Research of Deepening the Training Path for Students at the Vocational Undergraduate Level in Iron and Steel Metallurgy from the Perspective of School-Enterprise Integration

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Abstract: *This article explores multi-angle collaboration approaches under the context of deep integration between schools and enterprises, aiming to enhance the practical and innovative abilities of vocational undergraduate students, cultivate high-quality professionals for the metallurgy industry, and promote the sustainable and healthy development of the industry. The study finds that, under the current context of education-industry integration, there are issues in the student training pathways of metallurgical engineering vocational undergraduate education, including misalignment between training objectives and enterprise needs, disconnection between teaching content and actual work demands, insufficient practical teaching components, and limitations in teaching resources and methods. The article proposes practical explorations such as project-oriented curriculum development and implementation, introduction of corporate mentoring systems, improving students' comprehensive abilities through practical activities, and establishing comprehensive school-enterprise collaboration. It also provides recommendations for the metallurgical engineering vocational undergraduate education.*

Keywords: *school-enterprise cooperation; vocational undergraduate; talent cultivation; metallurgical engineering major*

1. Introduction

1.1 Research Background and Significance

The metallurgy industry, as a foundational and strategic sector of the national economy, plays a critical role in maintaining economic stability and promoting sustainable social development[1]. In the face of challenges such as global economic slowdown, stringent environmental policies, and market demand fluctuations, the cultivation of talent in the metallurgy industry has become increasingly crucial[2]. Traditional educational models can no longer meet the demands of the industry, and school-enterprise cooperation has become a key approach to cultivating metallurgy professionals[3]. School-enterprise collaboration integrates enterprise needs and industry trends into the curriculum, making learning more relevant to real-world applications, thereby enhancing its practical and targeted nature. As metallurgy technologies evolve rapidly, students are required to have solid theoretical knowledge and practical innovation capabilities[4]. The school-enterprise cooperation model allows students to learn through practical experience in real work environments, improving their practical skills and innovative thinking, which aligns with the new demands of the metallurgy industry for talent[5]. This research aims to explore multi-dimensional approaches under the deep integration of school-enterprise cooperation, to enhance the practical and innovative capabilities of vocational undergraduate students, cultivate high-quality professionals for the metallurgy industry, and promote the sustainable and healthy development of the industry.

1.2 Domestic and International Research Status and Gaps

Under the current context of education and industry integration, the student training pathways in iron and steel metallurgy vocational undergraduate education are undergoing a profound

transformation[2]. Traditional teaching models primarily focus on classroom-based theoretical instruction, with students passively receiving knowledge. The teaching model is unidimensional, lacking sufficient interaction between teachers and students, and failing to meet the needs for differentiated teaching and personalized adaptive learning[3]. The curriculum content lacks layering and emphasis, with teaching mainly focusing on the delivery of concepts, principles, and knowledge points, without establishing connections to engineering practices or project cases. This makes it difficult to capture students' attention and interest, and the insufficient use of heuristic teaching methods hampers the development of students' ability to analyze and solve real engineering problems comprehensively[6]. In the construction and reform of the iron and steel intelligent metallurgy technology program in higher vocational colleges, significant progress has been made in terms of practical conditions, faculty strength, and curriculum resources. However, the transformation and upgrading of professional talent cultivation still lags behind the new demands of the iron and steel industry. Currently, the talent cultivation objectives in higher vocational colleges still primarily focus on practical skills, lacking an integration of innovation awareness and capabilities in the context of the intelligent and green development of the steel industry.

1.3 Research Objectives and Research Methods

This study aims to construct a student training pathway for iron and steel metallurgy vocational undergraduates under the integration of school-enterprise cooperation. The research methods include: a literature review to examine talent cultivation models and the school-enterprise collaboration mechanism; comparative analysis and systematic planning, which involve identifying key elements and implementation strategies[7].

