"Four Pathways" Empowering the Construction of a Student Science and Innovation Education System— A Case Study of the College of Intelligent Engineering, Zhengzhou University of Finance and Economics

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Abstract: *Universities are an important source of technological innovation and the main platform for cultivating innovative and entrepreneurial talents. Promoting the deep integration of grassroots youth league work and scientific research is an inevitable requirement for the high-quality development of universities in the new era. It is also an important approach to adhering to the socialist direction of running schools and implementing the fundamental task of cultivating moral character. By leveraging grassroots youth league organizations, strengthening ideological guidance, and focusing on "grassroots youth league leadership, technological innovation, and scientific research education," this study integrates the four elements of "grassroots youth league leadership," "innovation teams and clubs," "innovation activities and competitions," and "innovation practice bases" with the cultivation of innovative talents, exploring the "Four Pathways" to construct a scientific innovation education system in the college.*

Keywords: *Universities; Technological Innovation; Grassroots Youth League Organizations; Integrated Education*

1. Project Background

Implementing the strategies of strengthening the nation through science and technology and cultivating talent is a crucial path to achieving Chinese-style modernization. "Empowering high-quality development through intelligent manufacturing" relies on the construction of a high-quality, skilled workforce. Disciplines like intelligent manufacturing are prominent examples under this context. In response to the national shortage of talent in intelligent manufacturing, it is essential to vigorously promote the integration of research education with industry-university-research collaboration to cultivate highly skilled professionals in intelligent manufacturing, thus contributing to China's modernization.

Universities are important sources of technological innovation and key platforms for the cultivation of innovative and entrepreneurial talents. Fostering students' innovative spirit and abilities is a key indicator of quality education and talent cultivation, and is a sacred mission entrusted to universities by the state. Promoting the deep integration of grassroots youth league organizations with scientific research is a vital requirement for the high-quality development of universities in the new era. It is also significant for fulfilling the fundamental educational task of nurturing virtue and talent, and for addressing the crucial questions of what kind of people to cultivate, how to cultivate them, and for whom they are being cultivated.

2. Project Significance

Grassroots youth league organizations in universities are the main platforms for nurturing young talents. As the frontline institutions that connect and unite young people, grassroots youth league organizations play an important role in serving students' technological innovation. For colleges and departments focusing on engineering disciplines such as Vehicle Engineering, Automotive Service Engineering, Intelligent Manufacturing Engineering, and Creative Design, the College of Intelligent

Engineering closely aligns with the university's central talent cultivation work. In accordance with the requirements and deployment of the university's youth league committee and the college, and in combination with the college's talent development goals and professional characteristics, it plays to the strengths of youth league organizations by actively promoting student science and innovation education.

2.1 Grassroots Youth League Organizations as a Link to Unite Youth

Grassroots youth league organizations are the vanguard, the front-line units that connect and unite young people. The fundamental vitality of the youth league organization lies in maintaining close contact with young people. To achieve widespread and effective connection and coverage of league members, it is important to enhance the attractiveness and cohesion of grassroots youth league organizations. By constructing a science and innovation education system, grassroots youth league organizations serve as a vital link to connect and unite young people and provide effective channels for technological innovation.

2.2 Student Science and Innovation Work as a New Mission and Task Entrusted to Grassroots Youth League Organizations

Science is the primary productive force, talent is the primary resource, and innovation is the primary driving force. The implementation of strategies like "scientific and educational rejuvenation of the country," "talent-driven development," and "innovation-driven development" creates new fields and tracks for development, continuously reshaping new drivers and advantages. By focusing on promoting youth technological innovation, grassroots youth league organizations mobilize and organize young people to contribute wisdom and strength toward scientific development and accelerating the transformation of the economic development model. They shoulder the honorable mission of cultivating innovative talents for the nation.

2.3 Advantages of Grassroots Youth League Organizations in Serving Student Science and Innovation

Whether in terms of ideological guidance, organizational development, or training league cadres, grassroots youth league organizations are dynamic and active. They work closely with students and are deeply embedded in student life. As such, they have a strong influence, appeal, and cohesion regarding student technological innovation. By providing vibrant youth league activities, they serve as an effective platform for promoting science and technological innovation, thus facilitating the successful construction of the science and innovation education system.

