Research on the mechanism of science-education-industry integration for cultivating innovative talents

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ABSTRACT

The integration of science, education, and industry has become a prevailing philosophy in higher education. This educational philosophy expands the talent cultivation domain of universities and aligns more closely with the growth patterns of innovative talents, making it an inevitable choice for cultivating high-level innovative talents in China. This study aims to explore the internal logic and mechanism construction path of empowering high-quality innovative talent cultivation through the integration of science, education and industry, in response to the needs of higher education reform and industrial upgrading. Through theoretical analysis and case study methods, it systematically analyzes the prominent issues currently existing in the integration of science, education, and industry, such as insufficient system design, goal misalignment, and limited coverage, revealing its historical inevitability, theoretical rationality, and practical feasibility in three aspects. The study finds that the key to achieving deep integration is to establish a motivating mechanism for multi-party collaboration, an operational mechanism for efficient resource allocation, a scientific evaluation mechanism, and a policy guarantee mechanism. This research provides a systematic solution for the reform of innovative talent cultivation models in universities, supporting the implementation of the national strategy of revitalizing the country through science and education, and offering important guidance for promoting the deep coupling of the education chain, talent chain, and industrial chain.

Keywords: *Education, Empower, Industry, Innovative talents, Integration of science, Mechanism.*

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Highlights of this paper

- Structural contradictions such as insufficient system design, deviation of training goals, and inadequate coverage of interdisciplinary resources in the practice of science, education, and industry fusion constrain the effectiveness of high-quality talent cultivation.
- The integration of science, education, and industry follows the triple logic of historical inevitability, theoretical scientificity, and practical effectiveness, the core of which lies in breaking down the barriers between science, education, and industry, and building a synergistic innovation ecology.
- The integration of science, education, and industry empowers the cultivation of high-level innovative talents through the construction of the four major mechanisms of motivation, operation, evaluation, and guarantee to realize the transformation from "mechanical coupling" to "organic symbiosis".

1. INTRODUCTION

With the deepening of a new round of technological revolution and the transformation and upgrading of industrial structures, there is an urgent need for high-quality skilled labor and innovative talents. This poses new demands on higher education's talent cultivation—both the philosophy and models of talent cultivation need reform and innovation. The report of the 20th National Congress of the Communist Party of China emphasizes the implementation of strategies for invigorating the country through science and education, strengthening the country through talent, and driving development through innovation, promoting the integration of vocational and general education, industry and education, and science and education. The concept of integrating science, education, and industry in higher education has thus been formally proposed. This is not only a re-examination of the internal relationship between education, science and technology and talents, but also a sublimation of the previous concept of "integration of science and education" and "integration of school and enterprise in running a school".

Whether it is the integration of science and education or the convergence of industry and education, the ultimate goal is the cultivation of high-level innovative talents. The dual integration of science, education, and industry expands the talent cultivation domain of universities and aligns more closely with the growth patterns of innovative talents, making it an inevitable choice for cultivating high-level innovative talents in China. Deepening the integration of science, education, and industry, as well as promoting collaborative education, is a necessary path for universities to cultivate high-quality applied talents who adapt to industrial transformation and achieve high-quality development (Wu, Wang, & Liu, 2024). Promoting the intersection of disciplines, majors, and research via "integration of science and education", optimizing resource allocation through "integration of industry and education" (Qiao, 2021) and constructing an open, collaborative platform for industry-university-research through dual integration of "science-education and industry-education" (Liu, Li, & Ding, 2021) constitute key strategies for reforming university talent cultivation paradigms.

