Research on the Path of Interdisciplinary Talent Cultivation in Chinese Research Universities under the Background of New Engineering

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Abstract: With the deepening of China's new engineering construction, the interdisciplinary talent cultivation of research universities in China is facing enormous challenges and opportunities. To meet the needs of the current global new round of technological revolution and industrial transformation, it has become a trend that accelerating the transformation of talent cultivation in new engineering education towards interdisciplinary talent cultivation. This study proposes that new engineering education has the attributes of interdisciplinary knowledge integration, complex system methodology, and agile responsiveness, and forms a "double helix" coupling relationship with interdisciplinary talent cultivation. To solve the problems of organizational barriers, technical bottlenecks in interdisciplinary courses, and one size fits all teacher evaluation in the cultivation of interdisciplinary talents in research-oriented universities, this article proposes measures such as restructuring the disciplinary organizational system, innovating the teaching curriculum system, building interdisciplinary teaching staff, promoting the collaborative education model between industry, academia, and research, and improving the quality evaluation system for talent cultivation.

Keywords: New Engineering; Research Universities; Interdisciplinary Talents; Interdisciplinary Intersection

1. Introduction

Under the dual drive of the global new round of technological revolution and industrial transformation, emerging industries such as artificial intelligence, biomanufacturing, and quantum technology have shown significant interdisciplinary characteristics, which puts higher demands on the cultivation of scientific and technological talents. According to the World Economic Forum's "2025 Future Jobs Report", by 2030, 22% of global employment opportunities will face change, and 40% of job skills will undergo changes. New job opportunities will be concentrated in technology fields such as artificial intelligence and data analysis, but there will be a significant shortage of talent supply. In response to the demand for cultivating new technological talents, the Chinese Ministry of Education has launched the construction of new engineering disciplines since 2017 and has successively issued policies such as the "Notice on Carrying out Research and Practice in New Engineering disciplines" and the "Notice on Recommending Research and Practice Projects in New Engineering disciplines".

As an important pillar of the national scientific and technological innovation system, Chinese research universities are the main battlefield for cultivating new engineering talents and undertake the important task of breaking through the boundaries of traditional disciplines and reconstructing the talent training system. The new engineering disciplines of Chinese research universities have obvious "national strategic" characteristics. In response to the national strategic development needs such as innovation driven strategy and the revitalization of the country through science and education, China's research-oriented universities must move away from a single discipline education model and achieve

cross-border integration based on cultivating high-level talents. However, at present, there are still many problems in the interdisciplinary talent cultivation of research universities in China. For example, the disciplinary organizational system of most research universities is still fixed in the construction of college majors for a long time, the proportion of interdisciplinary courses in the curriculum system is too small, and the evaluation dimension of the teaching staff is single [1]. As a result, the talents cultivated by Chinese universities find it difficult to face the systemic challenges in the global fields of science, technology, and engineering. To cultivate more strategic scientific and technological talents that meet the development needs of the current era, Chinese research universities should explore an independent path to cultivate interdisciplinary talents in the context of the national new engineering construction.

2. The Triple Attributes of New Engineering Education

Based on the rapid changes in global technology and industrial transformation, new engineering presents three unique attributes compared to traditional engineering. From the perspective of knowledge production, the new engineering education has changed the traditional engineering education's linear progression and individual teaching of knowledge points, in order to achieve cross-border integration of different knowledge points. On this basis, multiple entities such as universities, enterprises, and research institutes collaborate to carry out educational work, realizing a new mode of knowledge production that integrates cross-border knowledge points from all parties [2]. For example, in the development of intelligent manufacturing systems, it is not only necessary to use manufacturing knowledge, but also to integrate knowledge from fields such as mechanical engineering control theory, algorithm models in information science, and process optimization in management science. The new engineering education approach will integrate knowledge from multiple disciplines and rapidly update intelligent manufacturing technology.

Secondly, in terms of research methodology, the new engineering education is based on a complex systems perspective as its methodological foundation. The process of technological innovation and industrialization is not only a process of continuous iteration and evolution of technological systems, but also an evolutionary process of technological systems constantly adapting to social needs while being constrained by environmental factors. In this context, new engineering education needs to adhere to a complex systems perspective as a methodology to guide engineering teaching to cultivate students' knowledge of complex technological social systems and their ability to solve such problems. On the one hand, the new engineering education needs to organize and design engineering curriculum modules around various engineering professional technologies, and integrate the technical modules of different specialties ; On the other hand, new engineering education focuses on training students' ability to evaluate the social application of technology and adapt to the external environment of technology operation, enabling students' technical social governance capabilities to develop substantially [3].

