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From Germany's "Dual System" to the U.S. "Pluralistic Integration": Lessons for China's Innovative Talent Development

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Abstract: Against global competition, cultivating advanced innovative talent is critical for national development. This study uses educational economics and management theories to analyze China's current system, identify gaps, and propose optimization strategies based on the United States and Germany. Human capital theory and growth stage characteristics guide recommendations for interdisciplinary integration, collaborative education, and resource allocation. The proposed system strengthens top-level design, teaching reforms, and industry-academia collaboration to enhance self-reliant talent cultivation.

Keywords: top-notch innovative talents, cation economics and management, growth patterns, International experience, Cultivation system optimization

1. Growth Laws and Cultivation Needs of Top Innovative Talents in Contemporary China

1.1 Periodic Characteristics of Growth Laws

The development of top-tier innovative talent has distinct stage-specific features, with each educational phase having its cultivation tasks. This tiered approach provides a solid base for talent nurturing.

Primary and secondary education is fundamental for talent growth. It focuses on building basic knowledge, interests in learning, and cognitive habits. The curriculum is designed to effectively teach core subjects like language, math, and science. Also, activities such as experiments, science readings, and competitions are included to arouse students' curiosity.

At the undergraduate stage, deepening specialized studies is essential. University courses are in line with advanced research and industry needs, creating a broad curriculum. University-enterprise cooperation in practical teaching sets up internships, allowing students to blend theory with practice in product development and process improvement.

In the postgraduate study, the focus is on research breakthroughs to cultivate top academics and industry leaders. Research projects drive learning, with mentors choosing topics based on students' interests. Students are involved in all aspects of projects, enhancing their research skills. Frequent academic conferences at home and abroad foster exchanges, broadening students' views and inspiring innovation.

Since China's reform and opening-up, top-tier innovative talent cultivation has changed from a single model to

multiple ones. The cultivation in basic disciplines has evolved to "The Top-Notch Plan 2.0", and the "Strong Foundation Plan" integrates enrollment and talent-cultivation reforms.

1.2 Cultivation Needs of Interdisciplinary Top Talents

In an era characterized by rapid technological advancements and intricate challenges, the integration of interdisciplinary knowledge has become an essential attribute for cultivating exceptional innovative talent, thereby significantly contributing to groundbreaking innovation. However, traditional educational models often employ a discipline-specific approach, resulting in insufficient connectivity between subjects. Students, during their learning process, are frequently confined to the knowledge systems of individual disciplines, lacking the capacity to integrate and apply knowledge from diverse fields. This limitation hinders their ability to analyze and resolve interdisciplinary issues from multiple perspectives, thereby restricting their innovative capabilities and overall quality enhancement. Currently, several high-end and strategically emerging industries originate from interdisciplinary domains, and critical "choke point" technological issues cannot be resolved through a single discipline, necessitating the reinforcement of interdisciplinary talent cultivation[1]. Consequently, the cultivation of exceptional innovative talent increasingly emphasizes cross-domain and interdisciplinary approaches, demanding the establishment of academic connections across different disciplinary fields to achieve organic knowledge integration[2].

1.3 Cultivation Needs of Top Talents in Basic Disciplines

China's educational system is segmented into three primary stages: basic education, higher education, and vocational education. A notable disconnect exists between these stages, characterized by insufficient integration. Basic education primarily emphasizes foundational knowledge acquisition, with limited focus on cultivating students' interests and career planning. Higher education prioritizes specialized knowledge and research capabilities, yet its transition from basic education is often disjointed, necessitating a period of adjustment for students entering university. Vocational education also lacks strong linkages with both basic and higher education, as its objectives and curriculum frequently diverge from societal demands, thereby inadequately addressing the need for highly skilled technical professionals. A review of China's policies for cultivating top-tier innovative talent, including the "Top-Notch Plan," "Top-Notch Plan 2.0," and "Excellence Plan," reveals a concentrated focus on the university and postgraduate levels, with a marked deficiency in policy attention towards the cultivation of exceptional innovative talent during the basic education phase.

