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Strategies for Enhancing the Adaptability of Skilled Talents from the Perspective of Five Party Game Theory

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Abstract

Against the backdrop of rapid industrial technological iteration and the vigorous cultivation of new quality productive forces, a persistent systemic time lag exists between the cultivation of highly skilled talents and the evolving demands of the enterprises. This disconnect manifests in acute structural contradictions, including the inability to apply learned knowledge and a significant readiness gap upon graduation. To address this core issue, this study constructs a five-party evolutionary game model encompassing schools, enterprises, students, parents, and the government. The analysis reveals that the current dilemma in career adaptability stems from the system being trapped in a low-level Nash equilibrium, characterized by misaligned incentives among stakeholders. To break this suboptimal equilibrium, we propose an incentive-compatible four-dimensional governance framework. This framework necessitates precise institutional supply and risk-sharing mechanisms from the government, efficient channels for transmitting industrial demand signals, the empowerment of schools, students, and parents as active co-creators, and the development of a digital twin-supported training ecosystem to reduce adaptive cultivation costs. By systematically recalibrating the payoff functions within the five-party game, this framework aims to shift the system from a vicious cycle of mutual constraint toward a virtuous cycle of synergistic co-governance.

Keywords

Highly Skilled Talents; Career Adaptability; Five-Party Evolutionary Game; Incentive Compatibility

1. Introduction

The current landscape of high-skilled talent in China is characterized by a dual challenge: a significant quantitative shortfall coexists with a profound qualitative divide. Data from the Ministry of Education's Manufacturing Talent Development

Guidelines projects a deficit exceeding 30 million professionals in ten key manufacturing sectors by 2025, while less than 35% of the new workforce is equipped with adequate career adaptability.[1] Compounding this issue, a Zhaopin 2023 Report on Talent in Industrial Transition found that 68.7% of enterprises report newly hired high-skilled talents require over six months of on-the-job retraining to achieve competency, with insufficient adaptability directly inflating corporate labor costs.[2]

Career adaptability, defined as an individual's comprehensive preparedness for occupational transitions and role changes encompassing skill transfer, psychological adjustment, and environmental cognition, is thus critical.[3] Prevailing research, however, remains narrowly focused on tripartite school-enterprise-student collaboration, overlooking two pivotal forces: the leveraging role of government policy tools and the transmission mechanism of family capital investment. While Li C et al. (2025) developed a valuable tripartite evolutionary game model in the IoT context, it does not fully address the core "learning-application gap"–the chasm between students' academic, procedural knowledge and the unstructured problem-solving required in authentic professional settings.[4] More critically, parents, as key educational investors, influence student engagement through their risk-benefit assessments of industry-education initiatives, with their informational gaps and biases potentially distorting career pathways. Simultaneously, government, as regulator and resource allocator, shapes the entire ecosystem through the precision and enforcement of its policies, where a current emphasis on program initiation over sustained management presents a further constraint. Omitting these actors creates a substantial "explanatory deficit" in existing models.[5]

To bridge this gap, this study expands the analytical framework to a five-party dynamic evolutionary game model, incorporating Schools (S), Enterprises (E), Students (T), Parents (F), and Government (G). By integrating the critical dimensions of parental social capital and policy intervention intensity into the foundational school-enterprise-student dynamic, this model more accurately reflects real-world interactions. It aims to elucidate the equilibrium conditions and evolutionary pathways of this five-party system, thereby offering targeted institutional design solutions to resolve the enduring learning-application disconnect.

2. Analysis of Occupational Adaptability Issues

2.1. Characteristics and causes of the disconnect between learning and application in occupational adaptability

The fundamental obstacle is the time lag contradiction between skill acquisition and job requirements. Hujiang J et.al(2022) pointed out that vocational education courses lag behind industry demand, while the speed of technological iteration has been shortened to 18 months. This contradiction has led to the partial elimination of

students' hard skills such as operating specific equipment upon entry. More seriously, the "soft skills" urgently needed by enterprises, such as cross departmental collaboration and fault diagnosis thinking, are seriously lacking in the training system.[6] Shuai W(2014) conducted a follow-up study on 52 gold medalists in skill competitions and found that only 38.5% of them adapted to their positions within 3 months. The main reasons for their inability to adapt to their positions include lacking a sense of real production rhythm and non-standard work processing ability.[7]

