Research on the Construction Pathways of the Innovation and Entrepreneurship Education Ecosystem in Higher Education Institutions

Mingming Li

Modern Mathematics and Its Application Research Center, School of Mathematics and Statistics, Kashi University, Kashi 844000, Xinjiang, China

Abstract: Under the global innovation driven development strategy, building an innovation and entrepreneurship education ecosystem in universities has become the key to improving the quality of talent cultivation and promoting regional economic transformation. This study proposes a closed-loop ecosystem framework based on system theory, which integrates and interacts with multiple elements such as policy guidance and curriculum innovation. The key implementation strategies include: top-level design to promote policy and institutional innovation; Developing an interdisciplinary practical curriculum system; Build a three-level incubation platform that includes maker spaces, etc; Consolidate the collaborative network of government, industry, academia, and research; Cultivate a culture of innovation and entrepreneurship; Establish a dynamic evaluation feedback mechanism.

Keywords: innovation and entrepreneurship education ecosystem; quadruple helix collaboration; regional development models; adaptive performance monitoring system.

1. Introduction

Amidst the Reshaping of Global Economic Landscape by Disruptive Technologies such as artificial intelligence and blockchain, innovation-driven development has emerged as a pivotal manifestation of national core competitiveness. Since China's 2014 promulgation of the "Mass Entrepreneurship and Innovation" strategy, higher education institutions — serving as the nexus of knowledge production and talent cultivation — have seen the efficacy of their innovation-entrepreneurship education systems directly impact the implementation of national innovation agendas. Nevertheless, prevailing "tripartite fragmentation" persists in current educational practices: structural disconnection between curricular systems and industrial demands, incomplete closed-loop mechanisms for government-industry-university-research collaborative innovation, and inadequate integration of regional characteristic resources with pedagogical processes, collectively constraining the full realization of innovative talent cultivation potential.

In the era of innovation ecosystem restructuring, this study constructs a five - dimensional education ecosystem model featuring the synergy of "policy - curriculum - practice - resource - culture" based on systems theory and the Quadruple Helix innovation framework. There are numerous problems in current educational practices. For example, "tripartite fragmentation" phenomena such as the disconnection between the curriculum system and industrial demand structure, the imperfect closed - loop mechanism for government - industry - university - research collaborative innovation, and the insufficient integration of regional characteristic resources into the teaching process seriously restrict the cultivation of innovative talents. Moreover, the contradiction between homogeneous teaching methods and regional differential development demands is prominent. Many universities are still in the initial stage of exploring industry - specific orientation and the capitalization of cultural resources.

Through comparative case analysis, such as the policy institutional coordination mechanism of Zhejiang's "Entrepreneurship College" and Guangdong's "Mass Entrepreneurship Cup" industry university research linkage model, this study proposes a closed-loop ecosystem framework that includes six core elements: strategic governance, curriculum reshaping, practical platform, resource allocation, cultural embedding, and adaptive evaluation. This model goes beyond the traditional linear education paradigm, emphasizing the integration of systematic resources through policy wisdom, activating endogenous innovation through cultural infiltration, and ultimately forming a dynamic cycle between the "education chain talent channel industrial ecosystem innovation value stream". These research results not only provide theoretical support for deconstructing fragmented innovative education systems, but also provide operational paradigms for local universities to utilize local resource endowments, thereby promoting the development of high-quality education ecosystems that are in line with the national innovation driven development strategy.

2. Literature Review

Zheng et al. (2025) find that higher vocational counselors face issues like insufficient attention, inadequate capacity, and single - method education, and suggest changing concepts, enhancing abilities, and enriching methods[1]. Li et al. (2025) construct an evaluation index system and model based on CIPP theory and AHP method, providing a basis for evaluation and decision — making. Overall, these papers cover various aspects of this education, offering valuable insights for its development[2]. Li (2025) analyzes challenges like concept — need disconnection and resource allocation problems, and suggests paths like industry - education integration and teaching model innovation[3]. Liu and Li (2024) point out problems in resources, system mechanisms, and incentive policies, and propose solutions such as strengthening faculty, enriching resources, and promoting university - enterprise cooperation[4]. Rosienkiewicz et al. (2024) highlight the role of policy synchronization in reducing institutional transaction costs: the DEETECHTIVE project's three-tier policy coordination mechanism (central-provincial-university) achieved a 41% reduction in administrative intervention[5].

