Exploration into the Cultivation of Innovative Cross disciplinary Talents in New Engineering at Applied Undergraduate Universities

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Abstract: In today's era, technology is developing rapidly, and the integration among various industries is also becoming increasingly tight, showing an unprecedented depth and breadth. Against this backdrop, the cultivation of innovative interdisciplinary talents in new engineering is particularly crucial, as it plays an irreplaceable and significant role in promoting comprehensive social progress and industrial transformation and upgrading. This paper delves into the background, objectives, models, curriculum systems, and faculty team building of innovative interdisciplinary talent cultivation in new engineering at applied undergraduate colleges and universities. It aims to provide comprehensive theoretical support and practical guidance for applied undergraduate colleges and universities in the field of innovative interdisciplinary talent cultivation in new engineering. It is hoped that this can help to continuously deepen educational reform in colleges and universities, promote the steady improvement of talent cultivation quality, and thus better serve the national innovation-driven development strategy, meet the strong demand of industrial upgrading for high-quality innovative talents, and contribute a solid force to the long-term development of the country and the continuous progress of society.

Keywords: Application-Oriented Undergraduate Universities; New Engineering; Innovative Cross Disciplinary Talent Cultivation; Reform in Education

1. Introduction

With the rapid development of global technology, new engineering disciplines, as an important direction of engineering education reform, shoulder the mission of cultivating high-quality engineering and technical talents with innovative spirit, interdisciplinary knowledge, and practical ability. As an important component of China's higher education system, applied undergraduate universities bear the responsibility of cultivating applied talents for local economic and social development. However, the traditional engineering talent training model is no longer able to meet the needs of industrial development in the new era, and a new innovative cross disciplinary talent training model for engineering has emerged.[1] This article will explore the cultivation of innovative cross disciplinary talents in new engineering disciplines in applied undergraduate universities from multiple dimensions, in order to provide useful references for higher education reform.

2. Background of Cultivating Innovative Cross disciplinary Talents in New Engineering

The background of the cultivation of innovative interdisciplinary talents in new engineering mainly stems from the accelerated advancement of the current global scientific and technological revolution and industrial transformation. Our country is at a critical stage of reform and development, with in-depth development of industrialization, informatization, marketization, and internationalization, which has urgently called for a talent cultivation model of multi-disciplinary cross-integration innovation oriented by engineering capabilities. At the same time, in response to the new situation of international competition and to meet the new demands of national development, the construction of new engineering has become a

strategic focus of engineering education reform and development. It aims to cultivate high-quality composite talents who meet the needs of emerging industries and the new economy, so as to enhance the country's international competitiveness and innovation capability.

2.1 The Trend of Technological Development

With the rapid development of cutting-edge technologies such as artificial intelligence, big data, the Internet of Things, and biotechnology, the boundaries between disciplines are becoming increasingly blurred, and cross integration has become an important driving force for technological innovation. For example, in the field of intelligent manufacturing, multiple disciplines such as mechanical engineering, electronic information, and computer science permeate each other, jointly promoting the intelligent upgrading of the manufacturing industry. [2] If the new engineering talents cultivated by application-oriented undergraduate universities lack interdisciplinary knowledge and cross thinking, they will find it difficult to adapt to the trend of technological development and be unable to effectively innovate and solve problems in complex engineering practices.

2.2 The Demand for Industrial Upgrading

China is currently in a critical period of industrial upgrading, with traditional industries transforming towards high-end, intelligent, and green industries, and emerging industries flourishing. Taking the new energy vehicle industry as an example, it involves multiple disciplines such as automotive engineering, energy science, materials science, and electronic information. Enterprises need a large number of composite talents who not only understand automobile manufacturing technology, but also master interdisciplinary knowledge such as new energy battery technology and intelligent driving technology. As the main force in talent cultivation, application-oriented undergraduate universities must keep up with the pace of industrial upgrading, adjust their talent cultivation models, cultivate innovative cross disciplinary talents in new engineering fields, meet the demand of enterprises for high-quality engineering and technical talents, and promote the sustainable development of the industry.

