

Reform of School Management Mechanism for Cultivating Top-Notch Innovative Talents from the Perspective of Systems Theory

Lihui Ge

Abstract—At present, the competition of science and technology focuses on the competition of top-notch innovative talents. As the main position of talent training, the management mechanism of schools is very important to the growth of talents. This paper uses systems theory to analyze the existing problems of school management mechanism, puts forward the reform path from five aspects: goal, organization, resources, process and evaluation, and pays attention to the coordinated governance cooperation in all aspects, aiming at building an organic system, improving the efficiency of school training top-notch innovative talents, and providing theoretical support and practical guidance for education management practice.

Index Terms—top-notch innovative talents; school management mechanism; systems theory

I . INTRODUCTION

In today's increasingly fierce competition in global science and technology, top-notch innovative talents have become a key factor for countries to enhance their core competitiveness. From the perspective of historical experience, during the industrial revolution, the country that took the lead in cultivating a large number of innovative talents rose rapidly and dominated the world stage. Nowadays, in the frontier science and technology fields such as artificial intelligence and quantum computing, the quantity and quality of top-notch innovative talents directly determine a country's position in global competition. The "*Outline of the National Medium and Long-Term Program for Education Reform and Development*" clearly points out that it is necessary to explore ways to cultivate innovative talents throughout all levels of education, and proposes to "promote the organic connection of primary schools, middle schools and universities, the close integration of teaching, scientific research and practice, and the close cooperation of schools, families and society." The "*Outline of the national plan for building a leading country in education*" further emphasizes "improving the discovery and training mechanism of

top-notch innovative talents. " As the main position of cultivating talents, the school's management mechanism plays a decisive role in the growth of top-notch innovative talents. Using the viewpoint and method of systems theory to deeply analyze and reform the school management mechanism will help to build a more scientific and efficient education system and provide a solid guarantee for the cultivation of top-notch innovative talents.

II Connotation of school management mechanism from the perspective of systems theory

2.1 The core viewpoint of systems theory

The systems theory was formally proposed by the Austrian scholar Ludwig Von Bertalanffy in the 1940s. Its core viewpoints include integrity, relevance, hierarchy, dynamic balance, orderliness, etc. Integrity emphasizes that the system is an organic whole composed of interrelated and interactive elements, and the overall function is greater than the sum of some functions. The relevance points out that there is a close correlation between the elements in the system, and the change of one element will lead to the change of other elements and even the whole system. The hierarchy of the system shows that the system has different hierarchical structures, and the levels interact and restrict each other. The dynamic balance shows that the system seeks balance in the continuous development and change to adapt to the changes in the external environment. Orderliness is reflected in the arrangement and combination of internal elements of the system according to certain rules and orders, so as to ensure the stable operation of the system.

Systems theory has brought core influences and inspirations to the transformation of the school management mechanism for cultivating top-notch innovative talents. First, it is necessary to strengthen overall collaborative thinking, prompting schools to break free from the limitations of local optimization and view goal setting, organizational structure, resource allocation, teaching process and evaluation system as an organic whole. Avoid isolated reforms of individual subsystems, emphasize mutual cooperation among all links, and ensure consistent directions, resource sharing, and process connection for the cultivation of top-notch innovative talents. Second, it reveals the law of element correlation, helping managers realize that any change in any element of the management mechanism will trigger a chain reaction. Therefore, the reform needs to be considered comprehensively, and supporting measures should be planned in advance to avoid the failure of the reform due to neglecting one aspect for another. Third, guide the optimization of hierarchical rights and responsibilities. Based

on the principle of system hierarchy, promote schools to clarify the boundaries of rights and responsibilities at different management levels, form a clear and orderly management chain, improve decision-making and execution efficiency, and ensure the effective implementation of policies for cultivating top-notch innovative talents. Fourth, drive dynamic adaptation to changes, which requires the school management mechanism to remain flexible and establish a dynamic adjustment mechanism. In the face of technological development, policy changes and the transformation of talent demands, it is necessary to promptly optimize the training objectives, update the teaching content and adjust the management methods, so that the school can always maintain its adaptability to the external environment and continuously output top-notch innovative talents that meet the needs of The Times. The fifth is to standardize the construction of management order and guide schools to establish standardized and normalized management systems and procedures. From course development, teaching implementation to resource allocation and student evaluation, all are carried out in accordance with established rules, reducing the arbitrariness of management and providing a stable and sustainable institutional environment for the cultivation of top-notch innovative talents.

