook development, encouraging university-enterprise joint compilation of application-oriented textbooks that reflect the latest industry technologies and embody work-process orientation. Textbook development should follow the collaborative model of “enterprise technical personnel write cases, university faculty write theory, curriculum experts write pedagogy,” ensuring balance in the three dimensions of knowledge accuracy, practical authenticity, and pedagogical appropriateness [21]. Grant equivalent recognition to outstanding application-oriented textbooks as academic works, increasing faculty motivation to participate in textbook compilation.

#### *5.4. Faculty restructuring: opening institutional channels for two-way flow*

Broaden the sources of “dual-qualified” teachers. Revise faculty recruitment policies, appropriately relaxing academic qualification requirements for highly skilled talent from industry enterprises, emphasizing their practical ability and teaching potential. Establish “industry professor” and “master craftsman” positions, hiring industry-leading talents and highly skilled personnel as full-time or adjunct faculty. At the same time, reform the staffing management system, establishing specialized position sequences for enterprise-sourced highly skilled talent, clarifying their title promotion channels and career development paths, enabling them to be “attracted, retained, and developed well”.

Establish normalized and effective mechanisms for faculty enterprise practice. Drawing on Weifang University’s “Hundred Cadres Secondment Action Plan” experience, clarify the time requirements for faculty enterprise practice (e.g., no less than 6 months accumulated over every 5 years), task requirements (e.g., participation in technical projects, completion of practice reports, development of teaching cases), and assessment standards (e.g., application and transformation of practice outcomes in teaching). Build a number of faculty enterprise

practice bases, signing faculty practice cooperation agreements with enterprises clarifying the rights and obligations of both parties. To solve the problem of insufficient enterprise motivation to receive faculty for practice, combine faculty practice with enterprise technical problem-solving, enabling faculty to enter enterprises with research topics or technical challenges, achieving a three-way win of “enterprises gain technical support, faculty gain practical experience, universities gain teaching resources” [14]. At the same time, establish funding guarantee mechanisms for faculty practice training, reasonably solving compensation and teaching task adjustment issues during faculty secondment.

Improve the continuous development system for “dual-qualified” teachers. For already identified “dual-qualified” teachers, establish institutional arrangements for continuous development, requiring them to regularly update their industry experience and professional knowledge. Explore tiered certification systems for “dual-qualified” teachers, implementing tiered management based on teachers’ industry seniority, practical outcomes, and teaching level, providing differentiated development support for teachers at different tiers [18].

#### *5.5. Cooperation restructuring: from “agreement-based cooperation” to “governance-based cooperation”*

Promote the transformation of industrial colleges toward “substantive” operation. Industrial colleges should not be “plaque-hanging, name-only” virtual institutions, but should possess independent operational authority over human, financial, and material resources, establishing a board governance structure jointly formed by university and enterprise, granting substantive autonomy in program development, curriculum design, faculty appointment, and student management [22]. Substantive operation means that industrial colleges need clear organizational structures, full-time management teams, independent budgets, and operable operational systems. Universities should treat industrial colleges as reform special zones within the institution, granting greater flexibility in personnel systems, financial management, and teaching administration.

Build long-term mechanisms for university-enterprise interest communities. Explore cooperation models of “university-enterprise joint investment, risk sharing, benefit sharing.” Through co-building research and development centers, sharing intellectual property, and co-establishing enterprise entities, upgrade university-enterprise cooperation from “talent cultivation cooperation” to “strategic development cooperation,” transforming enterprises from “passive participants” to “active co-builders” [12]. Specific pathways include: encouraging enterprises to invest in industrial colleges in the form of equipment, capital, and technology, participating in college governance and sharing the outcomes of talent cultivation and technology research and development; supporting university-enterprise joint applications for research projects and industry-university-research platforms, jointly enjoying research outcomes and intellectual property; promoting the formation of joint research and development teams of university faculty and enterprise technical personnel, undertaking enterprise technical challenges, realizing the virtuous cycle of “educating through service, serving through education”.

Establish evaluation and feedback mechanisms for cooperation outcomes. University–enterprise cooperation should not "end with agreement signing, finish with plaque hanging," but should establish evaluation and feedback mechanisms covering the entire cooperation process. Both parties should jointly formulate cooperation objectives, phased tasks, and quality standards, regularly conduct cooperation outcome assessments, and timely identify problems and adjust strategies [17]. Assessment content should include the depth and effectiveness of enterprise participation in talent cultivation, students' learning gains in cooperation, and the actual contributions of cooperation to the development of both parties, avoiding the substitution of "process indicators" such as the number of agreements signed and activities held for "outcome evaluation".

## 6. Conclusion

This paper adopts university–local symbiosis as its core analytical framework. Through case studies of four local universities—Yichun University, Weifang University, Linyi University, and Zhejiang Wanli University—it reveals four empowering mechanisms: strategic embeddedness, dynamic program adjustment, platform development, and two–way empowerment. It also identifies five types of dilemmas—institutional environment, program development, curriculum and instruction, faculty, and depth of collaboration—and proposes corresponding breakthrough pathways.

The research shows that university–local symbiosis is not a simple upgrade of university–local cooperation, but a fundamental reconstruction of the university–region relationship. This requires local universities to transform at three levels: value, institution, and pedagogy. Specifically, they must shift from asking "what services can I provide" to "what does the region need me to become"; move from agreement–based collaboration to governance–based symbiosis; and transition from knowledge transmission to competency construction. The completion of these three transformations determines how far university–local symbiosis can go.

Looking ahead, against the background of accelerating the construction of a strong education nation, the deepening and promotion of the concept of university–local symbiosis will have a profound impact on the transformation and development of local universities. However, it is also necessary to recognize the boundaries and limitations of university–local symbiosis. Universities are educational institutions, not economic organizations. Therefore, application–oriented talent cultivation should not be narrowly reduced to job training, nor should it neglect students' holistic development, critical thinking, or lifelong learning abilities. How to maintain the relative autonomy of universities and the intrinsic value of education within university–local symbiosis is an issue that subsequent research needs to continuously focus on. In addition, how different types of regions (eastern coastal vs. central and western regions, large cities vs. small and medium–sized cities) can construct university–local symbiosis models according to local conditions remains to be answered by richer comparative studies and long–term tracking research.

## Declaration of Generative AI and AI-assisted Technologies

During the preparation of this manuscript, the authors used generative AI tools only to improve language and readability. The authors take full responsibility for the content of the manuscript.

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## Conflicts of interests

The authors declare that there are no potential conflicts of interest.

## Authors' contribution

Conceptualization, J.Y.; methodology, J.Y. and G.L.; validation, G.L.; investigation J.Y.; resources, G.L.; writing—original draft preparation, J.Y. and G.L.; writing—review and editing, J.Y. and G.L. All authors have read and agreed to the published version of the manuscript.

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