2.3 The Direction of Education Reform

The Ministry of Education is vigorously promoting the construction of new engineering disciplines, aiming to guide universities to actively adapt to national strategic needs and economic and social development needs, and deepen the reform of engineering education. The cultivation of innovative interdisciplinary talents in the field of new engineering is one of the core contents of the construction of new engineering. It requires universities to break down disciplinary barriers, build interdisciplinary curriculum systems and teaching models, and cultivate students' innovative thinking, interdisciplinary knowledge integration ability, and practical ability. Actively responding to the call for educational reform, application-oriented undergraduate universities are exploring and practicing the cultivation of innovative cross disciplinary talents in new engineering fields. This is an important way to improve their own educational quality and social service capabilities, and also an inevitable choice to achieve the connotative development of higher education.

3. New Engineering Innovative Cross disciplinary Talent Training Objectives

The training objective of innovative interdisciplinary talents in new engineering focuses on shaping talents with core qualities such as innovative thinking, the ability to integrate interdisciplinary knowledge and lifelong learning capabilities, professional skills in mastering core professional techniques, interdisciplinary practice, and technological application innovation, as well as comprehensive qualities including an international perspective, a sense of social responsibility, and leadership and team collaboration abilities. The aim is to enable students to adapt to the technological and industrial changes of the new era, become the main force in promoting social progress and industrial upgrading, and provide solid talent support for the national innovation-driven development strategy. The main framework diagram of the training objective of innovative interdisciplinary talents in new engineering is shown in the following Figure 1.

3.1 Knowledge Objectives

Innovative interdisciplinary talents in the field of new engineering should possess solid interdisciplinary knowledge, covering fundamental disciplines such as mathematics, physics, chemistry, as well as professional foundational disciplines such as engineering mechanics, circuit principles, and materials science. At the same time, it is necessary to master professional knowledge and skills in at least two related disciplines, such as mechanical engineering and electronic information engineering, computer science and biomedical engineering, etc. In addition, it is necessary to understand the cutting-edge technologies and development trends of related industries, such as the application of artificial intelligence in the industrial field and the latest developments in new energy technologies, in order to broaden knowledge horizons and provide knowledge reserves for interdisciplinary innovation. [3]

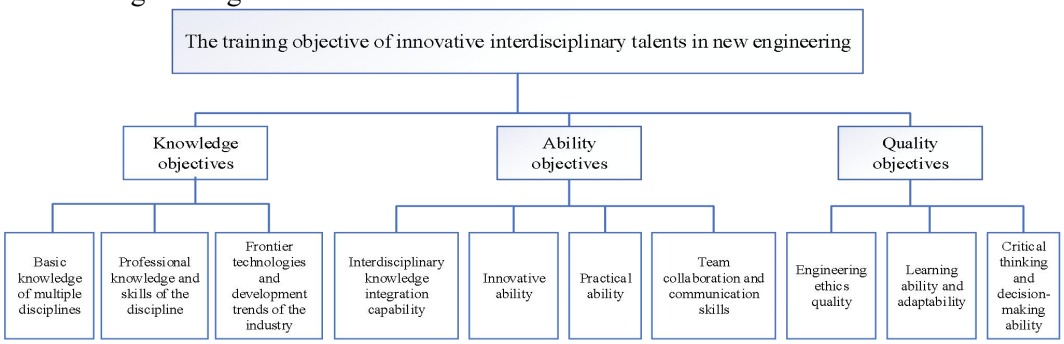

Figure 1. The Main Framework Diagram of the Training Objectives for Innovative Interdisciplinary Talents in New Engineering

3.2 Ability Goals

3.2.1 Interdisciplinary knowledge integration ability

Able to organically integrate knowledge from different disciplines, apply interdisciplinary theories and methods to analyze and solve complex engineering problems. For example, when designing an intelligent medical device, it is possible to comprehensively utilize mechanical design, electronic circuits, software programming, medical knowledge, etc., to achieve functional optimization and performance improvement of the device.

3.2.2 Innovation ability

Possess a keen sense of innovation and strong innovative thinking ability, able to propose novel engineering solutions and creative designs. Encourage students to break through traditional thinking patterns in learning and practice, carry out interdisciplinary research projects and innovation and entrepreneurship activities, and cultivate students' innovative spirit and entrepreneurial ability.