2.2 System structure of school management mechanism

From the perspective of systems theory, the school management mechanism is a complex system, which is composed of multiple subsystems. The goal system clarifies the direction and standard of cultivating top-notch innovative talents in schools, provides precise guidance for various management activities of schools, and guides teaching, scientific research and other activities to be carried out around the needs of personnel training. The organizational system covers the school's management structure and staffing, involving the management departments and teacher teams set up for the cultivation of top-notch innovative talents, ensuring the orderly development of management activities, promoting the cooperation of various departments, and forming a joint force for educating people. The resource system includes manpower, material resources, financial resources, information and other resources, such as excellent teachers, advanced experimental equipment, scientific research funds, academic information and so on. It provides material and intellectual support for personnel training and is the basis for achieving training objectives. The process system involves teaching, scientific research, practice and other personnel training links. From curriculum setting, classroom teaching to scientific research project development, social practice organization, etc., it directly affects students' growth and is the key implementation process for cultivating top-notch innovative talents. The evaluation system is

used to measure the effect of talent training, and feedback and adjust other subsystems through the evaluation of students' academic performance, innovation results, comprehensive quality and other aspects. These subsystems are interdependent and interact with each other to form an organic whole of the school management mechanism.

2.3 Existing problems: System imbalance and Efficiency constraints

The core predicament currently faced by the cultivation of top-notch innovative talents in schools is manifested in the structural imbalance of five major systems:

The problem of the target system is that the current target is not long-term and the direction is vague. Some schools have short-sighted problems in setting the goal of cultivating top-notch innovative talents. They overly focus on short-term achievements, such as the college entrance examination and high school entrance examination admission rates, and the number of awards won in subject competitions, while neglecting the cultivation of students' long-term innovative abilities and comprehensive qualities. The goals are ambiguous and lack clear measurable standards. There is no clear definition given for the extent to which students should possess innovative thinking, practical ability, etc. This makes the various management activities of the school lack precise orientation and it is difficult to effectively focus on the cultivation needs of top-notch innovative talents. For instance, in terms of curriculum design, in pursuit of the college admission rate, a large number of exam-oriented courses are arranged, and the time for extension and innovative courses is compressed, resulting in students' knowledge structure being monotonous and their innovative thinking being restricted.

The organizational system presents the problem of coexistence of rigidity and fragmentation. The organizational structure of the school is rigid, with too many levels, poor information transmission and cumbersome decision-making processes. There is a lack of effective communication and collaboration among various departments, and there is a phenomenon of each acting independently, resulting in the fragmentation of talent cultivation work. Take the organization of scientific research projects as an example. The Research Office is responsible for project application management, while the Academic Affairs Office is responsible for teaching arrangements. When students participate in scientific research projects, there may be conflicts between teaching and research time, and it is difficult to coordinate between the two departments, which affects students' participation and effectiveness in scientific research. This rigid and fragmented organizational system is unable to form a synergy for collaborative education, which restricts the efficiency and quality of cultivating top-notch innovative talents.

The resource system falls into the double dilemma of shortage and inefficiency. In terms of resources, there exists a coexistence of resource shortage and inefficient utilization. The shortage of teaching staff, especially the lack of teachers with innovative practical experience, makes it difficult to provide students with professional innovative guidance. The hardware resources such as experimental equipment and library materials are outdated and scarce, and cannot meet the needs of students for scientific research and innovation. Meanwhile, the allocation of resources is unreasonable and there is waste. For instance, after the purchase of some laboratory equipment, the usage frequency is low, a large amount of resources are idle, while the projects that are truly in urgent need of resources cannot be met. The shortage and inefficient utilization of resources have seriously hindered the development of the cultivation of top-notch innovative talents.

The process system exposes the problem of closure and unity. The process of talent cultivation in schools is closed and not closely connected with the external society, enterprises and research institutions. Students lack the opportunity to come into contact with practical problems and participate in cutting-edge scientific research. The training methods are monotonous, mainly based on classroom lectures, while practical teaching and inquiry-based learning are insufficient. In terms of curriculum design, there are clear boundaries between disciplines and a lack of interdisciplinary courses, which is not conducive to cultivating students' comprehensive qualities and innovative thinking. For instance, students majoring in science and engineering lack the cultivation of knowledge in the humanities and social sciences. When solving complex practical problems, their thinking is limited and it is difficult for them to propose innovative solutions. This closed and single training process cannot meet the diversified demands of cultivating top-notch innovative talents.