Compared to the extensive research on the independent integration of industry and education or science and education, current research on the cultivation of innovative talents under the dual integration of science-education, and industry-education remains insufficiently deep and systematic. Most of the existing research results are analyzed from the perspective of a certain specialty, a certain teaching link or teaching elements. For example, Kong, Hu, and Chen (2024) explored the impact of the integration of science and education on the cultivation of innovative public health talents through a survey of 409 full-time public health master's students at a medical university. Zhong, Fan, and Wang (2022) analyzed the significance of teaching reform in the "Transportation Economics and Policy" course for cultivating innovative talents under the integration of science, education, and industry. Li and Liu (2023) studied the logic and paradigm of cultivating top innovative talents through the construction of innovation and entrepreneurship laboratories under the dual integration of science, education, and industry. Some scholars have taken a more macro perspective, such as Liu, Xu, and Wu (2019) who deeply contemplated the practical circumstances of the dual integration of science-education, and industry-education and explored strategies. Jia and Guo (2023) analyzed the mechanism of innovation through the integration of science, education, and industry from the perspective of field theory.

On the whole, the existing research lacks the in-depth analysis of the internal logic of enabling innovative talents through the integration of science, education and industry, as well as systematic exploration of its implementation pathways. Therefore, with a focus on cultivating high-level innovative talents as the ultimate goal of the dual integration of science, education and industry, it is imperative to delve deeply into prevailing issues, comprehensively unravel the inherent logic of empowering talent cultivation through this integration, and meticulously explore the construction of empowerment mechanisms. Such endeavors will aid in overcoming practical obstacles and facilitate the effective implementation of strategies aimed at revitalizing the country through science and education, strengthening the nation through talent and driving development through innovation.

2. DEFINITION OF BASIC CONCEPTS

2.1. Integration of Science, Education, and Industry

The integration of science, education, and industry is based on the dual integration of science-education and industry-education. "Integration of science and education" refers to the convergence of scientific research and teaching. Scientific research provides new knowledge, ideas and materials for education, promoting teachers' academic accumulation and growth, and thereby advancing professional development. It enables students to acquire innovative abilities and methods, fostering innovation and creation under the guidance and influence of scientific research. The integration of science and education is mainly reflected in the convergence of research and teaching activities within schools and the joint efforts and collaborative education between universities and external research institutions.

"Integration of industry and education" refers to the combination and mutual integration of industry and talent cultivation, where industry encompasses all sectors of social development and the national economy. It mainly involves the relationship between schools and society, reflecting the supporting and leading role of industrial development in education. At the same time, its core is to break the surface docking of traditional school-enterprise cooperation, promote the two-way cycle of integrating industrial needs into the education process and feeding educational resources to industrial development, and ultimately cultivate practical and innovative talents who meet the needs of the industry.

The dual integration of science, education, and industry transcends mere concatenation of "science-education" and "industry-education"; rather, it constitutes a systematic amalgamation of resources, needs, and capabilities within the realms of science (Research), education (Teaching), and industry (Production). This endeavor fosters a profoundly collaborative innovation ecosystem, aiming to establish an efficient, closed-loop system encompassing knowledge creation, talent nurturing, and technology application, thereby guiding the cultivation of talent (Su & Yin, 2018). Unlike traditional industry-university-research cooperation, which mostly stays at the level of "project docking", the integration of science, education and industry emphasizes the deep binding of systems, resources, goals and interests, such as building entity platforms, sharing intellectual property rights, and jointly formulating talent training programs, forcing the adjustment of scientific research direction and curriculum reform with industrial demand, and at the same time feeding industrial upgrading through scientific research results. In this way, form a closed loop of "industry raises problems - scientific research solves problems - education imparting programs". Through the innovation of talent cultivation models, students are transformed from mere recipients of knowledge to active participants in research and industrial practices. This approach cultivates their proficiency in tackling complex problems through project-based learning in real-world scenarios. From the university's perspective, the dual integration of science-education and industry-education opens avenues for nurturing innovative talents, encompassing both internal and external dimensions.