3. Project Guiding Principles

The College of Intelligent Engineering at Zhengzhou University of Finance and Economics strengthens ideological guidance through grassroots youth league organizations, elevates talent cultivation quality with technological and research innovations, and closely aligns with the college's professional characteristics. Focusing on the "integration of science and education" as a distinctive educational model, the college adheres to the goal of "grassroots youth league leadership, technological innovation, and research-driven education." The central task focuses on technological and research innovation, integrating the four elements: "grassroots youth league leadership," "innovation teams and clubs," "innovation activities and competitions," and "innovation practice bases" with the cultivation of innovative talents. The college explores the "Four Pathways" to construct its science and innovation education system, proposing innovative points such as ideological guidance, youth league support, and strengthening the foundation of education through ideal and faith-based initiatives. Initial progress has been achieved.

4. Project Content

4.1 Leveraging the Service Role of Youth League Organizations in Education to Strengthen the Foundation of Research-Driven Education

4.1.1 Focusing on Top-Level Design, Innovating Systems and Mechanisms, and Enhancing the Leadership of Science and Innovation Education

Institutional support is a strong guarantee for scientific and technological innovation work. The College of Intelligent Engineering has positioned the goals and objectives of innovation work as follows: to attract every undergraduate to engage in scientific innovation, aiming for each student to achieve at least one innovation result during their four years of university, thereby promoting academic development and enhancing students' core employability. The college continuously improves the system and mechanisms for scientific innovation education, actively integrates resources, and establishes a leadership team for student scientific innovation, headed by the Party branch secretary and the dean of the college. This team works to implement a multi-faceted innovation education system with "policy support, financial backing, and departmental collaboration." The college has developed and implemented the "Undergraduate Participation in Faculty Research Projects Program" and the "Undergraduate Research Capacity Enhancement Plan," encouraging students to engage in scientific research and cultivate their research literacy and abilities. Specific processes for forming innovation teams, rewards mechanisms, and related policies and financial support are in place to ensure the success of student innovation activities.

4.1.2 Strengthening Organizational Empowerment, Solidifying Youth League Foundations, and Stimulating the Service Power of Science and Innovation Education

First, grassroots youth league organizations strengthen ideological guidance by combining macro-level theme education with micro-level grassroots activities. This approach cultivates a practical and pragmatic work style and encourages students to connect theory with practice. For first and second-year students, the college conducts educational activities to stimulate interest in scientific innovation, such as science lectures and research training sessions. Second, youth league support fosters the creation of "one league, one specialty," based on the college's disciplinary and professional features. Grassroots youth league organizations take the lead by setting up youth league branches in technology clubs, strengthening their organizational development and ideological guidance. Students are encouraged to join innovation teams from their first year, apply for research projects and patents, and increase participation in scientific innovation activities. Third, by enhancing the quality of second-class activities, the college organizes events like the "College Students' Science and Culture Festival," extracurricular academic competitions, "Smart Science Popularization on Campus" activities, and innovation exchange seminars, all of which strengthen students' practical abilities.

4.1.3 Strengthening Team Construction, Enhancing Talent Cultivation, and Increasing Cohesion in Science and Innovation Education

The college focuses on building "student organizations, innovation teams, and professional teacher guidance" as a three-pronged approach to team development. Teachers work alongside students to foster scientific research, innovation, entrepreneurship, and participation in various levels of competitions and science outreach activities. The college explores the implementation of a collaborative model involving "advisors, class teachers, and innovation mentors" to lay a solid foundation for students' scientific innovation. Additionally, the college innovates by activating youth league organizations through the enhancement of student leadership teams, expanding the reach of innovation work, and promoting a culture of recognition for innovation achievements. The student union, with its dedicated science and innovation department, organizes events, competitions, and team selection processes, creating a positive and cohesive atmosphere for scientific and technological innovation.