The evaluation system falls into a one-sided and lagging cycle. The evaluation system overly focuses on academic performance while neglecting the assessment of students' comprehensive qualities such as innovation ability, practical ability, and teamwork ability. The evaluation method is mainly based on examinations, which is monotonous in form and cannot comprehensively and objectively reflect the true level of students. The feedback of the evaluation results is not timely and cannot provide an effective basis for improvement in teaching and management work. For instance, the innovative performance of students in scientific research projects has not been fully reflected in the evaluation system, which has dampened their enthusiasm for participating in scientific research and innovation. This one-sided and lagging evaluation system cannot effectively guide the school

management mechanism to adjust and optimize in a direction conducive to the cultivation of top-notch innovative talents.

III TRANSFORMATION PATH: SYSTEM OPTIMIZATION AND EFFICIENCY IMPROVEMENT

3.1 Target System Transformation: Focus on the long term and precisely position

Based on the national strategic needs and students' lifelong development, formulate long-term and clear training objectives. It is necessary to clarify the specific standards that students should meet in terms of knowledge, ability and quality, such as solid basic knowledge of the subject, keen innovative thinking ability, strong practical ability and good teamwork spirit. The target is refined to different grades and different disciplines to form an operable and measurable target system. For example, the school formulates the dual-track goal of "academic guidance and innovative practice." The first grade of senior high school takes "interest enlightenment and foundation consolidation" as the core, and sets up school-based courses such as artificial intelligence introduction and interdisciplinary inquiry. The second grade of senior high school focuses on "improvement of scientific research ability" and requires students to participate in at least one subject research. The third year of senior high school is guided by "achievement incubation and graduation connection", and cooperates with university laboratories to carry out projects. At the same time, establish a dynamic adjustment mechanism for the goal, and optimize and improve the goal in time according to the needs of social development, the trend of education reform and the actual development of students. Such as the school's innovative development of the "growth self-portrait" system, real-time tracking of students' academic and five education data, combined with the national strong base plan dynamics, college enrollment trends and individual development differences, the annual optimization of the target system to ensure that the target is always adapted to students' potential and social needs.

During the process of transforming the target system, schools need to strengthen the strategic guiding role of top-level design and establish a three-in-one target calibration mechanism that integrates national strategies, university demands, and student development. Based on the holistic principle of systems theory, the goal of cultivating top-notch innovative talents is incorporated into the national talent strategic development framework. In line with the core literacy requirements proposed in the Outline of the national plan for building a leading country in education, a target matrix covering

dimensions such as basic discipline capabilities, cognition of cutting-edge technologies, and cross-disciplinary integration capabilities is established. By applying the principle of systematic correlation, a dynamic connection mechanism with key disciplines and advantageous specialties in universities is established. Through regular research on the talent selection standards and the direction of curriculum system reform in universities, a progressive relationship of knowledge system and ability structure is formed between the high school training goals and higher education. At the level of goal refinement, following the hierarchical characteristics of the system, a three-level goal system consisting of macro strategic goals, meso grade goals, and micro subject goals is constructed. At the macro level, anchor the strategic demand of the country for top-notch innovative talents. At the meso level, formulate step-by-step development goals based on the three-year high school study cycle. At the micro level, set specific training indicators in combination with the characteristics of the discipline. Meanwhile, based on the principle of dynamic balance of the system, a target elastic adjustment mechanism is established to conduct real-time monitoring of external environmental changes such as industrial structure upgrading and breakthroughs in scientific and technological frontiers, and to dynamically calibrate the training objectives. In addition, by leveraging the principle of orderliness of the system, a guarantee system for the implementation of the goals should be constructed. The rights and responsibilities of each department in the implementation of the goals should be clearly defined, and a process monitoring and effect evaluation mechanism for goal achievement should be established to ensure that the goal system achieves precise guidance for the cultivation of top-notch innovative talents in an orderly operation.