2.2. Innovative Talents

Innovative talents refer to multifaceted individuals who possess cross-boundary thinking, sustained creativity, and the ability to translate ideas into practical applications. They transcend existing knowledge boundaries, solve complex problems through technological innovation, model restructuring, or value creation, which thereby can drive industrial upgrading and societal progress. These talents not only possess specialized knowledge but also demonstrate a comprehensive suite of innovative capabilities that encompasses "cognitive breakthroughs, technological realization, and industrial implementation", rendering them a pivotal resource for national competitiveness in the knowledge economy era. The cultivation of high-level innovative talents has its specific path. At the operational level, disciplinary barriers need to be broken down. From the perspective of practical need, reconstruct their knowledge systems, enhance advanced capabilities, and foster qualities such as an adventurous spirit, social responsibility, and a sense of national belonging. This inevitably requires immersing them in complex practical scenarios, which necessitates the deep integration and synergistic empowerment of education, industry, and research.

2.3. Definition of Mechanisms

Entities consist of various components, and for these components to operate effectively, they must establish stable structural relationships and adhere to specific operational rules. This aligns with the concept of mechanisms. In essence, a mechanism pertains to the stable structural relationships and operational modalities among the constituents of an entity. Mechanisms typically comprise elements such as actors, rules, resources, dynamics, and feedback. As the complexity of an entity increases, so does the number of its constituent parts, thereby rendering the role of its mechanisms even more indispensable. In the context of fostering the cultivation of high-level innovative talents through the integration of science, education, and industry, the present scenario encompasses multiple subjects, including governments, universities, research institutions, and industries, as well as diverse aspects such as teaching, research, and production. This forms a complex system, and examining it from a mechanisms-based perspective can facilitate the successful attainment of objectives.

3. PROMINENT ISSUES IN SCIENCE-EDUCATION-INDUSTRY INTEGRATION FOR TALENT CULTIVATION

Currently, the integration of science, education, and industry to empower talent cultivation has transitioned from the conceptual level to the practical level. Various universities, leveraging their specialized characteristics and regional advantages, have actively explored this integration. Significant progress has been made in enhancing faculty quality, curriculum development, practical training models, cooperative frameworks, and mechanism construction. This marks a shift from mechanical integration to deeper, more substantive integration. However, several common issues have also emerged during this process.

3.1. Insufficient System Design, Lacking Substantive Deep Integration

The current integration of science, education, and industry is characterized by narrow scope, superficial engagement, singular forms, and poor stability. Universities, research institutions, and industries still tend to operate within their own domains, conducting research, teaching, and production activities independently. The openness and socialization of both sides are insufficient, and the complementary advantages in talent, information, knowledge, technology, intelligence, resources, and environment have not been fully explored, utilized, or leveraged. For instance, the enthusiasm of scientific research institutions and industries to participate in personnel training is not high; research institutions and industries show low enthusiasm for participating in talent cultivation; schools also lack the initiative to set up majors, curricula, and training standards based on cutting-edge scientific achievements, industry technology trends, and job competency requirements; a stable dual-qualified faculty team has not been formed; there is a disconnect between off-campus internship bases and on-campus teaching activities; the integration lacks comprehensive management systems; and the phenomenon of "each going their own way" in research and teaching activities within universities is still prevalent. The main reason for these issues is the lack of a dynamic mechanism and imperfect incentive mechanisms for the integration of science, education, and industry. Due to rational choices based on their own development and interests, the enthusiasm of industries and research institutions to participate in talent cultivation is inevitably affected. For universities, the prevailing concept and evaluation mechanism that prioritize research over teaching still dominate, which significantly dampens the enthusiasm of universities and faculty for integrating science, education, and industry.