2. Steel Metallurgy Vocational Undergraduate Student Training Status and Problem Analysis

2.1 Mismatch Between Training Objectives and Enterprise Needs

In the current context of vocational undergraduate education development, the school-enterprise collaborative education mechanism plays a crucial role. It has a decisive impact on cultivating technical-skilled talents who can meet the practical needs of enterprises. However, we must face the reality that there is a significant difference in talent cultivation objectives between schools and enterprises, which leads to a mismatch between objectives and needs[6]. Schools focus on improving employment rates and basic skills to meet national requirements, but the alignment with enterprise needs is limited. Enterprises focus on reducing operating costs and improving efficiency, requiring graduates who can quickly adapt and generate results. Therefore, school-enterprise cooperation needs to be deepened by clarifying enterprise demands, adjusting training plans, increasing practical teaching, and strengthening students' practical and innovative abilities. Enterprises should also participate in talent cultivation by providing internship opportunities, enhancing students' recognition and sense of belonging to the enterprise, and jointly cultivating technical-skilled talents with both theoretical knowledge and practical abilities[4].

2.2 Disconnection Between Teaching Content and Actual Work Requirements

One of the core goals of vocational education is to cultivate students' ability to effectively translate the knowledge and skills they have learned into practical application in the workplace. However, in some applied fields, such as the steel metallurgy industry, there is often a disconnection between the teaching content and the actual work requirements[1]. The reasons for this disconnection are multifaceted, including the lag in curriculum design, the limitations of traditional teaching methods, insufficient practical teaching opportunities, and the rapid changes in industry demands. Specifically, the course content fails to reflect the latest industry trends in a timely manner, teaching methods often lack the necessary interactivity and engagement, students have limited opportunities for practical experience, and the pace of technological advancements in the industry is very fast[3]. To effectively narrow the gap between education and industry needs, it is necessary to update the curriculum, reform teaching methods, strengthen practical components, and keep up with industry trends, thereby improving teaching quality, enhancing students' practical abilities and innovative thinking, and meeting the market's demand for professional talent[7].

2.3 Insufficiency of Practical Teaching Components

In higher education, practical teaching plays a crucial role, especially in the field of steel metallurgy vocational undergraduate education, where it is particularly prominent. However, the current practical teaching components exhibit some notable deficiencies and shortcomings. These shortcomings are primarily reflected in the lack of a close connection between practical teaching and the actual demands of the industry, the singular and insufficiently diverse teaching content and methods, the inadequacy of the teaching staff to meet educational needs, the insufficient provision of teaching facilities and resources, and the lack of a robust evaluation and feedback mechanism, which cannot effectively guide teaching improvements. In order to significantly enhance teaching effectiveness, it is necessary to initiate in-depth reform and optimization of practical teaching components from multiple perspectives. Through these comprehensive measures, we aim to cultivate students who possess solid theoretical foundations, practical operation skills, and innovative spirit, thereby contributing more outstanding talent to the steel metallurgy industry.

2.4 Limitations of Teaching Resources and Methods

In the current educational environment, the training of vocational undergraduate students in steel metallurgy is facing a series of challenges, particularly in the limitations of teaching resources and methods[2]. Traditional teaching models overly rely on classroom-based theoretical instruction, which often restricts students' active participation and interaction with teachers. As a result, students tend to passively absorb knowledge, lacking sufficient opportunities for deep reflection and personalized exploration. The limitations of teaching resources are primarily reflected in the slow pace of resource updates, relatively limited opportunities for hands-on practice, and insufficient teaching equipment and materials[3]. To better meet the needs of industry development and promote students' individualized growth, we must reform existing teaching resources and methods. This includes updating and expanding teaching resources, enriching and innovating teaching methods, and strengthening practical teaching and case analysis to cultivate students' practical abilities and innovative thinking[13].

3. Practical Exploration of the Training Path for Vocational Undergraduate Students in Steel Metallurgy

3.1 Project-Oriented Curriculum Development and Implementation

In the vocational education system, project-oriented curriculum development and implementation are key to enhancing teaching quality and students' practical abilities. For undergraduate students in the steel metallurgy program, constructing such a curriculum system based on educational practice and theoretical research is of practical significance[3]. This model focuses on solving real-world problems and allows students to learn knowledge, acquire skills, and develop problem-solving abilities through work projects. It not only boosts students' enthusiasm for learning but also helps them understand the connection between theory and practice, strengthening their ability to address practical problems[6]. The implementation of project-oriented courses requires accurately defining training objectives, clarifying theoretical knowledge, practical skills, and job competencies. Project courses should be designed based on industry needs, with the teacher's role shifting from knowledge transmitter to guide, supervisor, and evaluator, offering challenging tasks, guidance, and support. Additionally, a comprehensive evaluation system needs to be established, incorporating process and outcome assessments, and fostering students' teamwork, communication, coordination, and project management skills.