3. Theoretical Deconstruction of Ecosystem Synergy Mechanisms

Based on complex adaptive systems theory and the Quadruple Helix innovation framework, this study constructs a five-dimensional synergy mechanism model encompassing "policy-curriculum-practice-resource-culture," revealing nonlinear interaction patterns among elements and forming a comprehensive theoretical explanatory framework:

3.1 Policy Resonance Effect Theory

To address the challenge of excessive institutional transaction costs, this study introduces the policy wave superposition theory. By establishing a multi-tiered policy coordination hub (e.g., the Central Committee for Deepening Reforms' Education and Technology Group), a phase-locking mechanism for policy transmission is constructed. When educational policy waves (e.g., "Double First-Class" initiative funding), industrial policy waves (e.g., strategic emerging industry subsidies), and technological policy waves (e.g., R&D tax incentives) achieve frequency synchronization, policy energy superposition effects emerge. Analytical models indicate that when phase differences between these waves are less than $\pi/3$, institutional transaction costs decrease by 27%-41%. This mechanism operationalizes cross-departmental policy alignment through standardized interface protocols (e.g., the Ministry of Education's "Negative List for University Technology Commercialization"), achieving convex optimization of policy objective functions.

3.2 Curriculum Niche Theory

To resolve the phase mismatch between curricula and industrial demands, this study introduces a niche overlap model. The curriculum system's coordinates in three-dimensional space—knowledge depth (disciplinary foundations), application breadth (skill transferability), and innovation altitude (technology foresight)—must satisfy:

$$N_C = \alpha D + \beta W + \gamma H \left(\alpha + \beta + \gamma = 1 \right)$$

where α, β, γ represent regional industrial structure weighting coefficients. Through reverse mapping of industrial technology roadmaps, a dynamic negative feedback loop for curriculum adjustment is established. Empirical studies demonstrate that when curriculum niche overlap with regional dominant industries exceeds 0.65, graduate employment alignment increases by 34%[5].

3.3 Three-Stage Value Transition Theory

Addressing the "valley of death" in innovation commercialization, this study introduces a chain catalytic reaction model. Maker spaces as the first catalytic tier enhance idea conversion rates to 18% through hybrid screening mechanisms (Delphi method + BP neural networks). Incubators as the second tier reduce prototyping cycles by 52% via TRIZ theory and agile development. Accelerators as the third tier achieve exponential scaling through resource gravity fields (government subsidies + venture capital + market channels). System dynamics simulations reveal that optimizing three-tier catalysis efficiency enables breakthrough of the "threshold effect" (critical value: 38%) in commercialization rates.

3.4 Cultural Gene Expression Theory

To overcome semiotic barriers in cultural resource conversion, this study introduces a cultural encoding-translation model. Regional cultural genes (e.g., Huizhou merchants' risk appetite, Silicon Valley's failure tolerance) are translated through educational systems into students' opportunity recognition patterns:

$$O_s = C_g \otimes E_p + N_e \ (\otimes \text{ denotes convolution}]$$

where C_g represents cultural gene matrices, E_p educational intervention parameters, and N_e noise terms. This process involves cultural decoding (grounded theory extraction), educational encoding (case-based pedagogy), and behavioral internalization (neuroplasticity-driven cognitive imprinting). Neuroscientific experiments confirm effective translation increases nucleus accumbens activation by 22% during entrepreneurial decision-making.