3.2. Misaligned Objectives, A Weak Sense of Gain Among Students

The integration of science, education, and industry aims to consolidate high-quality resources from research and industry to optimize the structure and improve the quality of talent cultivation, with the fundamental goal of educating people. However, in current practices, there is a misalignment of objectives. In order to achieve "results" as soon as possible, all subjects even ignore objective conditions and possibilities, imitate and plagiarize, and lack bottom-up demand analysis and systematic supporting measures, therefore students often feel that there are many patterns, little harvest, and flashy. In addition, some projects completely deviate from the fundamental goal of integrating science, education, and industry, treat technological innovation as the ultimate goal, and are keen on joint technology breakthrough, product development, and achievement transformation between universities and enterprises. There is no timely return of scientific research to talent training, and the goal of integration does not focus on educating people, which deviates from the original intention of the policy of science and education integration and the integration of industry and education. The reason for this is the imperfect value co-creation mechanism of the integration of science, education, and industry. Various subjects have not truly understood the connotation of the integration policy and lack sufficient awareness of the importance and value of integrating science, education and industry in educating people.

3.3. Narrow Coverage, Difficult to Meet the Needs of Talent Cultivation

From the integration of science and education in first-class universities to the cooperation between schools and enterprises in vocational colleges, and to the proposal of the educational concept of "integration of vocational and general education, science and education, and industry and education," the integration of science, education and industry has become a universally applicable educational concept in higher education, aimed at cultivating innovative talents and implementing the national strategies of strengthening the country through science and education, talent and innovation-driven development. Therefore, the integration of science, education, and industry in educating people needs to target deeper levels and larger groups. However, the current integration projects have limited student coverage. Most integration projects are implemented at the college, major, or special class level, with relatively few projects at the university level. As a result, the benefits to students are limited to certain disciplines and majors, and the various high-quality resources of research institutions and industries are difficult to extend to students of different disciplines and majors in schools. In terms of cultivation levels, there are almost no projects that can cover undergraduate, master's, and doctoral students. Projects either only cultivate undergraduates without extending to graduate students, or some research projects only involve graduate students without providing opportunities for undergraduates. This, on the one hand, violates the growth pattern of innovative talents. On the other hand, it also reflects that the integration of science, education and industry in education is still only at the concept level and spontaneous stage, and has not risen to the education system of colleges and universities, which lacks effective top-level design and systematic planning.

To sum up, the difficulties in training innovative talents with integration of science, education and industry show that this work is still in its infancy. It also fully shows that it is necessary to deeply understand the internal logic of training high-quality innovative talents with integration of science, education and industry, explore the corresponding systematic design and improve the mechanism construction in order to truly achieve the expected goal.

4. THE LOGIC OF INTEGRATING SCIENCE, EDUCATION, AND INDUSTRY TO EMPOWER THE CULTIVATION OF HIGH-QUALITY INNOVATIVE TALENTS

Logic refers to the objective laws that govern the development and transformation of things. These laws determine the direction and outcomes of changes and reflect the inevitable causal relationships within things. Clarifying the logic behind the integration of science, education and industry to empower the cultivation of high-quality talents is essential for guiding and effectively advancing this process to achieve the desired results.

4.1. Historical Logic

From a historical perspective, the current cultivation of high-level innovative talents requires the empowerment of integrating science, education and industry. The evolution from the previous emphasis on both science and education and the collaborative education between schools and enterprises to the proposal of the concept of integrating science, education and industry represents both a deepening of understanding and a response to real-world challenges. From 1978 to the present, from the Special Class for the Gifted Young of the University of Science and Technology of China to the "National Liberal Arts and Sciences Base Construction" and then to the implementation of the Experimental Plan for Cultivating Top Students 1.0 and 2.0, in the cultivation of high-level innovative talents, we have actively aligned ourselves with world-class standards while fully basing ourselves on the existing national conditions, continuously proposing new concepts, exploring new models, and summarizing new experiences. Currently, China is facing the deepening advancement of the fourth technological revolution and the transformation and upgrading of its industrial structure, creating an urgent demand for high-quality innovative talents. However, universities, as the main battlefield for talent cultivation, remain relatively closed, and the students they cultivate are disconnected from the needs of industrial development. On the one hand, industrial development lacks the support of high-quality talents. On the other hand, students also face difficulties in employment. Especially in the face of the technological blockade of Western powers, the situation seems even more challenging. The concept of integrating science-education-industry for education is based on previous experiences in cultivating high-level innovative talents, directly addressing real needs, to reconsider the internal logic between education, science and talents, breaking the block of university talent cultivation, and fully unleashing the combined role of research and industry in the cultivation of high-level innovative talents. This is a historical choice and the necessary path for cultivating high-level applied talents under the current circumstances. This historical logic requires that we should be guided by the concept of integrating science, education and industry to educate people, make systematic efforts from multiple aspects such as top-level design, system construction, model exploration, and teacher training, and always focus on the core goal of cultivating innovative talents.