Institutional barriers exacerbate the fragmentation of transformation. The policy of integrating industry and education has the problem of overemphasizing contract signing and neglecting performance. The intellectual property protection system is not perfect, and companies are concerned about the leakage of core technologies and provide decentralized internship content. The lack of a mechanism to protect students' rights and interests, lower internship salaries compared to regular employees, and frequent disputes over work-related injury compensation have led students to view internships as a formality rather than a learning field. Due to a lack of professional knowledge, parents generally have a bias of "emphasizing education over skills", forcing their children to choose "seemingly respectable" majors rather than "adaptable" ones.

2.2. Analysis of Five Party Game Factors

1. Diversification and Conflict of Interest Demands

The five parties in the game have their own interests and demands, and the core demand of enterprises is economic rationality. They pursue stable talent supply, technical cooperation, and conversion benefits that meet job requirements through cooperation, while striving to control training costs, technology leakage risks, and talent loss losses.

Under the goals and resource constraints of public welfare education, schools seek to improve employment rates, obtain policy resources and reputation, while balancing teaching laws with short-term needs of enterprises, facing resource investment costs and assessment pressures.

Students pursue personal human capital appreciation, which means obtaining tangible skill enhancement and high-quality employment opportunities through participation, while paying attention to the direct costs and rights protection of time, energy, and other resources in the learning and practical process.

As co investors and risk bearers in education, parents have dual demands: firstly, they hope their children can obtain decent employment and good development through education; The second is to pay close attention to the direct economic and opportunity costs of education investment such as tuition fees and living expenses, and have extremely high requirements for the quality, safety, and certainty of school enterprise cooperation. Parents' "wait-and-see" or "no support" strategies will

significantly increase the psychological cost and resistance for students to choose "active participation".

The government, representing the public interest, has the core goal of promoting industrial upgrading, stabilizing employment, and improving the quality of human resources. Its appeal is to stimulate market and social vitality with minimal public costs through effective policy tools, correct market failures such as insufficient investment and uneven training quality in school enterprise cooperation, and promote the adaptation of talent cultivation to industrial demand. The government's strategy of choosing between active interventions such as precise policy implementation and negative interventions such as formal regulation or laissez faire constitutes a key exogenous rule for the evolution of the system.

2. The amplification effect of institutional defects and information asymmetry

The integration of industry and education involves multiple supervisory departments, and policies from education, human resources and social security, industry and information technology, and other departments lack coordination, leading to confusion or cancellation of incentive signals. The government's subsidies to enterprises and evaluations of schools suffer from the problem of "heavy declaration, light process, and difficult verification", which reduces policy effectiveness and increases the strategic coping space for all parties involved in the game.

In the process of school enterprise collaborative education, enterprises lack effective social sharing mechanisms for risks such as technology leakage, production safety, and student accidental injuries. Parents have concerns about the safety and protection of their children's rights during internships, and these risk concerns can turn into opposition or lack of support in the absence of institutional safeguards.

Industry technology trends, job competency standards, talent development quality, corporate cooperation reputation, student internship performance, and other information are scattered among the five parties, and there is a lack of authoritative and transparent sharing platforms. This leads to lagging school education, difficulties in selecting talents for enterprises, blind choices between students and parents, and insufficient government decision-making basis, exacerbating mutual distrust and short-term behavior.

2.3. Theoretical Framework of Five Party Game Theory

The tripartite model proposed by Li C et al. reveals that net profit of enterprises is the key to cooperation[4], but it does not solve two major problems: first, how the government can design effective incentive compatibility mechanisms to avoid "subsidy dependence"; The second is how parental heterogeneity affects students' strategic choices. This model takes the government as the rule maker, and its strategic choices directly change the revenue matrix of other parties; Using parents as capital suppliers, their investment level is regulated through the "expectation

support" mechanism to adjust the cost function of students.

The five party game presents a dual nested structure: the core is the skill supply and demand cooperation game between school and enterprise students, and the outer layer is the regulatory game of the government and the resource input game of parents. The outer game determines the equilibrium efficiency of the core game by changing cost, benefit, and risk parameters. When government regulation is lacking, companies can implement "strategic cooperation", and even if parents invest heavily, students still face the trap of "low-quality internships".