2. International Experience Reference

2.1 Pluralistic Integration Model in the United States

The U.S. pluralistic talent cultivation model integrates universities, research institutions, and enterprises into an innovation ecosystem, exemplified by Stanford University's Silicon Valley partnerships. University-industry research collaborations tackle cutting-edge challenges like AI algorithm optimization and chip development through joint projects with Google/NVIDIA, aligning academic theories with industrial needs. Corporate leaders serve as visiting professors at Stanford, delivering courses on emerging trends while offering internships enabling students to participate in core projects at Apple/Tesla. This hands-on experience directly bridges academic learning with industry innovation. Stanford's Technology Licensing Office facilitates efficient technology transfer, achieving over 30% patent conversion rate. Notable spin-offs like Hewlett-Packard demonstrate the virtuous cycle where university innovations fuel corporate growth, which in turn reinvests in academic development. This system continuously produces top-tier talent for U.S. tech leadership,

solidifying its global innovation dominance.

2.2 Expansion of Germany's Dual System

Germany's vocational education "Dual System" excels in cultivating innovative talents by integrating vocational schools and enterprises.Students simultaneously act as trainees and apprentices, with curricula tailored to industry demands through theoretical instruction (covering mechanical, automotive, and electronic sectors) and enterprise-based practical training at leading firms like BMW/Siemens. The automotive mechatronics program exemplifies this model: theoretical knowledge on vehicle structure/electronics is applied directly through hands-on assembly/debugging of Mercedes-Benz electric powertrains. Joint school-enterprise evaluations ensure graduates possess comprehensive competencies. Over 80% secure immediate employment with training companies, becoming technical innovators who drive Germany's high-end manufacturing and "Made in Germany" reputation. This system provides critical human capital for Industry 4.0 and advanced manufacturing sectors.

3. Enlightenment of International Experience for China

3.1 Strengthening the Concept of Collaborative Education

Drawing on international practices, China should establish a tripartite government-university-enterprise ecosystem [3] to enhance collaborative innovation talent cultivation. The government plays a pivotal role through strategic planning, performance-based funding incentives, and legal frameworks clarifying stakeholder responsibilities. Universities must break disciplinary silos by creating interdisciplinary platforms, sharing academic resources, and aligning curricula with industry trends. Enterprises, leveraging their technological advantages, should co-develop training bases, participate in program/curriculum design (e.g., Huawei/Tencent's "Intelligent Science Experimental Classes"), and provide mentorship/internships. This integrated model builds a multi-level collaborative framework[4], fostering an environment for top-tier talent growth through aligned policy support, academic innovation, and industry engagement.

3.2 Optimizing the Practical Teaching System

The active participation of foreign enterprises in talent-cultivation practical training offers valuable lessons for our country. Thus, we should prioritize optimizing internship and practical training systems to boost students' practical and innovative skills.

First, we need to ensure enterprises' full involvement in the entire practical teaching process. Right from the start, integrate real-world enterprise project cases into curriculum design and use project-driven teaching. For example, in software development courses, they include actual software project modules from enterprises. Students can work in groups to simulate enterprise development, enhancing their complex problem-solving ability. Also, enterprises should be deeply engaged in internship management. Collaborate with universities to design internship plans and evaluation criteria, and assign personalized internship tasks according to job requirements to guarantee internship relevance and effectiveness.

Second, expand the practical training base network. Besides large enterprises, tap into the potential of small and medium-sized enterprises (SMEs) and emerging start-ups. This creates diverse practical scenarios for students with different majors and interests. For instance, link creative arts majors with creative studios and new energy majors with start-up tech firms. Moreover, strengthen the cooperation between universities and research institutions. Select students to take part in cutting-edge research projects. This enables them to develop innovative thinking and master advanced research methods at the research forefront. For example, students can assist in major scientific research projects at national

laboratories, accessing top-tier research resources and inspiring innovation.

By enriching and diversifying the practical teaching system, we can support the growth of outstanding innovative talents, laying a solid groundwork for their entry into society and participation in innovative endeavors.

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