4.2. Theoretical Logic

The integration of science, education and industry enables the cultivation of high-level innovative talents to become a historical choice. The reason why it is scientific, feasible and effective is that theoretically, the integration of science, education and industry conforms to the growth law of innovative talents, the law of education and the concept of collaborative education.

The concept of integrating science, education and industry conforms to the growth law of innovative talents. High-level innovative talents are a collection of morality, knowledge and ability, and they are a group with a sense of social responsibility, able to continue learning and cope with realistic challenges. It is difficult to obtain these qualities through a single college body and traditional classroom teaching. The core of integrating science, education and industry lies in breaking down the barriers between traditional education, research and industry, constructing a multidimensional collaborative innovation ecosystem, achieving a dynamic cycle of knowledge acquisition and practical application, and developing innovative thinking and professional ability; by strengthening the application of learning, enhancing students' interdisciplinary competence; through the drive of real problems, cultivating students' innovative and lifelong learning abilities; and through the dynamic updating of knowledge, improving students' ability to adapt to industry revolution.

The educational concept of integrating science, education and industry matches the laws of education and teaching. Education and teaching is the process of cultivating "whole" people. As the subject of practice, people can get all-round development only when they integrate into the real situation. The integration of science, education and industry breaks the closure of traditional education, reconstructs the logic of "teaching" and "learning" through the deep collaboration of science, education and industry, and achieves of the essence of education. It deeply practices the systematic learning theory combining theory with practice, fully embodies the educational essence of "integration of knowledge and action", effectively promotes the "student-centered" teaching transformation and the innovation of the assessment and evaluation system, activates the principal initiative of students, and is conducive to the all-round development of people in education.

The integration of science, education and industry fits the concept of collaborative education. Synergy theory posits that there are mutual influences, connections, cooperation, and competition among the elements and subsystems within a system, and that the optimization of the overall function can be achieved through cooperative synergy. The collaborative education of science, education and industry emphasizes the exchange of material, energy and information between the educational system and the external environment (industry, research), the "triple coupling" of the education chain, industry chain, and innovation chain, breaking organizational boundaries, coordinating the goals of various subjects, reshaping the roles of various subjects, and forming a spiral educational "spillover" effect through functional complementation.

The theoretical logic of integrating science, education and industry requires us to catch the growth patterns of students, follow the laws of education and teaching, involve advanced teaching concepts and methods, and design and implement talent cultivation from a systemic and holistic perspective, avoiding top-down arrangements and superficial practices that violate the "original intention" of integrating science, education and industry.

4.3. Practical Logic

The effectiveness of integrating science, education and industry to empower the cultivation of high-level innovative talents has gradually become evident in practice. Different universities, based on their existing foundations, disciplinary characteristics and social resources, have actively explored various approaches. For instance, BUAA (Beijing University of Aeronautics and Astronautics) has established a "Technology Trend Monitoring System" with the Aviation Industry Corporation of China, updating 20% of the course content each semester. Xi'an Jiaotong University has implemented a new deep integration model of "1121", which stands for "one center, one incubation, two focuses and one sharing." Harbin Engineering University has developed a model of "Integration of Science and Education, Integration of Industry and Education, and Integration of Courses and Competitions" for cultivating innovative and top-notch talents. Qilu University of Technology has adopted a university-institute cooperation model, while Northeast Agricultural University has based its approach on innovation and entrepreneurship laboratory models. These initiatives have effectively promoted the improvement of talent cultivation quality, providing us with valuable insights and experiences on how to empower through the integration of science, education and industry.

