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Research on the Training System of Green and Low-carbon Innovative Talents in Colleges and Universities

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Abstract: With the deepening implementation of the "dual carbon" strategic goals, China's demand for innovative talents in the green and low-carbon sectors has become increasingly urgent. As the primary platform for talent cultivation, universities must establish a scientific, systematic, and efficient training system for green and low-carbon innovation talents. This paper analyzes the present situation and problems of cultivating green and low-carbon innovative talents in colleges and universities, and puts forward some strategies for building the system from the aspects of training objectives, curriculum system, practical teaching, teaching staff, international cooperation, etc.

Keywords: Higher Education; Green and Low-carbon; Innovative Talent Cultivation System.

1. Research Background

Carbon peaking and carbon neutrality have become topics of widespread societal concern. With the "dual carbon" goals now elevated to national policy, building a community with a shared future for mankind and creating a sustainable ecological environment have become the mainstream of our era. Higher education institutions should strengthen the development of core knowledge systems related to carbon peaking and carbon neutrality, produce high-quality textbooks in this field, and establish comprehensive resource libraries. These efforts will encourage college students to focus on green and low-carbon development issues during their studies, deepen their understanding of achieving carbon peaking and carbon neutrality strategic objectives, and integrate the concept of green and low-carbon development into ideological education, classroom teaching, and public consciousness. By coordinating online and offline educational resources and leveraging the exemplary role of university ideological education WeChat public accounts, targeted measures should be implemented to build a distinctive, vertically integrated, and content-rich national education system for green and low-carbon development. This will guide young people to embrace green and low-carbon development concepts, laying a solid ideological and practical foundation for achieving carbon peaking and carbon neutrality goals. To meet the national requirements for cultivating professionals in the "carbon peak and carbon neutrality" initiative, we integrate green and low-carbon concepts into education, deeply aligning specialized training with the "dual carbon" goals. This approach enhances students 'environmental awareness, actively guides them toward sustainable lifestyles, and promotes extensive green education and public awareness campaigns. By embedding green development into the national education system, we ensure its comprehensive integration across all levels and aspects. The ultimate aim is to nurture high-caliber professionals who embrace green principles, adapt to a low-carbon society, and drive sustainable progress, thereby providing unique educational support for China's carbon neutrality objectives [1].

2. Research Significance

Global climate change has become a major issue that humanity must face. China has set the strategic goals of achieving carbon peak by 2030 and carbon neutrality by 2060, which not only represent profound systemic changes in the socio-economic system but also impose unprecedented demands on talent support. Green and low-carbon innovative talents are those who master the concepts and technologies of green, low-carbon, and circular development, serving as a crucial force to promote industrial restructuring and upgrading and drive sustainable economic development. Universities bear the important task of cultivating talents for the nation, and the traditional single-discipline, knowledge-injection-style training methods can no longer meet the demand for interdisciplinary and innovative talents under the dual-carbon strategy. Therefore, conducting systematic research on green and low-carbon innovative talents in universities and establishing a future-oriented talent cultivation system to nurture such innovative talents holds significant theoretical importance and urgent practical necessity [2].

3. Necessity of the Study

(1) Strong policy support

To advance green and low-carbon industries and achieve the "dual carbon" goals, the Chinese government has implemented a series of policy measures, providing robust support and resource guarantees for cultivating innovative talents in green and low-carbon fields at universities. Policy-wise, the state prioritizes the establishment of green and low-carbon-related disciplines and majors in higher education institutions, while increasing funding for research projects in these areas. Special funds have been allocated to support scientific innovation and talent development in green and low-carbon fields, with local governments also introducing supportive policies that offer financial assistance and preferential measures for talent cultivation and research. These policies have created a favorable policy environment and financial support for universities to nurture innovative talents in green and low-carbon fields, effectively attracting more professionals to engage in education and research in this

sector.

(2)The industry is developing rapidly.

As global awareness of climate change deepens, the green and low-carbon industry is entering a golden era of rapid growth. Sectors like new energy, energy conservation, carbon capture and storage (CCS), and green finance are expanding at an unprecedented pace, driving continuous market expansion and surging demand for innovative green professionals. China's green and low-carbon sector is poised for a rapid increase in specialized talent needs. This industry's rapid development offers universities broad career prospects and practical platforms for talent cultivation. Higher education institutions should align closely with industry demands, refine talent development programs, optimize curricula, and nurture green and low-carbon innovators who meet market needs.