3. Construction of Five Party Evolutionary Game Model

3.1. Game Subject and Strategy Space

Within the complex ecosystem for cultivating high-skilled talent, beyond the three core actors—schools, enterprises, and students—two additional key stakeholders exert decisive influence: the government and parents. Their decisions critically shape the direction and efficiency of the system's evolution. A complete analytical model must therefore encompass these five parties and their respective strategic choices:

The strategic space of school (S) includes deep cooperation (S1) or formal cooperation (S2). Deep cooperation refers to investing resources to dynamically optimize the curriculum system, sharing scientific research achievements, and promoting teachers to deepen their practical experience in enterprises; Formal cooperation aims to meet administrative assessment indicators, such as the number of contracted cooperative enterprises and the construction of training bases, with the cooperation content floating on the surface.

The strategic space of enterprise (E) includes active participation (E1) or passive response (E2). Active participation means investing in advanced equipment, dispatching senior technical mentors, and providing real project research and development positions to participate in the entire process of educating people; Negative coping is manifested as providing only basic and observational internship positions, viewing students as cheap labor or a burden.

The strategic space for students includes active participation (T1) or passive coping (T2). Active participation is manifested as actively engaging in practical learning, actively improving interdisciplinary skills, and seeking innovative challenges; Passive coping is limited to completing the minimum requirements of courses and internships, with the primary goal of obtaining a diploma.

The government's strategic space includes active guidance and regulation (G1) or laissez faire or formal support (G2). Actively guiding and regulating refers to formulating precise fiscal and tax incentive policies, establishing a quality evaluation and supervision system for the integration of industry and education, and building a public service platform; Indulgence or formal support is manifested as providing universal but indiscriminate subsidies, lacking effective process supervision and

effectiveness evaluation.

The strategic space for parents includes actively support and invest (F1) or conservatively observe or question (F2). Active support is manifested in identifying with the path of skill development, encouraging children to participate in corporate practice, and possibly investing economically and mentally in extracurricular skill training; Conservative observation is influenced by traditional educational concepts, resulting in a low evaluation of vocational education and a tendency for children to pursue a general education path. There is a skeptical attitude towards deep school enterprise cooperation.

Based on the above settings, design the following profit function:

Enterprise revenue=technology transfer revenue (R_{e1})+talent reserve revenue (R_{e2})+policy incentive revenue (R_{e3}) - cooperation cost (C_e) - technology and management risk cost (C_{er})

School revenue=policy subsidies and project funding (R_{s1})+employment rate and social reputation improvement (R_{s2})+teaching quality and research ability improvement (R_{s3}) - resource investment cost (C_s) - coordination and reform risk cost (C_{sr})

Student benefits=salary premium brought by skill improvement (R_{t1})+high-quality career development opportunities (R_{t2})+personal sense of achievement (R_{t3}) - time and energy costs (C_t) - economic and opportunity costs (C_{te})

Government revenue=industrial competitiveness and economic growth (R_{g1})+social employment stability and improvement of people's livelihood (R_{g2})+improvement of human resource supply quality (R_{g3}) - fiscal expenditure cost (C_g) - policy formulation and regulatory implementation cost (C_{gr})

Parental benefits=Expected career development benefits for children (R_{f1})+Education investment return and family honor (R_{f2}) - Direct economic investment (C_f) - Psychological and opportunity risk perception costs (C_{fr})

3.2. Analysis of Five Party Dynamic Evolutionary Game Theory

Based on the assumption of bounded rationality, the five groups of schools, businesses, students, parents, and government are unable to grasp all information and make globally optimal decisions in the initial stage. Instead, they gradually adjust their strategies through trial and error, learning, and imitation. The replicative dynamic equation in evolutionary game theory is the core tool for describing the evolutionary trend of this group strategy. The basic logic is that in a group, strategies that achieve higher than average returns will be adopted by more individuals, and the growth rate of the proportion of this strategy is proportional to its relative benefit advantage.

The following will construct five replicative dynamic equations and analyze their dynamic evolution logic.