The practical logic requires us to continuously explore and innovate in practice to solve real problems and promote social progress. It emphasizes practicality, flexibility and adaptability. Therefore, each institution should choose an appropriate integrated education model based on its own disciplinary characteristics and resource advantages, and should evaluate, test, and adjust the educational effectiveness of these models in practice.

5. MECHANISM CONSTRUCTION FOR EMPOWERING THE CULTIVATION OF HIGH-LEVEL INNOVATIVE TALENTS THROUGH THE INTEGRATION OF SCIENCE, EDUCATION, AND INDUSTRY

Mechanisms, characterized by stability, long-term nature, and systematicity, are crucial for the synergy of various elements and the stable functioning of the overall system. The realization of the logic behind empowering the cultivation of high-level innovative talents through the integration of science, education, and industry also requires effective mechanism guarantees to achieve the transition from "mechanical coupling" to "organic symbiosis".

5.1. Construction of the Motivation Mechanism

Motivation is the force that drives various subjects to take action. It stems from the recognition of common goals and the assessment of benefits. The motivation mechanism for the participation of relevant entities in the integration of science, education and industry for talent cultivation can mainly be considered from three aspects: value co-creation, benefit sharing, and risk sharing.

Firstly, through publicity and education, create an atmosphere and values of integrating science, education and industry in the whole society, and use new values to shape the understanding of various subjects, especially the social responsibility of industry and scientific research institutions, and internalize it into conscious actions of various subjects.

Secondly, it is necessary to establish a benefit-sharing mechanism. As mentioned above, the low enthusiasm of the industry to participate in the integration of science, education and industry is a rational choice based on interest considerations. Therefore, it is particularly important to establish a benefit-sharing mechanism.

Benefits can be shared through various policies and systems, such as tax relief and other preferential policies, agreement in advance on the proportion of patent income sharing of joint research and development projects, improvement of teaching conditions, the quality of innovative talent training and the results of science, education and production integration into the assessment and evaluation of colleges and universities, and the implementation of science, education and production integration into the assessment of teachers.

Furthermore, a risk-sharing mechanism can be established to address the risk concerns of different subjects. At the government level, a risk compensation fund for industry-education integration can be established to compensate for failed industry-education integration projects, and risks can be reduced through various channels such as innovations in insurance systems. In summary, when all subjects are in a situation where benefits outweigh concerns, their level of participation is bound to increase significantly.

5.2. Construction of the Operational Mechanism

The operational mechanism refers to the interaction and coordination among the various components within a system, ensuring its effective functioning through rules and processes. In the context of integrating science, education and industry, the operational mechanism involves collaboration among various subjects, the flow of resources, and the connection between different processes.

Firstly, it is necessary to coordinate the roles and collaboration rules of all participating entities. For example, the core function of universities is knowledge supply and innovation incubation, primarily achieved through developing industry-specific courses and forming interdisciplinary research teams. Industries fulfill the functions of defining needs and providing real-world scenarios by issuing lists of technological demands and offering real projects and mentors. Scientific research institutions achieve technological breakthroughs and commercialization of research results by building pilot platforms and participating in standard-setting. Governments play a role in policy guidance and ecosystem creation by establishing special funds and constructing data-sharing platforms. Third-party institutions play a role in evaluation and certification, as well as resource matching, by developing capability certification systems and organizing industry-education matchmaking events.

Secondly, an effective resource allocation mechanism must be established, such as the joint construction and sharing of laboratories by universities and enterprises, equipment leasing cloud platforms, industrial technology demand databases, and talent capability archives. By analyzing corporate technological needs and university research capabilities, cooperative proposal schemes are generated to enhance matching efficiency.