3.2.3 Practical ability

Possess strong engineering practical skills, proficient in using various experimental equipment, instruments, and tools to carry out engineering design, experimental operations, data analysis, and engineering implementation. By participating in corporate internships, engineering practice projects, subject competitions, and other activities, one can accumulate rich practical experience and improve their ability to solve practical engineering problems.

3.2.4 Teamwork and communication skills

Innovative cross disciplinary projects in new engineering fields often require collaboration among personnel from multiple disciplines to complete. Therefore, students should possess good teamwork spirit and communication skills, be able to effectively communicate and collaborate with personnel from different majors, leverage their respective strengths, and jointly promote the progress of projects. At the same time, it is necessary to have a certain international perspective and cross-cultural communication skills, and be able to participate in international cooperation projects and academic exchange activities. [4]

3.3 Quality Objectives

3.3.1 Engineering ethics quality

Establishing correct engineering values, complying with engineering ethics norms, possessing a good sense of social responsibility and professional ethics. In engineering practice, it is necessary to fully consider the impact of engineering activities on society, the environment, and humanity, to ensure the sustainable development and social

benefits of engineering projects.

3.3.2 Learning ability and adaptability

Possess strong learning ability and self-improvement ability, able to quickly adapt to the development and changes of new technologies and knowledge, and constantly update one's knowledge system and skill level. At the same time, it is necessary to have good psychological qualities and adaptability, be able to maintain a positive attitude in complex and changing engineering environments, and cope with various challenges and pressures.

3.3.3 Critical thinking and decision-making skills

Cultivate students' critical thinking abilities, enabling them to conduct in-depth analysis and critical thinking on engineering problems, without blindly accepting traditional concepts and authoritative viewpoints. On this basis, possessing scientific decision-making ability, able to make reasonable engineering decisions and scheme choices based on actual situations and data analysis results.

4. New Engineering Innovative Cross disciplinary Talent Training Model

The training model of innovative interdisciplinary talents in new engineering covers diverse content, breaks down disciplinary barriers, constructs interdisciplinary teaching teams, and integrates knowledge from multiple fields. It adopts teaching methods such as project-driven and industry-university-research cooperation, allowing students to learn innovation through practice. At the same time, it focuses on curriculum system design, incorporating cutting-edge knowledge and interdisciplinary content to create flexible courses. It strengthens the construction of faculty teams, enhances the comprehensive abilities of teachers, and cultivates innovative interdisciplinary talents that meet the demands of the new era through the combination of theory and practice, and the collaborative education of schools and enterprises, thus promoting educational reform and industrial upgrading. The main components of the training model of innovative interdisciplinary talents in new engineering are shown in the following Figure 2.

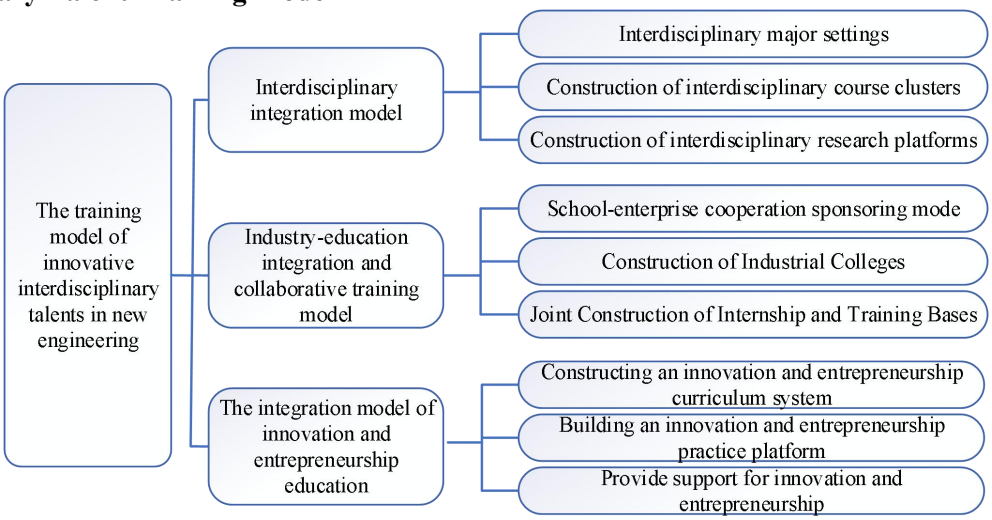

Figure 2. The Main Composition Diagram of the Training Model for Innovative Interdisciplinary Talents in New Engineering