Thirdly, agile response ability is an important guarantee for new engineering education to keep pace with the times. Compared with the technology iteration cycle of the past 5-8 years, the current major technology change cycle has been greatly reduced. Therefore, it is necessary to reform the education mode with the times to timely change the technology, so that the new engineering education can respond at any time with some major technological innovation and the development direction of important disciplines, and achieve the state of going hand in hand with major technological innovation by establishing the corresponding dynamic curriculum adjustment mechanism [4]. The university new engineering education should establish a technology change monitoring system to dynamically monitor the direction and trend of new technology change, and carry out the construction of modular curriculum group according to these directions and trends. At the same time, it is also necessary to strengthen the flexibility of talent training program setting and the efficiency of teaching resource allocation.

3. Coupling Relationship between New Engineering and Interdisciplinary Talent Training

The organization for economic cooperation and development (OECD) has formulated high-quality teaching objectives, focusing on the cultivation of students' future oriented abilities [5]. The interdisciplinary talent cultivation in China's research universities can be localized by applying the OECD learning framework to form high-quality teaching centered on students, highlighting the three-layer ability cultivation structure centered on students, namely the hard skills layer, the soft skills layer and the meta competence layer. The hard skill layer highlights the comprehensive application ability of multidisciplinary technology and methods, and combines the technical means originally scattered in various disciplines, such as programming tools, engineering simulation software, data visualization platform, etc., to form new technical means and solutions; The soft skill layer focuses on cultivating students' innovative problem-solving ability in the collaborative work of interdisciplinary teams [6]; The meta competence layer emphasizes adaptive skills, including the ability to understand new concepts, the ability to transfer cross domain knowledge, and the ability to solve unstructured problems [7].

The relationship between the construction of new engineering and interdisciplinary talent training is a dynamic balance of "double helix" structure, which is mainly reflected in the mutual enabling mechanism between the two. In the demand side dimension, the upgrading of industrial technology requires the support of education supply side. The future industries represented by artificial intelligence, biological manufacturing and quantum technology are developing rapidly. These industries put forward relevant new engineering talent capacity requirements to the new engineering construction system through technology roadmap, post capacity model, etc. For example, the car road cloud collaborative algorithm engineers and human-computer interaction designers required by the development of the intelligent connected automobile industry. On the supply side, interdisciplinary talent training in colleges and universities needs the support of the new engineering construction system. The traditional "discipline oriented" linear talent training mode will shift to the "problem oriented" network training mode, while the interdisciplinary talent training mode will put interdisciplinary talents back into the industrial system for training [8].

The coordinated evolution of the "double helix" structure of new engineering and interdisciplinary talent training needs to rely on a certain two-way information circulation carrier, so as to ensure the mutual support of the industrial system and the education system. Among them, the industrial system uses technology foresight to propose the type of interdisciplinary talents' ability required for the education system in the future, while the education system is based on the ability of graduates to feed the industrial system to complete interdisciplinary talents' training. The system evolution of new engineering and interdisciplinary talent training also needs the elements of the industrial system and the education system to adapt. Among them, the education system should be based on the technical route of the industrial system and the related patent achievements to develop the matching training scheme, curriculum system and talent model, so as to form a virtuous cycle of mutual support and development with the industrial system.

4. The Training Path of Interdisciplinary Talents in China's Research Universities

There are still many problems in the cultivation of interdisciplinary talents in China's research universities, such as the interdisciplinary education barriers under the form of the traditional collegiate organizational structure, the low technical content of interdisciplinary courses, the relatively prominent subject unity of teacher evaluation, and so on [9]. These problems are not conducive to the cultivation of high-level interdisciplinary talents, nor conducive to the innovation ability of the industry, and hinder the development of national strategic scientific and technological forces. In view of this, according to the triple logic of new engineering education and its coupling relationship with interdisciplinary talent training, China's research universities should establish an effective path for interdisciplinary talent training. According to the major national strategic guidance, research universities should build a new interdisciplinary talent training mode with the characteristics of Chinese Research Universities from the aspects of

discipline organization system reconstruction, curriculum system innovation, interdisciplinary faculty construction, industry university research collaboration platform construction, and talent training quality evaluation system construction.

4.1 Reconstructing Discipline Organization System

The construction of new engineering courses puts forward new requirements for the organization system of discipline construction in colleges and universities, and the interdisciplinary talent cultivation in colleges and universities also needs to be based on the necessary discipline organization construction. Research universities can innovate and explore the three-level collaborative organizational form of "College-Institute-Center", break the traditional organizational boundaries of the college structure, and form a new pattern in which colleges focus on basic education, research institutes carry out technology research and development education, and innovation centers promote the transformation of technological achievements. For example, research universities can establish intelligent industry research institutes, and combine the resources of multiple colleges such as the school of computer science, the school of automation and the school of information engineering to form an interdisciplinary talent training mode of "artificial intelligence + X". Colleges and universities can also promote the construction of virtual teaching and research offices in multiple colleges, and dynamically reorganize advantageous teaching and research resources by means of interdisciplinary project teams. In addition, research universities should refer to the requirements of the measures for the establishment and management of interdisciplinary disciplines, actively explore the way of "discipline group" construction, and combine the actual situation to continuously launch comprehensive disciplines with the integration of multiple disciplines. In particularly, we should focus on building new interdisciplinary groups focusing on the development of intelligent science and technology, integrated circuit science and engineering, etc., in combination with the needs of current and future industrial development.