Thirdly, a closed-loop management process for the entire chain should be constructed. Industries can drive the design and development of university courses by releasing demands, thereby updating data resource libraries. Industries drive the curriculum design and development of universities by publishing their needs, updating data resource libraries. The process design encompasses teaching implementation, project practice, and commercialization of research results, featuring dual-mentor joint teaching, virtual simulation training based on industrial propositions, and roadshows for research and development outcomes. Quality control is exercised over the advancement of the entire process, while simultaneously guarding against potential risks.

Finally, a feedback optimization mechanism should be established to form a closed loop, driving continuous improvement in curriculum content and training emphases.

5.3. Construction of the Evaluation Mechanism

The evaluation mechanism refers to a system or process designed to conduct scientific and objective assessments of objects or projects. Evaluation acts like a baton, guiding the behavior of the involved entities. To establish an evaluation mechanism, the first step is to form diversified evaluation bodies, including both external and internal evaluation entities. External evaluation bodies can be composed of science and technology associations, educational administrative institutions, and certain research institutes. Internal evaluation bodies primarily refer to specialized management organizations at the university and college levels, such as university-level or college-level committees or management working groups for the integration of science and education in innovative talent cultivation, tasked with scientifically evaluating this work.

Secondly, evaluation indicators must be clarified, and a systematic evaluation system also should be constructed. The primary indicators for evaluating the integration of science, education and industry in talent cultivation can include the proportion of scientific research commercialization, the degree of integration between research and teaching, student participation in scientific research, the suitability between students' employment positions, and the level of participation in technological breakthroughs. Based on these, further refinement into secondary indicators is carried out.

Thirdly, evaluation norms must be established. This involves establishing and improving evaluation systems or rules for the cultivation of innovative talents, used to clarify evaluation entities, define evaluation rules and requirements, provide feedback on evaluation work, and make improvements. Systematic and scientific evaluation norms can ensure the effective operation of the integration of science, education and industry in talent cultivation and lay a solid foundation for subsequent incentive measures.

5.4. Construction of the Safeguard Mechanism

The safeguard mechanism is a series of systems, rules, measures and methods designed to ensure the smooth implementation of a certain work. Its core purpose is to prevent risks, solve problems, maintain stability and ensure effective operation even in unexpected or crisis situations. For the integration of science, education and industry to empower the cultivation of high-level innovative talents, the safeguard mechanism mainly consists of policy, organizational, resource, and quality safeguards.

Policy safeguards refer to top-down design by the state and government, issuing laws and regulations on the integration of science, education, and industry, clarifying the statutory obligations and incentives for enterprises and research institutions to participate in education, and defining the distribution of rights and interests among "universities, enterprises and students." From an organizational perspective, disputes in cooperation are resolved through the establishment of physically operating platforms and management mechanisms, ensuring continuous and in-depth integration of science, education, and industry. As for resource safeguards, government departments, social organizations and industries need to provide special funding support; establish mechanisms for the integration and sharing of elements to promote the construction of a dual-qualification teacher workforce; and build sharing platforms to realize interoperability and shared use of equipment and data. The quality safeguard mechanism should focus on constructing evaluation indicators and platforms based on dimensions such as student ability enhancement, teacher performance and cooperation effectiveness.

Main Points: The integration of science, education, and industry expands the talent cultivation domain of universities and aligns more closely with the growth patterns of innovative talents, making it an inevitable choice for cultivating high-level innovative talents in China.

Logic refers to the objective laws that govern the development and change of things, determining the direction and outcome of these changes and reflecting the inevitable causal relationships. Clarifying the logic of how the integration of science, education, and industry empowers high-quality talent cultivation is essential for guiding and effectively advancing this process to achieve the desired results.

Mechanism, characterized by stability, long-term nature, and systematization, is crucial for the synergy of various elements and the stable functioning of the overall system. The integration of science, education, and industry to empower high-level innovative talent cultivation requires the construction of effective mechanisms to transition from "mechanical coupling" to "organic symbiosis."

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