(3)Technological innovation drives progress

The rapid advancement of new energy and cutting-edge technologies has reshaped the landscape of green and low-carbon innovation talent cultivation in universities, introducing updated curricula and research trends. This evolution not only propels the growth of green and low-carbon industries but also presents new opportunities and challenges for academic teaching and research. In terms of education, emerging technologies compel universities to continually update their curricula, integrating the latest technological achievements and research methodologies into teaching practices. This ensures students acquire cutting-edge professional knowledge and stay abreast of the latest research developments. The rise of new technologies also provides university faculty with expanded research topics and directions, enabling them to engage in technical innovation based on their personal interests and professional expertise, thereby offering technical support for green and low-carbon development.

4. Current Status and Issues of Green and Low-carbon Innovative Talent Cultivation

(1) Unclear training objectives

Higher education institutions lack well-defined objectives for cultivating green and low-carbon professionals, failing to align with the evolving demands of the green and low-carbon industry. This results in graduates who fall short of practical requirements in terms of knowledge structure and competencies. Some universities merely treat green and low-carbon-related majors as extensions or supplements to traditional disciplines, without establishing a distinct and comprehensive training framework.

(2) The curriculum system needs further improvement.

The curriculum system for green and low-carbon-related majors in higher education institutions faces several challenges. Firstly, the course design lacks systematic organization, failing to comprehensively cover core knowledge and skills in the green and low-carbon field, with courses like carbon trading management being notably scarce. Secondly, the content updates lag behind the rapid pace of technological innovation and the latest advancements in the field, resulting in a disconnect between students' acquired knowledge and practical applications.

(3) Weakness in practical teaching components

Practical teaching serves as a vital pathway to cultivate innovation and hands-on skills among college students. However, green and low-carbon majors in higher education still face multiple challenges in practical education. The limited establishment of practical teaching bases deprives students of authentic scenarios and project-based experiences. Moreover, the content of practical teaching remains disconnected from real-world applications, while the activities themselves are often monotonous and outdated. These shortcomings hinder the effective development of students' practical operational skills and problem-solving abilities.

(4) Unreasonable structure of faculty team

The green and low-carbon sector, as an emerging interdisciplinary field, demands advanced knowledge and practical skills from educators. However, most university instructors in this field come from traditional academic backgrounds, lacking specialized expertise and experience in green and low-carbon practices, which fails to meet the needs of cultivating innovative talents. Additionally, the faculty lacks industry experience and corporate connections, hindering students' understanding of industry trends and real-world business requirements.

(5) Insufficient international cooperation and exchange

Green and low-carbon development is a global challenge that requires enhanced international cooperation and exchange. However, universities currently have limited international collaboration in cultivating green and low-carbon innovation talents. Students often lack global perspectives and cross-cultural communication skills, and their engagement with world-renowned universities and research institutions remains superficial in areas like talent development and scientific research cooperation. This results in students being unable to access the latest international cutting-edge knowledge and technologies.

5. Implementation Path of Green and Low-carbon Innovative Talent Training

(1) Clarify the training objectives

Higher education institutions should align with the requirements and trends of green and low-carbon industries, leveraging their disciplinary strengths and unique features to establish specific, forward-looking, and era-appropriate goals for cultivating innovative green and low-carbon talents. These goals should encompass three dimensions: knowledge, skills, and qualities, with a focus on developing students' awareness of green and low-carbon practices, innovative thinking, practical skills, and interdisciplinary capabilities. The aim is to nurture professionals with a solid theoretical foundation in green and low-carbon technologies, expertise in new energy and energy-saving technologies, and the ability to engage in project planning, design, management, and research and development [3].

(2) Improving the curriculum system

1)Optimize the curriculum structure

Create a curriculum system with green and low-carbon as the main ideological orientation, which organically combines many disciplines such as natural science, engineering technology, economic management, environmental science, etc. Set up four levels of general education courses, professional basic courses, professional core courses and practical teaching courses to ensure the systematicness and integrity of the curriculum.

2) Update course content

The course incorporates cutting-edge research achievements, the latest developments, and relevant policies and regulations in the green and low-carbon field, enabling students to become knowledge consumers and practitioners who keep pace with the times. It elaborates on various existing clean energy sources and their technical characteristics, while also clarifying the operational mechanisms and trading principles of the carbon market.