3.2 Organizational System Transformation: Flexible collaboration and Efficient operation

Build a flat organizational structure, reduce management levels, and improve the efficiency of information transmission and decision-making speed. Strengthen communication and collaboration among departments, and establish a cross-departmental coordination mechanism. For instance, set up a leading group for the cultivation of top-notch innovative talents, with the president serving as the group leader and the heads of relevant departments as members. Regular meetings should be held to jointly discuss and solve the problems encountered in the process of talent cultivation. Break down disciplinary barriers, promote the integration of disciplines, establish interdisciplinary research centers or innovation colleges, integrate resources such as faculty, courses, and experimental equipment from different disciplines, and provide students with a platform for interdisciplinary learning and research.

For instance, in the field of artificial intelligence, resources from disciplines such as computer science, mathematics, and psychology are integrated to carry out interdisciplinary teaching and research activities and cultivate compound innovative talents. In addition, it is necessary to enhance the cooperation between the school and external organizations, establish an alliance for industry-university-research collaboration, and jointly carry out talent cultivation and scientific research project cooperation with enterprises and research institutions, so as to broaden the channels for talent cultivation.

In the process of organizational change, it is necessary to strengthen the institutional guarantee and technical empowerment of organizational synergy. On the one hand, it is necessary to establish and improve the cross-departmental power and responsibility list and coordination rules, clarify the functional positioning and coordination process of each department in the cultivation of innovative talents, and incorporate the synergy effect into the department and individual performance evaluation system by regularly holding joint meetings and implementing joint assessments. On the other hand, with the help of digital management platform to build organizational collaboration network, the use of process automation technology to achieve teaching arrangements, resource allocation, project management and other business online linkage, improve organizational efficiency. In addition, the external collaborative governance mechanism is introduced to build an open organizational system with multi-subject participation. Finally, an organizational reform and innovation pattern with efficient flow of internal and external factors and coordinated efforts at all levels is formed, which provides a solid organizational guarantee for the cultivation of top-notch innovative talents.

3.3 Resource System Transformation: Diversified expansion and Efficient allocation

Through a variety of ways to expand resources, increase investment in the construction of teaching staff, introduce teachers with rich industry experience and high academic level, and strengthen the training and further education of existing teachers, so as to improve teachers' innovative teaching ability and scientific research level. Actively strive for government financial support, social donations and corporate cooperation funds, improve the school's hardware facilities, purchase advanced experimental equipment, books and materials. Strengthen the integration and sharing of resources, establish a resource management information platform, unify the management and allocation of various resources in schools, and improve the efficiency of resource utilization. For example, realize the online reservation of laboratory equipment to avoid idle equipment; promote the digital construction of library

book resources, and facilitate online access for teachers and students. In addition, we should make full use of network resources to carry out online course learning, academic lectures and other activities to expand students' learning space.

In terms of resource allocation, schools should establish a dynamic assessment mechanism and allocate resources based on the actual needs of teaching and research. For instance, priority should be given to ensuring the resource input for key disciplines, innovative projects and practical courses. Through information technology means, resources such as laboratory equipment, library materials, and teaching venues are integrated into a unified platform. Teachers and students can check the usage of resources online and make reservations, thereby improving the utilization rate of resources. It can also promote the sharing of resources among schools within the region, achieve the intercommunication of high-quality courses, teachers and equipment, avoid redundant construction and waste of resources, maximize the benefits of limited resources, and provide strong support for the cultivation of top-notch innovative talents.

3.4 Process System Transformation: Open and diverse, collaborative cultivation

Strengthen the cooperation between schools and society, enterprises and research institutions, establish off-campus practice bases, and enable students to participate in actual project research and development, production practice and other activities, so as to enhance students' understanding of social demands and improve their practical and innovative abilities. Enrich the training methods, adopt diversified teaching approaches such as project-based learning, inquiry-based learning, and group cooperative learning, and stimulate students' interest and initiative in learning. Strengthen the construction of interdisciplinary courses, break the boundaries of disciplines, design comprehensive courses, and cultivate students' comprehensive qualities and interdisciplinary thinking abilities. For instance, interdisciplinary courses such as "Science and Technology and Society" and "Environmental Science and Sustainable Development" are offered to guide students to apply multi-disciplinary knowledge to solve practical problems. At the same time, emphasis is placed on the individualized development of students. Based on their interests, specialties and potential, personalized training plans are formulated for them and personalized guidance is provided.