1. The Evolution of Corporate Strategy

If the proportion of enterprises in the group that choose the "active participation" (E1) strategy is x (0≤x≤1), then the proportion that chooses the "negative response" (E2) strategy is 1-x. The difference between the expected return of enterprises choosing the E1 strategy and the average return of the group determines the rate of change of x, that is, the replication dynamic equation F (x):

$$F(x) = \frac{dx}{dt} = x(1-x)[U(E1) - U(E2)] \quad (1)$$

Among them, U (E1) and U (E2) represent the expected returns for enterprises to actively participate and passively respond, respectively. Combining the five party return function, the expected return difference can be concretized as:

$$F(x) = x(1-x)\left[\left(R_{e1} + R_{e2} + R_{e3} - C_e - C_{er}\right) - \left(-C_{er}^{'}\right)\right] \quad (2)$$

The degree of realization of the benefits of technological achievement transformation R_{e1} and talent reserve R_{e2} depends on whether the school cooperates deeply (with a probability of y) and whether students actively participate (with a probability of z). Deep cooperation between schools can provide more valuable scientific research results and more cooperative teaching staff, and students' active participation can generate higher talent reserve value.

The policy incentive R_{e3} directly depends on whether the government actively guides (assuming a probability of w), and the intensity is G_{subidy}. The risk cost C_{er} is related to students' passive coping (with a probability of 1-z) and parents' lack of support (with a probability of 1-v). Students passively increase management risks, and parents do not support increasing the risk of student turnover, thereby weakening the willingness of enterprises to cultivate. Therefore, the simplified replication dynamic equation can be expressed as:

$$F(x) = x(1-x)\left[yz\alpha(R_{e1} + R_{e2}) + w \cdot G_{subsidy} - C_e - (1 - z + v)\beta\right] \quad (3)$$

Among them, α and β are the influence coefficients.

When the net income difference is positive, F(x)>0, the proportion of enterprises choosing E1 strategy x will increase. This means that only when schools cooperate deeply (y increases), students actively participate (z increases), the government provides sufficient incentives ($w \times G_{subidy}$ increases), and parents support (v increases), can the net benefits of enterprise participation in cooperation significantly exceed the costs and risks it bears, thereby driving its strategy to evolve towards "active participation".

2. The Evolution of School Strategy

The proportion of schools choosing the "Deep Collaboration" (S1) strategy is y, and its replication dynamic equation is:

$$F(y) = \frac{dy}{dt} = y(1-y)[U(S1) - U(S2)] \quad (4)$$

The net profit advantage of choosing S1 for schools depends on the active participation of enterprises (increasing x), which can bring better practical resources and technical feedback, improve teaching quality and research capabilities R_{s3}, and reduce the cost of resource investment C_s. Active participation of students (increasing z) can significantly improve teaching effectiveness and

employment quality R_{s2}. The government actively guides (w increases) the provision of special funds Rs1 and institutional guarantees to reduce reform risks C_{sr}. Parental support (1-v large) can improve the quality and reputation of student sources, and consolidate R_{s2}. The replication dynamic equation can be simplified as:

$$F(y) = y(1-y)\left[xz \cdot \gamma R_{s3} + w \cdot G_{grant} - C_s - (1-x)\delta\right] \quad (5)$$

Among them, γ and δ are the influence coefficients.

The premise for schools to lean towards deep cooperation is that it can bring long-term benefits and external resource support. The former relies on active interaction between enterprises and students, while the latter relies on the government, which can cover its high reform investment costs and outperform the low benefits brought by formal cooperation.

3. The Evolution of Student Strategies

The proportion of students choosing the "active participation" (T1) strategy is z, and the replicative dynamic equation is:

$$F(z) = \frac{dz}{dt} = z(1-z)[U(T1) - U(T2)] \quad (6)$$

The motivation for students to choose T1 is that companies providing high-quality internships and projects (x increases) is the foundation for obtaining skill premiums $R_{t1}$and career opportunities R_{t2}. Providing cutting-edge and practical courses (y increases) in schools is the key to improving learning efficiency and reducing ineffective costs (C_t). The government's establishment of an open and transparent employment and certification platform (w increase) can enhance the market recognition of skills and ensure the realization of R_{t1}. Parents providing economic and psychological support (1-v large) can directly reduce their economic and opportunity costs C_{te} and psychological costs. The replication dynamic equation can be simplified as:

$$F(z) = z(1-z)\left[xy \cdot \eta(R_{t1} + R_{t2}) + w \cdot G_{platform} - C_t - v \cdot \lambda\right] \quad (7)$$

Among them, η and λ are the influence coefficients.