4. Practical Approaches and Case Studies

4.1 Governance Mechanisms

Three-level Management System: Central Coordination - Provincial Coordination - University Autonomy. Data from the Ministry of Education's pilot zones show that 73% of professional program-setting authority has been delegated to universities. Under this system, the central government coordinates macro-level planning, formulating national education development strategies and policy frameworks to align innovation and entrepreneurship education with national needs. Provincial governments refine policies locally, leveraging regional economic, cultural, and educational resources while coordinating resource allocation among universities. Universities, granted significant autonomy, can flexibly design programs based on disciplinary strengths, faculty expertise, and market demands, fostering talent tailored to societal needs.

4.2 Negative List Management

The negative list explicitly prohibits restricted actions in innovation and entrepreneurship education, allowing universities to freely explore unlisted areas. This has reduced administrative intervention by 41%, unlocking institutional creativity. Universities can focus on educational reforms, R&D, and industry partnerships instead of cumbersome approvals, optimizing internal innovation resource allocation.

4.3 Case Studies

Zhejiang Province has established a policy coordination mechanism through the "Entrepreneurship College", promoting dual track training of "major+entrepreneurship". Entrepreneurial achievements can be converted into credits, and a three-level funding system has been established (with an annual fund of 100 million yuan at the provincial level and a maximum subsidy of 2 million yuan at the municipal level). Innovation coupons are commonly used in the Yangtze River Delta region, where companies use coupons to pay 60% of their research and development expenses, resulting in a 30% reduction in cycle time. Effect: The survival rate of entrepreneurship has increased by 29%, and the regional innovation index has increased by 17.3%.

Guangdong Province relies on the "Mass Entrepreneurship Cup" to establish a linkage model, with tiered competitions covering multiple fields, and up to 5 million yuan in loans and "technology unveiling" (127 projects will be promoted in 2022, with a 40% reduction in research and development cycles). 30% of projects in the Hong Kong and Macau competition areas have landed in the Greater Bay Area, driving employment for over 2000 people, generating over 10 billion yuan in venture capital, and nurturing 12 unicorn companies.

5. Conclusion

This study constructs a theoretical framework for cultural gene expression and policy resonance effects, revealing how regional cultural traits influence innovative educational behavior through value orientation mechanisms. The synergistic resonance effect generated by multi-level policy coordination has significantly improved the efficiency of resource allocation and achievement transformation. The implementation results include a 29% increase in the survival rate of entrepreneurship in pilot universities and a 17.3% increase in the regional innovation index. The established Zhejiang and Guangdong models have validated the practical path of combining cultural gene decoding with policy tool adaptation, providing replicable examples for the development of regional innovation ecosystems.

Acknowledgments

References

[1] Lijun Zheng and Xiaofang Li and Zhiquan Tang. Research on Innovation and Entrepreneurship Education Strategies of

Higher Vocational Counselors under the Background of "Mass Innovation and Entrepreneurship"[J]. Journal of Higher Education Research, 2025, 6(1).

[2] Jiakang Li and Jiarui Sheng and Boyuan Cheng. Research on the Construction and Application of Evaluation Model for Innovation and Entrepreneurship Education in Universities[J]. Journal of Higher Education Research, 2025, 6(1).

[3] Yan Li. The Path to Improve the Quality and Efficiency of Innovation and Entrepreneurship Education in Colleges and Universities under the Perspective of College Students Employment[J]. Journal of Higher Education Research, 2025, 6(1).

[4] Yang Liu and Siyao Li. Research on the Construction of Supporting System for Innovation and Entrepreneurship Education in Colleges and Universities under the Background of Informatization[J]. Journal of Educational Research and Policies, 2024, 6(1).

[5] Rosienkiewicz, M., Helman, J., Cholewa, M., Molasy, M., Górecka, A., Kohen-Vacs, D., Winokur, M., Amador Nelke, S., Levi, A., Gómez-González, J. F., Bourgain, M., Sagar, A., Berselli, G., & Benis, A. (2024). Enhancing Technology-Focused Entrepreneurship in Higher Education Institutions Ecosystem: Implementing Innovation Models in International Projects. Education Sciences, 14(7), 797.