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Exploration of Practical Teaching of Resource Recycling Science and Engineering Major Based on the Training of Applied Talents

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Abstract: Resource recycling science and engineering is a new interdisciplinary subject. In order to meet the needs of the development of the circular economy, it is highly necessary to improve students' innovative abilities and practical skills. This paper analyzes the problems existing in the practical teaching of this major and puts forward some approaches to the construction of practical teaching of resource-based major from the aspects of content system construction of practical teaching of resource recycling major, deep cooperation between schools and enterprises, construction of dual-teacher teams, and integration teaching of industry-university-research competition. It has effectively improved the training quality of applied talents in the resource recycling major.

Keywords: Resource recycling science and engineering; Practical teaching; Applied talents

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1. Introduction

The Resource Recycling Science and Engineering major is an emerging industry field that has risen in recent years with the popularization of the national sustainable development philosophy and the development of green and low-carbon, energy-saving and emission-reduction, and circular economic models [1,2]. The construction and development of this discipline hold significant importance for promoting green and low-carbon sustainable development.

Our institution introduced the Resource Recycling Science and Engineering major in 2018. As a newly established chemical engineering major in a local applied university, our teaching management departments and professional teachers have been concerned about strengthening the practical components within the talent cultivation system to closely align with the development requirements of the local resource recycling industry, reforming the practical training model, and cultivating high-quality interdisciplinary applied talents adapted to the "new engineering" background, to meet the industry's demand for students' comprehensive qualities and

application skills, and to adapt to the future development of the emerging resource recycling industry [3].

2. Issues in practical teaching

With the deepening advancement of China's green and low-carbon ecological civilization construction strategy, the demand for resource recycling talents is not only increasing in quantity but also in quality requirements for talent cultivation, with a greater emphasis on innovation ability and the ability to solve complex social problems. The Resource Recycling Science and Engineering major, as an emerging interdisciplinary discipline, aims to address the issues of efficient resource utilization and recycling [4]. To better cultivate high-quality applied talents that meet market demands, practical teaching reform is particularly necessary. With the development of the economy and population growth, overexploitation and irrational use of resources have led to a series of environmental and social problems.

2.1. Incomplete relevant rules and regulations

The traditional undergraduate internship teaching model in general universities lacks a sound and reasonable organizational framework and rules and regulations. The university teaching committee, teaching operation system, student management, and other rules and regulations are generally formulated and composed by the university's management departments and teachers [5], lacking the participation of technical personnel and management personnel from enterprises related to the profession. It does not consider the actual situation of student practice for enterprise production, causing many inconveniences to enterprises [6].

2.2. Low professional distinguishability and indistinct features in practical teaching design

In the professional talent cultivation plan, the combination of professional basic courses, professional courses, and practical courses is not close enough, lacking depth and systematicity, making it difficult for students to apply the knowledge they have learned to actual work. Moreover, the setting of professional practical courses is too similar to other environmental and other professional courses, lacking professional characteristics.

2.3. Failure of practical teaching cases to meet current enterprise needs

With the promotion of green and low-carbon circular economy concepts, the market's demand and standards for resource recycling are also continuously improving, but the teaching content has not timely reflected these changes. The cases used in practical teaching are often data or projects from many years ago, which do not conform to the current industry development trend and have not kept up with the latest scientific and technological achievements and innovations.

2.4. Low quality of practical bases and student cognition deviation

The practical teaching bases for the resource recycling major are concentrated in enterprises such as organic fertilizer production, environmental testing, and waste metal recycling [7]. There is a lack of stable partnerships closely related to local resource recycling professionals, insufficient school-enterprise cooperation and exchange, and a phenomenon of disconnection between production and education [8].

2.5. Limited dual-teacher resources

As it is an emerging interdisciplinary content, most teachers go from university to university, and the teacher

resources with a practical background and experience in resource recycling are relatively weak, which leads to an inability to provide high-quality practical teaching resources for students when offering resource recycling-related practical courses.

3. Measures to strengthen resource major construction

3.1. Improving rules and regulations

To strengthen the management of practical teaching and improve the quality of practical teaching, a sound management system should be established, and a Resource Recycling Major Teaching Steering Committee composed of university professional teachers and enterprise technical leaders should be established. Enterprise technical personnel participate in the formulation of professional talent cultivation plans, the setting of practical course systems, the formulation and actual implementation of practical teaching plans [9], and jointly maintain the long-term stable development of off-campus practical bases.

3.2. Constructing the practical teaching content system of the resource recycling major

The professional skills of the resource recycling major need to be clarified. Through the cultivation of this major, students need to possess four professional skills: agricultural waste resource utilization skills, material processing and preparation skills, process design and equipment selection skills, and environmental pollution repair skills.

A detailed practical teaching objective system for the resource recycling major should be constructed. Based on the requirements for cultivating college students' practical skills and the ability to solve complex agricultural production practical problems under the background of new engineering, the role of practical teaching is emphasized [10], and practical teaching is used as a means of education and teaching, unified with theoretical teaching. By carefully studying the talent cultivation plan, professional course system, and the requirements for skill and quality goals in professional training, the practical teaching goals are refined to formulate specific and clear practical skill goals.