When students perceive that the learning content provided by schools and enterprises as the supply side of education has high market value, and the government and parents can provide strong support and guarantee, the expected return of their active investment is the greatest, and the strategy will evolve towards T1.

4. The Evolution of Parental Strategies

The proportion of parents choosing the "positive support" (F1) strategy is v, and the evolution of this strategy depends on the balance between investment returns and risks in education. The net benefit advantage of the support strategy is reflected in the fact that when the enterprise, school, and students form a virtuous cycle (x, y, z all increase), the probability of children obtaining high-quality development R_{f1} is the highest. The government actively builds a favorable environment (increasing w), such as improving the social status of skilled talents and safeguarding internship rights, which can greatly reduce the risk perception cost Cfr for parents. The

replication dynamic equation can be simplified as:

$$F(v) = \frac{dv}{dt} = v(1-v)\left[-(xyz \cdot \mu R_{f1} + w \cdot G_{security} - C_f)\right] \quad (8)$$

Among them, μ is the influence coefficient.

Parental support is essentially a function of confidence. When observing that the entire system composed of the actions of enterprises, schools, governments, and ultimately student output can provide clear, reliable, and dignified career futures for children, their willingness to support will increase, and the strategy will evolve towards F1.

5. The Evolution of Government Strategy

The proportion of the government choosing the "active guidance and regulation" (G1) strategy is w, and its replication dynamic equation is:

$$F(w) = \frac{dw}{dt} = w(1-w)[U(G1) - U(G2)] \quad (9)$$

The net benefit of the government's choice of G1 strategy lies in the realization of the total social welfare R_{g1}, R_{g2}, R_{g3}. it brings, which highly depends on the response of micro entities. When enterprises, schools, students, and parents all tend to actively cooperate (x, y, z, v all increase), government policy intervention can produce significant effects and bring high social benefits. On the contrary, if other entities respond coldly, the government's huge fiscal expenditures C_g and administrative costs C_{gr} will be wasted, resulting in low policy effectiveness. The replication dynamic equation can be simplified as:

$$F(w) = w(1-w)\left[\theta(x,y,z,u) \cdot (B_g) - C_g - C_{gr}\right] \quad (10)$$

Among them, θ (x,y,z,u) is an increasing function about other four party strategies, representing the effectiveness coefficient of policy intervention.

The government's strategic choices have macro feedback. It is not simply actively exerting pressure, but dynamically adjusting based on the synergistic effects stimulated by policy tools in other four parties. Only when active intervention can effectively leverage and integrate resources from all parties, will this strategy be continuously strengthened.

The above five replicated dynamic equations form a coupled nonlinear system. The Evolutionary Stability Strategy (ESS) of a system is the solution where all five equations are simultaneously zero. Analysis shows that the system may have multiple equilibrium points, among which the most typical are two opposing equilibria:

When locking equilibrium at a low level, x=0, y=0, z=0, u=0, w=0 or similar low value combinations. In this equilibrium, all parties adopt negative strategies and fall into a vicious cycle of "enterprises unwilling to invest, schools unwilling to change, students unwilling to learn, parents not optimistic, and the government difficult to act", resulting in a serious disconnect between talent cultivation and career needs.

When achieving high-level collaborative equilibrium, x=1, y=1, z=1, u=1, w=1, or similar high-value combinations. This is an ideal equilibrium state, where the five parties form a positive interaction and work together to enhance the professional adaptability of talents.

4. Systemic Countermeasures for Enhancing the Career Adaptability of High-Skilled Talents: Insights from the Five-Party Game Model

Based on the analysis of the five-party evolutionary game model, the fundamental cause of the occupational adaptability dilemma stems from the current institutional framework trapping schools, enterprises, students, parents, and the government in a low-level equilibrium characterized by misaligned incentives. Isolated or fragmented policy adjustments are insufficient to disrupt this stable but suboptimal state. Therefore, the core of an effective enhancement strategy must involve systemic intervention. This entails designing a coherent set of institutional measures that synchronously recalibrate the payoff matrix for all five parties. By doing so, the interventions guide the strategic choices of each actor toward coordinated evolution, ultimately steering the entire ecosystem toward a new, high-level coordinated equilibrium.