4.1 Interdisciplinary Integration Model

4.1.1 Interdisciplinary major setting

Applied undergraduate universities should break the traditional division of disciplinary majors and establish new interdisciplinary engineering majors based on regional industrial development needs and disciplinary advantages. For example, offering a major in "Intelligent Manufacturing Engineering" that integrates disciplines such as mechanical engineering, automation, computer science and technology; Or establish a major in Biomedical Engineering, combining disciplines such as biology, medicine, and electronic information engineering. [5] These interdisciplinary majors provide students with a platform for systematic learning of multidisciplinary knowledge, enabling them to naturally form cross disciplinary thinking and knowledge structures in the process of professional learning.

4.1.2 Construction of interdisciplinary course

clusters

Building interdisciplinary course clusters based on existing disciplines and majors. For example, in the field of mechanical engineering, a "Mechanical Electronic Cross disciplinary Course Group" is established, including courses such as "Mechanical and Electrical Transmission Control", "Sensor and Detection Technology", and "Application of Embedded Systems in Machinery"; In the field of computer science and technology, the "Computer Communication Interdisciplinary Course Group" is offered, covering courses such as "Computer Networks and Communication", "Mobile Communication Technology", "Internet of Things Engineering", etc. Through the study of interdisciplinary course groups, students can establish knowledge connections between different disciplines, broaden their professional horizons, and cultivate interdisciplinary thinking.

4.1.3 Building interdisciplinary research platforms

Universities should strengthen the construction of interdisciplinary research platforms, such as establishing "Intelligent Materials and Devices Research Center", "New Energy Vehicle Engineering Research Center", etc. These research platforms gather research teams and resources from different disciplines, providing good conditions for teachers and students to carry out interdisciplinary research projects. Encourage teachers and students to participate in interdisciplinary research projects, collaborate with research teams from different disciplines, and conduct research on practical engineering problems. For example, establishing an "interdisciplinary research team of pharmacy chemistry materials science" to jointly carry out research on new drug development, drug action mechanisms, and the preparation of pharmaceutical related new materials. Seeking ways to provide funding support, establishing interdisciplinary innovation funding programs, offering interdisciplinary graduate scholarships, and encouraging students to engage in experimental and practical innovation.

4.2 Integration of Industry and Education Collaborative Education Model

4.2.1 Adopting the school enterprise cooperation model, we deeply cooperate with enterprises to jointly develop talent training plans, curriculum systems, and teaching content.

Enterprises provide universities with the latest engineering cases, practical projects, and technical standards based on their own technological needs and industry development trends, making talent cultivation more closely aligned with industry reality. [6] For example, a certain university cooperates with an intelligent manufacturing enterprise, and the enterprise sends engineers to participate in the course teaching and practical guidance of the "Intelligent Manufacturing Engineering" major, integrating the actual production process and intelligent device operation specifications of the enterprise into the teaching, improving students' engineering practice ability and employment competitiveness.

4.2.2 Constructing an industrial college, relying on advantageous disciplines and majors, and jointly building an industrial college with industry leading enterprises.

The Industrial College implements dual subject management of school and enterprise, with enterprises deeply involved in the entire process of the college's operation, including professional settings, faculty team construction, and teaching resource allocation. For example, a certain university and an electronic information enterprise jointly established the "Electronic Information Industry College". The faculty of the college is composed of university teachers and enterprise engineers, and the teaching facilities and laboratories are jointly invested and constructed by the university and enterprise. During the study period in the industrial college, students can fully experience the production environment and corporate culture of the enterprise, achieving seamless integration between school education and enterprise needs.

4.2.3 Implement the joint construction of internship and training bases, cooperate with enterprises to jointly build internship and training bases, and provide students with a real engineering practice environment.