3)Strengthening the construction of interdisciplinary courses

The field of green and low-carbon development involves knowledge and technologies from multiple disciplines, thus emphasizing the creation of interdisciplinary courses. Offering interdisciplinary electives enables students to engage in cross-disciplinary learning, broadening their knowledge and perspectives. For instance, a course like "Green and Low-Carbon Development and Development Economics" can be established as an interdisciplinary learning program.

(3) Enhancing Practical Teaching

1)Strengthening the construction of practical teaching bases

Higher education institutions should establish stable partnerships with green and low-carbon enterprises, research institutions, and other organizations to create practical teaching bases. These bases provide students with authentic work environments and project experiences, enabling them to develop practical skills and innovative thinking through hands-on practice. By collaborating with new energy companies to establish practical teaching bases for new energy power generation, students can become designers and managers of new energy projects [4].

2) Enrich practical teaching content

Design diverse practical teaching components, including lab sessions, course projects, graduation designs, internships, and innovation and entrepreneurship programs. These projects should address real-world needs, demonstrate appropriate complexity and difficulty, and cultivate students' problem-solving skills. Examples like "Campus Energy Conservation and Emission Reduction Solutions" and "Green Building Design and Evaluation" are excellent choices.

3)Establishing a Practical Teaching Evaluation System

Establish a scientific and rational practical teaching evaluation system to conduct comprehensive and objective assessments of students' practical processes and outcomes. The evaluation content should encompass various aspects such as practical operational skills, innovative thinking abilities, and teamwork capabilities. Evaluation methods may include teacher assessment, student self-evaluation, and peer evaluation.

(4) Optimizing the teaching staff

1)Introduction of high-level talents

The university should increase the introduction of high-level talents with professional background and practical experience in the field of green and low-carbon to enrich the teaching staff, and introduce experts and scholars in the fields of new energy technology, energy conservation and environmental protection technology, and carbon trading management.

2)Enhance teacher training

Organize regular training and academic seminars on green and low-carbon fields, update teachers' knowledge structure and educational concepts, and encourage them to take up temporary posts in green and low-carbon enterprises or research institutions to gain new practical experience. This will help them improve their practical teaching abilities.

3)Establish a "dual-qualified" faculty team

We recruit technical experts and managers from green and low-carbon enterprises as part-time instructors to form a dual-qualified faculty team, who can teach some practical courses.

(5) Enhancing International Cooperation and Exchange

1)Carry out international cooperative education

Universities should collaborate with renowned domestic and international universities and research institutions to establish joint programs, develop talent cultivation plans, create curriculum systems, and engage in teaching and research cooperation. For instance, joint training programs with foreign universities can provide students with international learning opportunities [5].

2) Organize international exchange activities for students

Students are encouraged to participate in international academic conferences, competitions, and overseas internships to broaden their global perspectives and enhance cross-cultural communication skills. Domestically, events such as the Energy Conservation and Emission Reduction Competition have been organized.

3)Introducing high-quality international educational resources

The paper adopts the professional teaching materials, courses and teaching methods of the high-level universities and enterprises at home and abroad, and summarizes and draws lessons from some successful experiences. On this basis, the paper optimizes and improves the existing educational concepts and models to achieve the goal of cultivating talents.

6. Conclusion

The establishment of a green and low-carbon innovation talent cultivation system in higher education constitutes a complex systemic endeavor. This paper proposes that interdisciplinary integration should serve as the core, with coordinated reforms implemented across five key dimensions: educational objectives, curriculum design, practical teaching, faculty development, and international collaboration. Such an approach will enable universities to nurture innovative talents equipped with green and low-carbon awareness, innovative capabilities, practical skills, and interdisciplinary competencies, thereby providing robust talent support for China's green and low-carbon industry development. Higher education institutions must continuously monitor trends and evolving demands in the green and low-carbon sector, promptly adjust their talent cultivation systems, and ensure alignment with societal needs.

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This achievement represents a milestone in the 2025 undergraduate experimental teaching reform project at Liaoning University of Science and Technology, titled 'Reform and Practice of the <ERP Sand Table Simulation> Experimental Course under the Background of Carbon Peak and Carbon Neutrality' (Project ID: PX2125447).

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