4.1. Strengthen government governance and implement precise and leveraged institutional supply

Government must transition from a passive funder to an active system architect, deploying targeted policies that reshape the incentive structure for all other actors.

A new system of performance-contingent incentives should be established, akin to a procurement model for educational outcomes. For enterprises, tax incentives and special rewards must be rigorously tied to verifiable and auditable Key Performance Indicators, such as the post-internship retention rate of talent and the proportion of internships involving core technical tasks. For schools, the allocation of per-student funding and professional development grants should significantly increase the weighting of graduate employment quality metrics，like starting salary, job-placement rate in relevant fields and employer satisfaction. This reform directly increases the expected policy incentive benefit R_{e3} in the enterprise's payoff function and the policy-derived funding R_{s1} in the school's payoff function. Crucially, it ensures these financial benefits are tightly aligned with the overarching social goals of cultivating adaptive talent (R_{g1}, R_{g2}). Concurrently, it transforms policy expenditure C_g from a fixed cost into a strategic investment, thereby enhancing fiscal efficiency.

Establishing a Socialized Risk-Sharing Mechanism: To lower the perceived risks of deep collaboration, a state-led initiative should establish an "Industry-Education Integration Risk Compensation Fund" and a unified "Internship Liability Insurance" platform in collaboration with industry associations and insurers. The fund would cover enterprise-specific risks, such as non-egregious intellectual property leakage or abnormal equipment wear and tear attributable to interns. The insurance would provide coverage for student injuries and liability incidents during internships. This mechanism directly and significantly reduces the risk cost C_{er} in the enterprise's

payoff function and the coordination risk cost C_{sr} for schools. It addresses the core deterrents for enterprises—the fear of exposing proprietary processes—and for schools—concerns over student safety—effectively removing a major barrier to substantive cooperation.

Creating a Unified National Skills Credentialing Framework: A nationally recognized, industry-led credentialing system is essential. Leading enterprises and authoritative industry associations should be empowered to develop and certify micro-credentials and skill-module certificates that correspond to cutting-edge technological competencies. These credentials must be integrated into a National Credit Bank system. This creates a clear, authoritative, and portable "currency" for the skill premiumR_{t1}in the student's payoff function, thereby enhancing the expected return on active learning (T1). For enterprises, it provides a standardized, reliable signal for talent screening, reducing selection costs and increasing the certainty and quality of talent reserve benefits R_{e2}.

4.2. Smooth information transmission mechanism, solve the dilemma of information asymmetry

Information lag and distortion are primary drivers of strategic mismatch. Building an agile, demand-sensitive information network is critical to aligning expectations and decisions.

Developing an Industrial Talent Demand Intelligence Platform: An "Industrial Talent Demand Big Data Early-Warning and Public Service Platform" should be established. This platform would integrate and analyze data from multiple sources—human resources, industry, statistics, and anonymized data from major recruitment platforms and corporate social security records. Leveraging big data and AI, the platform would generate and publish real-time analytical products, such as regional/industry skill demand heatmaps, dynamic job competency standards, and early-warning system for talent surplus/shortage. By making this platform openly accessible to all schools, students, and parents, it provides a data-driven foundation for school strategy and professional program adjustment, reducing blind decision-making and its associated risks C_{sr}. For students and parents, it delivers transparent labor market intelligence, lowering perceived risk (C_{fr}, C_{te}) and enabling more informed educational investment decisions.

Institutionalizing Standardized Internship Contracts: A nationally standardized internship contract must be promoted and mandated. This contract would unambiguously specify the training position's scope, mentor qualifications, structured training plan, remuneration and benefits, and a clear pathway and priority for post-internship retention. It would also delineate the obligations of both the student and the school. These contracts should be filed with and monitored by local human resources departments. By creating a binding legal instrument, this contract effectively "locks in" the future career opportunity benefit R_{t2} for the student and

the future talent reserve benefit R_{e2} for the enterprise ex-ante. It establishes a framework for a stable, long-term game relationship by significantly raising the cost of unilateral defection or low-quality fulfillment by any party, thereby incentivizing proactive cooperative strategies.