4.2 Innovating Teaching Curriculum System

The cultivation of interdisciplinary talents relies on comprehensive and interdisciplinary teaching content, which requires research universities to scientifically construct interdisciplinary curriculum modules. The academic affairs department of a research university can set up credits for three types of courses, including basic general courses, professional core courses and interdisciplinary practice courses, in accordance with a certain proportion. For example, the educational administration department set up course module credits for the above three types of courses in the proportion of 30%, 30% and 40%, highlighting the importance of interdisciplinary courses. Research universities should also innovate in the teaching content of courses, especially in accordance with the needs of industrial development, highlighting the technical teaching content of emerging industries and future industries. At present, artificial intelligence, quantum technology, low altitude industry, brain science and other industries have great development potential. Research universities should closely focus on the above industries to set up technical and skill courses. In addition to strengthening the teaching of theoretical knowledge and skills, universities should actively implement the "project-based" teaching method and set up interdisciplinary project practice courses. In the teaching of interdisciplinary courses, in addition to requiring students to study basic courses such as machine learning, teachers must also complete project practice in cross fields and gradually carry out theoretical and practical teaching in theory teaching, case study, project development, achievement transformation and other aspects [10].

4.3 Building Interdisciplinary Teaching Staff

Under the background of new engineering construction, the construction of interdisciplinary teaching staff plays an important role in breaking the disciplinary barriers and cultivating interdisciplinary talents. Interdisciplinary talents training in research universities needs teachers with interdisciplinary literacy. The school can adopt the method of system innovation to develop an efficient and high-quality teaching staff and

inject new momentum into the cultivation of interdisciplinary talents. Colleges and universities should strive to improve the multi-level employment system of "double employment, joint employment and special employment" in the reform of personnel management system and mechanism. Qualified colleges and universities can build a pyramid type teacher talent matrix.

In terms of appointing teachers, academicians, discipline leaders and senior professors form a joint teaching team. Under the guidance of the interdisciplinary talent training strategy formulated by the university, academicians and discipline leaders, as the chief responsible person, plan the coordinated development of discipline development, discipline planning and scientific research of the college. It can also mobilize teachers outside the college to conduct joint teaching or joint research, so that students can be guided by professors outside the college. Universities can establish a joint assessment system between colleges and departments, and the teacher assessment department of the school sets indicators such as cross scientific research achievements, composite curriculum development, interdisciplinary talent training, etc., as the main assessment criteria for teachers. Research universities should also actively explore the criteria for teacher accreditation, and reconstruct a new model for the docking of education chain and industry chain. Colleges and enterprises can jointly build industrial education bases, regularly select young teachers from colleges and universities to settle in enterprises, engage in industrial innovation practice activities or participate in cutting-edge technology research, technology research and development and other projects of enterprises, and send enterprise engineers to colleges and universities to teach practical projects. In a word, the construction of interdisciplinary teaching staff is no longer a simple reform of the teacher personnel management system, but a new mode of knowledge production while innovating the talent training mode.

4.4 Deepening the Mode of Industry-University-Research Collaborative Education

Under the background of new engineering construction, industry-university-research collaboration is an important starting point for research universities to carry out interdisciplinary talent training. Research universities can build a collaborative education innovation platform around the "education chain-industry chain-innovation chain", and explore a new mode of industry education integration education that reflects the national strategic needs. Colleges and universities can establish future industrial technology colleges to carry out interdisciplinary talent training based on major national science and technology projects; The courses of the future institute of industrial technology should be interdisciplinary and establish a multi-dimensional knowledge structure; The contents of the students' practical projects and graduation design topics of the future institute of industrial technology should be close to the future industrial technology research and product research. Enterprise engineers participate in the whole process of student project practice to ensure that 100% of the content of student project practice comes from the real R&D projects of enterprises and truly solve the practical problems of industrial development [11]. In terms of the innovation of the practical teaching system, colleges and universities should actively build training bases, introduce enterprise level industrial software and intelligent production lines, make the training projects change to practice, and open the flow channels of talent cultivation resources between enterprises and schools [12]. On the one hand, schools can reverse train students according to the real project needs of enterprises; On the other hand, enterprises can also introduce more market resources into colleges and universities, so that students can fully understand the latest market technologies and products, and greatly improve students' ability to solve complex engineering problems.