Enterprises design internship and training projects for students based on their own production processes and technical characteristics, and arrange for enterprise mentors to provide on-site guidance. For example, at an internship and training base of a new energy vehicle enterprise, students can participate in practical production processes

such as assembly, debugging, and performance testing of new energy vehicles, understand the production process and technical requirements of new energy vehicles, and improve their engineering practical skills and problem-solving abilities. At the same time, universities can also use the internship and training bases of enterprises as places for teachers to practice, promote communication and cooperation between teachers and enterprises, and enhance the engineering practice teaching level of teachers.

4.3 Integration Model of Innovation and Entrepreneurship Education

4.3.1 Building an innovation and entrepreneurship curriculum system

Integrating innovation and entrepreneurship education throughout the entire process of cultivating new engineering talents, constructing an innovation and entrepreneurship curriculum system that includes general education courses, professional education courses, and practical teaching links. General education courses mainly cultivate students' innovation and entrepreneurship awareness and basic literacy, such as courses such as "Fundamentals of Innovation and Entrepreneurship" and "Innovative Thinking and Methods"; Professional education courses focus on integrating innovation and entrepreneurship concepts into professional curriculum teaching, offering courses such as "Professional Innovation and Entrepreneurship Case Analysis" and "Professional Project Planning and Implementation".[7]

4.3.2 Building an innovation and entrepreneurship practice platform

Establishing a number of experimental teaching demonstration centers, on campus and off campus practical teaching bases, industry collaborative education platforms, etc. with innovation and entrepreneurship as their characteristics, to promote collaborative education among the school, the school, the school enterprise, the school institution, the school government, and international cooperation. Especially promote the collaboration between disciplines and majors in our university, connect the basic courses of similar disciplines and majors, focus on the integration and sharing of course resources, and explore the establishment of a cross departmental, cross disciplinary, and cross professional innovation and entrepreneurship talent training model.

4.3.3 Providing innovation and entrepreneurship support

By integrating various forces to provide entrepreneurship counseling, quality improvement, resource integration, intellectual support, policy services and other support, we aim to cultivate students' spirit and ability of "double innovation" through multiple channels, and comprehensively cultivate and enhance the most promising student innovators and entrepreneurs in school.

5. Measures for the Construction of Teaching Staff

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5.1 Strengthening the Cultivation of Interdisciplinary Knowledge and Skills among Teachers

5.1.1 Interdisciplinary course training

Universities should organize teachers to participate in interdisciplinary course training to help them master the basic knowledge and cutting-edge trends of multiple disciplines. For example, teachers majoring in mechanical engineering can participate in short-term training courses in fields such as electronic information engineering and computer science to broaden their knowledge. Through online course platforms such as' Strong Teacher Online ', teachers are provided with rich interdisciplinary educational resources to support self-directed learning and improvement. [8]

5.1.2 Interdisciplinary research projects

Encourage teachers to participate in interdisciplinary research projects, collaborate with teachers from different disciplines and corporate engineers to conduct research on practical engineering problems. For example, establishing an "Intelligent Materials and Devices Research Center" to gather multidisciplinary research teams from mechanical engineering, materials science, electronic information, and other fields to jointly carry out scientific research projects. Establish a special research fund to support

teachers in conducting interdisciplinary research, enhancing their research abilities and interdisciplinary thinking.

5.1.3 Enterprise practice and secondment training

Arrange teachers to conduct practical training in enterprises to understand their actual production processes and technical needs. For example, collaborating with intelligent manufacturing enterprises, arranging teachers to participate in practical engineering projects on the production line of the enterprise for several months. Establish a system of teacher enterprise secondment, select teachers to serve as technical consultants or project leaders in enterprises, and deeply participate in the technological innovation and project management of enterprises.

5.2 Optimize the Structure of the Teaching Staff

5.2.1 Introducing teachers with interdisciplinary backgrounds

Universities should actively introduce teachers with interdisciplinary backgrounds, such as dual degree or doctoral degrees with interdisciplinary research experience. These teachers can provide rich knowledge and experience for the cultivation of interdisciplinary talents in new engineering fields. [9] By implementing a high-level talent introduction program, we aim to attract outstanding interdisciplinary talents from both domestic and international backgrounds to join the teaching workforce, thereby enhancing the overall level of the teaching staff.