The practical teaching content is reconstructed. A practical teaching content system applicable to the cultivation of applied talent in the resource recycling major has been constructed, dividing practical teaching into three levels: basic practice, professional practice, and comprehensive practice. The comprehensive practice focuses on combining teachers' scientific research mainly for the resource utilization of industrial and agricultural waste, from material preparation, practical application, testing, etc., to train students' scientific research ability and innovation ability, encouraging participation in social practice, innovation design competitions, and other exercises to improve students' comprehensive abilities.

A diversified practical teaching implementation method is established. The traditional practical teaching method that only uses laboratories has changed. Practical teaching is carried out through experiments, comprehensive practical training, course design, professional skill training, social surveys, graduation design, and internships, establishing online teaching resources experimental project operation short videos, and other digital teaching resources and diversified teaching forms, innovating practical teaching methods.

4. Strengthening in-depth school-enterprise cooperation

4.1. Establishing the green low-carbon development industry college platform

By actively striving for national and local scientific research projects and financial support, the Green Low-

Carbon Development Industry College has been established to promote the deep integration of production and education, jointly carry out green and low-carbon teaching, scientific research activities, and other school-enterprise cooperation projects. It also jointly builds internship and training bases, allowing students to participate in real project practices, understand industry dynamics, and provide more internship and employment opportunities for students, improving the quality and targeting of applied talent cultivation.

4.2. Establishing a school-enterprise resource-sharing mechanism

A school-enterprise cooperation information platform has been established to promote information and resource sharing, including textbook construction, case libraries, databases, project libraries, etc., regularly update textbooks and teaching cases, and invite enterprises to participate in case writing to ensure that the content is synchronized with the latest technology and market trends, ensuring the practicality and timeliness of the cases. Mutual appointment of part-time teachers is also carried out. Enterprise technical personnel are employed as part-time teachers to participate in professional teaching work, and at the same time, teachers can visit enterprises for on-the-job training.

5. Strengthening the construction of dual-teacher teams

5.1. School and enterprise jointly formulating practical teaching team construction measures

Young teachers are encouraged to understand enterprise needs, participate in enterprise R&D projects or social service projects, help enterprises solve demand problems, and carry out teaching and scientific research work in combination with production practice. Teachers combine theoretical teaching with practical needs and focus on cultivating students' abilities to solve practical engineering problems and innovative abilities.

5.2. Clarifying the target positioning of dual-teachers

Dual teachers should possess core abilities such as resource recycling professional knowledge, practical skills, and practical teaching. They also should have professional ethics, innovation awareness, team collaboration, and other qualities.

5.3. Strengthening theoretical learning and professional advanced studies

Teachers can participate in advanced study classes organized by universities, industry associations, or professional institutions through online and offline methods. Each teacher should participate in at least one professional construction meeting every year to understand the current professional development status and improve the level of professional construction.

5.4. Strengthening international exchange and cooperation

It is important to leverage the advantages of the college's existing environmental ecology professional Sino-foreign cooperative education, actively introduce advanced foreign teaching concepts and resources, carry out international scientific research cooperation and academic exchange activities, and improve the international influence and competitiveness of the discipline.

6. Implementing the integration of industry, education, research, and competition in teaching

In response to the requirements for the cultivation of applied talent in the resource recycling major, the practical teaching of the resource recycling major is reformed in an integrated manner of industry, education, research, and competition.

6.1. Implementing project-driven teaching

Through the Green Low-Carbon Development Industry College, cooperation with related enterprises, and the resource sharing mechanism, professional course teaching activities are carried out with real industry project cases as carriers, integrating more practical teaching content into the classroom and enriching and building a project case library and database co-built with enterprises.

6.2. Promoting the transformation of scientific research results

It is necessary to strengthen cooperation with enterprises, actively encourage teachers to lead and participate in scientific research projects, and promote technological innovation and transformation through industry-education-research cooperation projects. Teachers need to enhance their ability to serve society, transform research results into teaching content, encourage students to participate in scientific research projects, and improve the quality of talent cultivation.

6.3. Promoting learning with competitions

Teachers should combine the various extracurricular innovation competitions and scientific and technological activities carried out by the country, Shandong Province, and the school. Students actively participate in the Challenge Cup competition, Internet+, energy-saving and emission-reduction competition, environmental protection competition, social practice activities, science popularization creative competition, scientific and technological innovation competition, etc. [4]. This year, the students actively participated in various competitions and won more than 40 awards in university-level competitions.

7. Conclusion

This paper explored the practical teaching of the resource recycling major from the construction of the practical teaching content system, strengthening in-depth school-enterprise cooperation, building a dual-teacher team, and implementing the integration of industry, education, research, and competition in teaching, improving the cultivation of students' innovative and practical skills.

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Disclosure statement

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