4.2 Using Innovation Teams and Clubs as Platforms to Create an Atmosphere for Research-Driven Education

4.2.1 Fostering Innovation Teams to Improve Technological Innovation Abilities

The college leverages its organizational advantages to implement a support plan for cultivating research and innovation teams. Breaking down professional and academic barriers, the college organizes interdisciplinary teams under the leadership of the College of Science and Innovation

Association. These teams include the 3D Printing Innovation Studio, Financial Intelligence Creative Studio, Huizhi Science and Innovation Space, and Zhichuang Innovation Team. These student-led teams, in collaboration with faculty, focus on technological innovation, entrepreneurship, and participation in skills competitions, improving the overall technological innovation capacity of the teams.[1]

4.2.2 Developing Professional Clubs to Expand the Reach of Technological Innovation

Student clubs are an essential part of university campus culture and the second classroom. By aligning with professional characteristics, the college fosters specialized science and technology clubs, which effectively promote student growth. For example, the College of Intelligent Engineering supports the development of academic science clubs, such as the Science and Innovation Association and the Automotive Enthusiasts Club. These clubs focus on specialization, offering students opportunities to participate in technology competitions, showcase works, attend professional lectures, and exchange experiences. The college has held the "Science and Technology Carnival" and "Science and Technology Exhibition" for three consecutive years, with strong academic and professional focus, creating a vibrant campus atmosphere for scientific research and exchange. These activities inspire and motivate students to engage in technological innovation and practice.

4.3 Using Science and Technology Competitions and Activities as Vehicles to Build a Science and Innovation Service Brand

4.3.1 Vigorously Promoting Science and Technology Competitions to Achieve "Learning through Competitions" and "Empowering through Competition"

The school, in line with its disciplinary characteristics and professional advantages, has established a student extracurricular academic and scientific activity system with science and technology competitions as the starting point. By organizing activities such as the Student Science and Technology Cultural and Art Festival, "Challenge Cup," Internet+, Student Academic and Technological Works Competitions, and Student Entrepreneurship Plan Competitions, the school guides innovation teams and various academic and scientific clubs to engage in activities around these major competitions. This process continuously cultivates students' practical innovation abilities and entrepreneurial skills, promoting the development of innovation awareness in an open and comprehensive manner, improving innovation capabilities, and guiding students to enhance their overall quality and problem-solving abilities through participation in competitions.

4.3.2 Continuously Enriching Science and Technology Activities to Expand Platforms for Student Participation in Technological Innovation

The school constantly enriches the carriers of science and technology innovation education in line with its professional characteristics and academic advantages. Leveraging innovation teams and clubs, the school regularly organizes lectures and salons on youth science and technology innovation, and builds campus-specific innovation activities. For three consecutive years, the school has held Science and Technology Achievement Exhibitions and "Science and Technology Carnival" events. The student union, in collaboration with innovation teams, organizes science and technology activities such as "Intelligent Manufacturing Popularization into Campus," and together with faculty, organizes "Intelligent Manufacturing Science Popularization" teams to participate in the summer "Three Rural Areas" social practice activities. This approach has helped establish a regular, distinctive, and high-quality innovation activities system.[2]

4.4 Using Innovation Practice Bases to Incubate Science and Technology Innovation Talent

4.4.1 Establishing Student Innovation Bases to Serve Student Technological Innovation

The school focuses on promoting teaching experiments and practical training platforms through scientific research projects, establishing experimental centers for industry-academia-research collaboration. The laboratories are open to students all day, encouraging early participation in research projects, laboratories, and research teams to develop students' research and practical innovation abilities. Supported by the provincial engineering technology research center and municipal key laboratory research platforms, the school uses a complete system to stimulate the enthusiasm of young league members for scientific and technological innovation.

4.4.2 Building Research-Based Education Platforms to Guide Shared Development for Teachers and Students

The school emphasizes integrating research project resources and building platforms for collaborative research and innovation between teachers and students. Through the establishment of a mentor system and undergraduate involvement in faculty research projects, excellent students are invited to participate in scientific research, with a focus on cultivating students' inquiry abilities and creative thinking, thereby sparking innovation and entrepreneurship.

4.4.3 Strengthening School-Enterprise Cooperation to Realize Industry-Education Integration and Promote the Transformation of Technological Achievements

The school strengthens the integration of teaching and research, deepens industry-education integration, and broadly integrates technological innovation resources. Through school-enterprise cooperation, the school collaborates with enterprises to co-develop projects and products that serve local development, nurturing and incubating innovative talent while advancing scientific research and innovation work.[3]

5. Innovation Points of the Project

5.1 Strengthening Ideological Guidance to Enhance the Internal Driving Force of the School's Science and Innovation System, Keeping the Youth League Members Full of Passion and Vitality for Innovation

In constructing the school's science and innovation talent development system, the school fully utilizes the guiding advantages of the Youth League organizations. The working idea is "wherever the youth are, the Youth League organizations should be there." By focusing on ideological guidance and helping build the Youth League, the school continues to work on guiding youth league members' thoughts and team-building activities. Based on the four key elements of "Grassroots Youth League Guidance," "Innovation Teams and Clubs," "Innovation Activities and Competitions," and "Innovation Practice Bases," the school formulates related learning content such as technological innovation and intelligent science popularization. This approach, starting from small areas and moving outward, subtly leads the youth to establish a concept of cultivating talent through technological innovation, keeping the youth league members' vitality and creativity alive.