5.2.2 Collaboration between schools and enterprises to build a teaching staff

Collaborate with enterprises to build a teaching staff, invite enterprise engineers to serve as part-time teachers, participate in course teaching and practical guidance. For example, a certain university cooperates with a new energy vehicle enterprise, and the enterprise sends engineers to participate in the course teaching and practical guidance of the "New Energy Vehicle Engineering" major. Establish a mechanism for school enterprise joint training of teachers, where university teachers and enterprise engineers jointly carry out scientific research projects and teaching reforms, achieving resource sharing and complementary advantages.

5.2.3 Establish a mechanism for teachers to transfer across disciplines

Encourage teachers to transfer across disciplines and provide training and support for teachers to transfer across disciplines. For example, establishing a flexible staffing management system to support teachers' mobility between different disciplines and optimize teacher resource allocation.

Establish a special fund for interdisciplinary job transfer to provide necessary financial support for transferring teachers and help them smoothly transition to new subject areas.

5.3 Enhance the Teaching Ability of Teachers

5.3.1 Teaching methods and skills training

Regularly organize teachers to participate in teaching methods and skills training, learn advanced teaching concepts and methods, such as project-based teaching, case teaching, flipped classroom, etc. Through forms such as teacher development salons, teacher observation classes, and teacher workshops, promote communication and cooperation among teachers, share teaching experience and innovative methods.

5.3.2 Teaching resource construction

Encourage teachers to develop interdisciplinary teaching resources, such as writing interdisciplinary textbooks, creating multimedia teaching materials, and building online courses. Establish a teaching resource sharing platform to promote resource sharing and collaborative innovation among teachers, and improve the efficiency of teaching resource utilization.

5.3.3 Teaching evaluation and feedback

Establish a scientific and reasonable teaching evaluation system, regularly evaluate the teaching effectiveness of teachers, provide timely feedback on evaluation results, and help teachers improve teaching methods and enhance teaching quality. Through various methods such as student evaluation, peer review, and teaching supervision, comprehensively understand teachers' teaching performance and provide multi-dimensional feedback for teachers.

5.4 Improve the Support System for Teacher Development

5.4.1Construction of Teacher Development Centers

Strengthen the construction of university

teacher development centers to provide comprehensive development support services for teachers, including teaching and training, scientific research guidance, career development planning, etc. The Teacher Development Center should be equipped with professional staff and regularly organize various training and academic exchange activities to enhance teachers' professional competence and comprehensive abilities.

5.4.2 Digital Empowerment of Teacher Development

Implement the Digital Empowerment of Teacher Development Action, utilize modern information technology methods, and enhance teachers' digital literacy and information technology teaching capabilities. Building a digital big model platform to promote the transformation of education models from standardized "teaching" to personalized "learning", serving students' autonomous and personalized learning, and assisting teachers' professional development and training. [10]

5.4.3 Incentive and guarantee mechanism

Improve the teacher incentive mechanism, establish teaching rewards, scientific research rewards, social service rewards, etc., and commend and reward teachers who have outstanding performance in the training of new engineering cross disciplinary talents. Strengthen the guarantee of teacher benefits, improve the salary and welfare level of teachers, and attract more outstanding talents to join the education industry.

6. Conclusion

Based on the positioning of applied undergraduate universities, guided by industry orientation, we focus on adjusting the interdisciplinary professional structure of new engineering disciplines, innovating the training mode of engineering talents, optimizing the training plan of engineering talents, reforming the teaching methods of new engineering disciplines, strengthening the construction of dual teacher and dual ability teaching staff, and building an effective teaching quality assurance system. We deepen the construction of professional connotation, in order to promote the close connection between the training of engineering talents in applied undergraduate universities and regional socio-economic development. Through the above measures, application-oriented undergraduate universities are expected to improve the quality of training innovative interdisciplinary talents in new engineering fields, providing strong support for cultivating high-quality engineering and technical talents that meet the needs of the new era.

Acknowledgments

This paper is supported by 2022 Guangxi Higher Education Undergraduate Teaching Reform A-class Project "Research and Practice on the Construction of New Engineering Interdisciplinary Majors in Applied Undergraduate Universities" (Project Number: 2022JGA381).

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