4.5 Improving the Quality Evaluation System of Talent Training

The single dimension talent training quality evaluation system has been unable to meet the needs of interdisciplinary talent training. Therefore, if research universities want to seize the opportunity of new engineering construction, they should also innovatively build a new mechanism to ensure the quality of interdisciplinary talent training. Based on the particularity of interdisciplinary talent training, colleges and universities should establish a

talent training quality evaluation system and quality monitoring system in line with the law of interdisciplinary talent training. Firstly, by adjusting the evaluation methods of school education and teaching, we must establish a perfect and whole process multi-agent evaluation system for the quality of interdisciplinary education and teaching, and continuously develop an interdisciplinary ability evaluation model suitable for the comprehensive quality evaluation of college students [13]; The second is to improve the evaluation indicators. Research universities need to set evaluation indicators such as the proportion of interdisciplinary courses in accordance with the requirements of the ministry of education and the discipline evaluation indicators of the ministry of education; Thirdly, in view of the dimension of interdisciplinary talent ability evaluation, the ability of students' interdisciplinary knowledge mapping, complex engineering technology breakthrough and other aspects are comprehensively investigated from the dimensions of basic knowledge mastery, compound technology learning, and innovation ability evaluation; The fourth is to establish a big data analysis and monitoring system based on the internet of things in colleges and universities and a prediction model for the quality of interdisciplinary talent training, monitor students' participation in courses, project completion, enterprise feedback and other contents in the learning process, and warn of possible interdisciplinary talent training deviations, and timely push personalized training programs.

5. Conclusion

This article discusses the cultivation path of interdisciplinary talents in Chinese research universities under the background of the construction of new engineering. This article firstly discusses the attributes of new engineering education from the aspects of knowledge production, research methodology, and agile response capability. Then, the coupling relationship between the construction of new engineering disciplines and the cultivation of interdisciplinary talents was analyzed. Based on the above analysis, it is proposed to cultivate interdisciplinary talents in Chinese research universities through restructuring the interdisciplinary organizational system, innovating the teaching curriculum system, building interdisciplinary teaching staff, deepening the collaborative education model between industry, academia and research, and improving the quality evaluation system for talent cultivation.

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References

[1] Wang H., Li S.M., Wang H.B. The Practical Dilemma and Practice Path of Chemical Engineering Talents Training in Local Undergraduate Colleges under the Background of New Engineering. Educational Theory and Practice, 2025, 45 (9): 18-21.

[2] Zhou D., Lv G.R., Guo P.X., et al. Design Teaching Method of Interdisciplinary Curriculum Project in the Context of New Engineering Education. Research on Higher Engineering Education, 2023 (6): 16-26.

[3] Li M., Chen H.B. Analysis on the Cultivation of Outstanding Engineers in "New Engineering" based on the Theory of Tacit Cognition. Journal of Northeast University (Social Science Edition), 2025, 27 (2): 143-150

[4] Yang M., Luo J.Y., Xu H. From Basic Research to Industrial Development: Practical Research on the Cultivation of Innovative Talents in Basic Disciplines in Colleges and Universities under the New Engineering Concept. Science and Technology Management Research, 2024, 44 (10): 13-21.

[5] Shao Z.B. Connotation and Enlightenment of OECD Education Output Index. Journal of Nanjing Normal University (Social Science Edition), 2020 (6): 50-61

[6] Pei Y.X., Wang H.F., Li Q. Exploration and Practice of Interdisciplinary Talent

Training under the Background of New Engineering. Research on Higher Engineering Education, 2021 (2): 62-68.
[7] Ke L.S. Exploration on Interdisciplinary Teaching Reform of Basic Courses in Colleges and Universities in China under the Background of New Engineering. Exploration of Higher Education, 2024 (3): 124-128.
[8] Klaassen R. G. Interdisciplinary Education：A Case Study. European Journal of Engineering Education, 2018, 43(6): 842-859
[9] Wan C., Yu Y., Huo B. Construction and Discussion of Mechanics Interdisciplinary Course under the Background of New Engineering. Mechanics and Practice, 2022, 44 (2): 379-384.
[10] Edstrom K., Malmqvist J., Roslof J. Scholarly Development of Engineering Education–the CDIO Approach. European Journal of Engineering Education, 2020, 45(1):1-3.
[11] He X.Y., Yang G.S., Zhou Y.M. Interdisciplinary Embedded Experimental Teaching for New Engineering Construction. Laboratory Research and Exploration, 2019, 38 (10): 182-186.
[12] Liu X.Q., Ge W.Q., Li B. Reform and Practice of New Engineering Talent Training Mode based on Ability Training. China University Teaching, 2023 (11): 30-37.
[13] Zhang X.B., Liu B.C. Interdisciplinary Talent Training Mechanism: Theoretical Logic, Practical Problems and Optimization Path. University Education Science, 2023 (6): 43-51.