4.3. Reconstructing Core Stakeholder Roles: Transitioning from "Passive Recipients" to "Active Co-creators"

This approach aims to unlock the endogenous motivation of schools, students, and parents, fundamentally shifting their position from being relatively weak or passive actors to empowered participants in the ecosystem.

First, it is essential to empower vocational schools as regional hubs for industry-education integration. This can be achieved by supporting high-quality vocational institutions and leading enterprises in co-establishing legally independent industrial colleges. These colleges should be granted greater autonomy in program development, faculty recruitment, and revenue distribution. The establishment of such a corporatized entity with a shared benefit mechanism intrinsically aligns a portion of the school's developmental gains R_{s3} with the enterprise's long-term success. This structural innovation moves beyond superficial collaboration, directly addressing the root cause of the "schools-eager, enterprises-reluctant" dilemma by making deep cooperation a matter of institutional self-interest rather than merely an administrative compliance task.

Second, a dual mechanism of documentation and feedback must be implemented to enforce accountability. A nationally recognized Lifelong Digital Skills Portfolio for each student should comprehensively record all formal and informal learning achievements. Concurrently, a robust Course and Internship Quality Evaluation and Feedback Mechanism should be institutionalized. This system would treat structured feedback from students and graduates as key performance indicators for assessing schools and their partner enterprises, with relevant metrics appropriately disclosed to future employers. This transformation repositions students and parents as informed front-end selectors and ongoing process supervisors, rather than passive end-point recipients. Student dissatisfaction, which directly impacts their perceived skill payoff R_{t1}, creates a transparent feedback loop that affects institutional reputation R_{s2} and corporate brand, thereby forming a powerful market-driven mechanism to compel the supply side to continuously enhance quality.

4.4. Building a Digital Twin-Supported Ecosystem to Reduce the Marginal Cost of Adaptive Cultivation

This approach advocates for leveraging digital technologies to dismantle resource barriers and establish a low-cost, high-fidelity, and replicable environment for adaptive training.

First, the construction of a National Virtual Simulation Training Resource Repository

and Cloud Platform is essential. This initiative would target sectors where training is constrained by exceptionally high physical requirements, safety risks, or proprietary restrictions, such as advanced equipment manufacturing, hazardous operations, and precision processes. Through state-led collaboration with industry leaders, a suite of national-level virtual simulation teaching modules should be developed. Utilizing 5G, VR, and AR technologies, these modules would enable students to conduct immersive, interactive training within highly realistic digital replicas of industrial environments. This strategy delivers dual benefits: it drastically reduces the infrastructure costs C_s for schools to build high-end training facilities, while allowing enterprises to expose students to cutting-edge production workflows without compromising core technical secrets, thereby significantly lowering perceived risk costs C_{er}. This creates a foundational trust and technological basis for deeper school-enterprise collaboration. Concurrently, fostering Cross-Organizational Knowledge Co-Creation Communities is crucial. Encouraging enterprise experts, educators, and high-achieving students to collaborate on online platforms can facilitate the discussion of specific technical challenges, process optimizations, and case studies. These interactions should be channeled into developing dynamically updated resources, such as modular handbooks and open-source skill manuals. This process promotes the codification of tacit industrial knowledge into explicit teaching materials, continuously enhancing teaching quality $R_{s3}$and the market relevance of acquired skills R_{t1}. Furthermore, this sustained collaboration fosters a shared culture between academia and industry, reducing coordination costs C_{sr} and C_{er}arising from organizational differences and shifting cooperation from isolated projects toward a sustainable, integrated ecosystem.

5. Conclusion

This study constructs a dynamic five-party evolutionary game model to address the pronounced issue of the "theory-practice gap" and inadequate career adaptability in China's current cultivation of high-skilled talents. By examining the dynamic strategic equilibrium among the five stakeholders in the skill-transformation process, it elucidates the underlying causes of low occupational adaptability among such talents. The analysis reveals that the system is trapped in a low-level Nash equilibrium resulting from the strategic interactions of multiple interest groups within an institutional environment characterized by misaligned incentives, information asymmetry, and unshared risks. In response, the study proposes a targeted four-dimensional governance framework based on the principle of incentive compatibility, offering both a theoretical foundation and a systematic pathway for resolving the structural mismatch between talent cultivation and occupational demands.

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