3.2 Introducing the Enterprise Mentor System to Strengthen the Role of Practice Mentors

In the context of the integration of education and practice, the traditional teacher-led training model can no longer meet the needs of technical professions. Introducing the enterprise mentor system and strengthening the role of practice mentors is key to improving educational quality and aligning talent development with enterprise needs[14]. The enterprise mentor system brings practical operational experience and industry standards into education, enhancing students' professional skills and overall qualities, making learning more aligned with industry demands, and increasing employability. In the steel intelligent metallurgy technology program, the role of the enterprise mentor system includes providing real learning scenarios, enhancing professional skills, increasing awareness of corporate culture, and helping students establish a correct career development view[20]. However, implementing

the enterprise mentor system also faces challenges, such as coordinating mentor work schedules with teaching time and establishing an evaluation system to ensure teaching quality. In conclusion, the enterprise mentor system is an important pathway for school-enterprise cooperation and improving talent development quality[17]. Through optimizing the implementation mechanism, it can effectively enhance students' professional skills and overall qualities, meet enterprise needs, and lay a foundation for students' career development.

3.3 Enhancing Students' Comprehensive Abilities through Practical Activities

Practical activities are key to enhancing students' comprehensive abilities within the education system, especially in applied disciplines such as metallurgy engineering. These activities strengthen the connection between theory and practice, improving engineering practice, innovative thinking, and problem-solving skills. Metallurgical engineering students learn to apply knowledge in real work environments through laboratory work, internships, and project design, which is crucial for becoming on-site engineers. These activities deepen the understanding of theory and train independent thinking and teamwork[12]. For example, the "3+1" model allows students to apply theory in practice, while school-enterprise cooperation provides internship opportunities that help students gain work experience and gain a deeper understanding of corporate culture[19]. This teaching model enhances professional literacy and employability, while also stimulating innovation and research interest. Therefore, practical activities not only enhance engineering abilities but also improve innovative capacity and comprehensive qualities, laying a foundation for future career development[20].

3.4 Establishing Comprehensive School-Enterprise Cooperation

Achieving high-quality talent development requires multi-dimensional, in-depth integration between schools and enterprises. Schools and enterprises should establish all-round cooperation in areas such as party building, group building, scientific research innovation, teacher development, curriculum, talent training, student activities, internships, and employment. First, a high-level professional team of materials metallurgy experts should be established to empower students and improve human resource levels in steel enterprises[14]. Second, industry cooperation models should be referenced to improve talent development programs, enrich the "order-based" training model, and provide students with qualification certificates or internship proofs to resolve conflicts between learning, internships, and employment. Third, to improve the quality of talent cultivation in the steel industry, vocational education should establish a "dual-teacher" expert team. Modern steel production has driven the integrated application of technologies such as industrial internet, cloud computing, big data, and artificial intelligence, and in response to the development of smart industries, enterprise teachers should be employed to teach and pass on cutting-edge knowledge[15]. Fourth, schools should cooperate with high-level institutions to offer interdisciplinary courses, and teachers should regularly enter enterprises for professional development to enhance their academic expertise.

4. Conclusion and Outlook

It is recommended that the vocational undergraduate education in steel metallurgy should construct a curriculum system that integrates industry development and technological advancement while strengthening awareness of green and low-carbon practices. The curriculum should combine theory and practice, collaborate with enterprises, reflect actual production demands, and enhance students' employability. Innovative teaching methods, such as project-driven and problem-oriented models, should be adopted to strengthen practical teaching, such as internships and practical training, fostering students' independent thinking and problem-solving abilities. The construction of a qualified teaching staff is crucial, requiring regular training, knowledge updates, and improvement of teaching and practical guidance capabilities. Establishing school-enterprise cooperation platforms can enhance the effectiveness of education, provide more internship opportunities, and supply talent that meets industry demands.

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