5.2 Strengthening the Youth League and Deepening the Development of Student Clubs to Maximize the Effectiveness of Youth League Building

Student clubs are the primary platform for talent development and improving students' capabilities at universities. The school adheres to the goal of "one club" development and continuously strengthens the guiding role of grassroots Youth League organizations. It promotes deep integration between student clubs and academic disciplines, student comprehensive quality improvement, and the development of the school's science and innovation culture. This expands the coverage of club branches, increasing the enthusiasm and initiative of the youth in participating in technological innovation. Through a joint mechanism between Youth League organizations and student associations, the school strives to cultivate high-level student science and technology innovation projects in the field of innovation and entrepreneurship.

6. Project Outcomes

Since the implementation of the "Four Major Paths" to construct the college students' science and innovation talent development system, the School of Intelligent Engineering has seen vibrant development in student technological innovation work. Student participation in technological innovation has surged, with increasing numbers, levels, and awards year by year. The system has achieved near-complete coverage, with all students engaged, making it a key brand work for the school's distinctive development in science and innovation education.

6.1 Deepening the Collaborative Education Mechanism and Enhancing the School's Talent Development Effectiveness

The school insists on a multi-faceted education approach and integrates technological innovation education into the key aspects of its Youth League development. By enabling multi-level collaboration between student affairs and faculty, the school has built a comprehensive talent development system, thereby improving the effectiveness of its educational efforts.

6.2 Significant Achievements in Technological Innovation, Enhancing Teacher and Student Participation in Innovation

The atmosphere for technological innovation in the school has become increasingly strong. Students have been actively participating in innovation teams and projects since their first year, creating a positive environment where students are eager to engage in, compete in, and excel in technological innovation. The school's innovation teams have achieved excellent results in competitions such as the "Zhengzhou Local Universities Vocational Skills Competition – CNC Machining Technology and Industrial Robotics Technology," the "Higher Education Cup" College Student Advanced Drawing and Product Information Modeling Innovation Competition, and the "Tonglifang Cup" National Vocational Colleges Automated Production Line Virtual Simulation Competition, among others. Over the past year, the teams have led students to produce over 50 products, won one second prize and two third prizes in the 2021 Challenge Cup competition, and earned one silver and one bronze in the 2022 Challenge Cup competition. Additionally, the school participated in national and provincial skill competitions four times, winning 4 national first prizes, 8 second prizes, 7 third prizes, and 1 excellence award. The teams also led students in completing 10 provincial and municipal-level innovation projects, with 8 new projects initiated.[4]

6.3 Deepening the School's Innovation Service Brand and Expanding Professional Influence

The school actively organizes students to participate in national competitions such as the "Challenge Cup" and the "Internet+" College Student Innovation and Entrepreneurship Competition. Students have earned honors in national and provincial competitions such as the "Challenge Cup." Approximately 20% of students have received awards at the provincial level or higher, published papers, or obtained patents. This has highlighted the core competitiveness of the school's programs and expanded its influence.

Conclusion

Uniting the youth in the major cause of technological and research innovation is an important demonstration of the leadership role of grassroots Youth League organizations. The primary service group for the Youth League is the student body. The School of Intelligent Engineering, based on its academic strengths and focusing on student needs, continues to deepen the integration of Youth League development work with technological innovation, sparking the potential for innovation and reinforcing the strong leadership of grassroots Youth League organizations. At the same time, this process nurtures a culture of practical innovation among the youth. The school will continue to rely on expert leadership, professional guidance, and specialized teams to fully support student technological innovation activities, enhancing the quality of innovation projects and cultivating high-level college student technological innovation projects. This will help promote the favorable transformation of research results by both faculty and students.

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