In the process of system reform, it is necessary to take the integrity and dynamic balance of systems theory as the guidance to construct the whole chain cultivation ecology of the integration of production and education and the integration of learning and research. First of all, break the closed

boundary of school education, through the establishment of collaborative education alliance, the real industry projects, scientific research frontier topics into teaching resources, the formation of problem-oriented, task-driven practice teaching mode. Secondly, deepen the reform of the curriculum system, and build a modular curriculum group according to the advanced logic of foundation consolidation, ability expansion and innovation breakthrough: the basic module strengthens the core knowledge of the discipline, the expansion module sets up interdisciplinary theme courses, and the innovation module carries out in-depth learning based on scientific research projects, so as to realize the dynamic docking of curriculum content with industrial needs and academic frontiers.

At the level of teaching method innovation, a hybrid learning environment is constructed based on digital technology, which combines online resource autonomous learning with offline inquiry teaching. Through virtual simulation experiments and remote collaborative projects, it breaks the limitation of time and space and enhances the interaction and immersion of learning. At the same time, a double tutorial system is established, and students are jointly guided by teachers, enterprise engineers and scientific researchers to realize the integration and transmission of theoretical knowledge and practical experience. In addition, based on the dynamic analysis of students' learning data, artificial intelligence technology is used to generate personalized learning paths for each student, and intelligently recommend adaptive curriculum resources, practical projects and instructors to meet students' differentiated development needs. Through the establishment of process quality monitoring mechanism, real-time monitoring and dynamic adjustment of teaching implementation, project progress, student feedback and other links are carried out to ensure that the training process always conforms to the growth law of top-notch innovative talents, and finally form an open, collaborative, flexible and efficient modern education mode.

3.5 Evaluation System Transformation: Comprehensive and scientific, with timely feedback

Construct a diversified evaluation system, comprehensively consider the students' academic performance, innovation ability, practical ability, comprehensive quality, etc., and use various evaluation methods such as examinations, assignments, project reports, practical results display, self-evaluation, and peer evaluation to comprehensively and objectively evaluate the development of students. Establish a process evaluation mechanism, pay attention to students' performance in the process of learning, scientific research and practice, and give feedback and guidance in a timely manner. For example, in the process of students' participation in scientific research projects, students'

research progress and innovative ideas are evaluated regularly to help students adjust their research direction in time. Strengthen the use of evaluation results, link the evaluation results with students' awards, enrollment, employment, etc., and provide a basis for school management decisions to promote the continuous optimization of school management mechanisms.

In terms of evaluation methods, diversified evaluation methods are adopted. In addition to the traditional examination, project defense, research report, innovative works display and other forms are added, and students' self-evaluation, mutual evaluation and teachers, industry experts, enterprise tutors and other multi-party evaluations are introduced to ensure the objectivity and comprehensiveness of the evaluation. It is very important to establish a process evaluation mechanism. It uses information technology to record students' daily learning, scientific research practice, and activity participation. Through regular feedback meetings and personalized guidance, students are given timely suggestions for improvement to help students adjust their learning direction.

In terms of the application of evaluation results, they should be directly linked to student rewards, college admission recommendations, and the formulation of personalized learning plans, etc., to stimulate students' enthusiasm and initiative. Meanwhile, schools should conduct in-depth analysis of the evaluation data to identify deficiencies in teaching and management, providing data support for management decisions such as optimizing curriculum settings, arranging teacher training, and allocating resources. This will form a virtuous cycle of evaluation, feedback, and improvement, promoting the continuous optimization of the school's management mechanism and effectively enhancing the quality of cultivating top-notch innovative talents.

IV. CONCLUSION

From the perspective of systems theory, the subsystems of school management mechanism are interrelated and influence each other, which work together on the cultivation of top-notch innovative talents. Through the reform of the system of goal, organization, resources, process and evaluation, a school management mechanism system with clear goal, flexible organization, sufficient resources, open process and scientific evaluation can be constructed, which can effectively improve the efficiency of school training top-notch innovative talents. In the process of practice, schools should fully realize the importance and interrelation of the reform of each subsystem, promote the coordinated implementation of various reform measures with systematic thinking, create a good environment for the growth of top-notch innovative talents, and provide strong talent support for national scientific and

technological progress and social development.

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