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Reform and Practice of Mineral Processing Innovative Talents Training System for International Engineering Education: Taking Wuhan University of Science and Technology as an Example

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ABSTRACT
In accordance with the disciplinary characteristics of the mineral processing engineering major of Wuhan University of Science and Technology, this article aims at cultivating high-quality international engineering application-oriented talents, and focuses on improving students' engineering practice ability. Through reforming the training model, revising the training plan, optimizing the curriculum system, strengthening practicing teaching reforms, promoting school-enterprise cooperation, encouraging college students to participate in extracurricular scientific and technological innovation, and improving the construction of teaching staff, etc., students' engineering practice and innovation capabilities have been greatly improved.
Keywords*: International engineering education, mineral processing, innovative talent training, technological innovation*

1. INTRODUCTION

The international engineering education certification system is to establish a mutual recognition system for degrees and professional qualifications by signing a mutual recognition agreement. The signatory countries recognize each other's academic qualifications. Graduates can apply for jobs and postgraduate studies in other countries without barriers. It has international substantive equivalence [1]. The training of talents implemented in the context of international engineering education is based on the international education system, multi-disciplinary collaborative innovation, focusing on highlighting professional characteristics, and its core is to promote engineering education reform and improve the quality of engineering education; promote the connection and cooperation between engineering education, enterprises and industries, Enhance the adaptability of talent training; promote the international mutual recognition of engineering education and enhance international competitiveness [2]. In 2016, China was approved as a full member of the "Washington Agreement", indicating that the quality of China's engineering education has been recognized by the international engineering community, achieving the international substantive equivalent of engineering degrees, and also putting forward higher requirements for China's engineering education [3-4].
The major of mineral processing engineering is one of the most distinctive key majors of Wuhan University of Science and Technology. The major was founded in 1973. After more than 40 years of development, it has formed iron ore agglomeration, fine-grained mineral separation, mineral hydrometallurgy, and comprehensive mineral resources. Main research directions such as utilization. In 2010, mineral processing engineering was approved as a national specialty major; In 2013, mineral processing engineering was approved as a major national engineering education program; and in 2017, mineral processing engineering passed the evaluation of the international engineering education certification system. Its professional orientation is: cultivating the comprehensive development of morality, intelligence, physical beauty, strong sense of social responsibility, good humanistic qualities and a certain international perspective, a certain innovation ability, teamwork, management coordination ability and lifelong learning ability, and can solve complex engineering problems. High-quality applied talents. The training goal is to cultivate the comprehensive development of morality, intelligence, physical beauty, strong sense of social responsibility, good humanistic qualities, a certain international perspective, and certain innovation capabilities based on mineral processing, comprehensive utilization of resources, steel metallurgy, environmental engineering and other related fields. Teamwork and management coordination ability and lifelong learning ability, with the basic ability to engage in production, process and equipment design, research and development, technical management and operation, high-quality applied talents who can solve complex engineering problems.

The “Belt and Road” region is the world's main source of mineral raw materials. There are nearly 200 types of mineral resources stored in the region, valued at more than US$250 trillion, accounting for 61% of the world's total. Therefore, cooperation in the field of mineral resources is an important part of the “Belt and Road” initiative. To train qualified engineering talents for the development of mineral resources in the “One Belt, One Road” area and the country, the mineral processing engineering discipline of Wuhan University of Science and Technology has implemented the training of outstanding engineering talents and the idea of running schools for international engineering education in recent years. Based on the knowledge, ability, and quality requirements that international mineral processing professionals should possess in the future, the establishment and practice of a mineral processing excellent talent training model for international engineering education has achieved remarkable talent training results.

2. TRAINING MODE AND PRACTICE OF INNOVATIVE TALENTS FACING INTERNATIONAL ENGINEERING EDUCATION

2.1. Planing the Implementation System of Talent Training Goals

In view of the professional positioning and training goals of engineering education, relevant guarantees and implementation plans have been formulated from teaching plans, training plans, teaching implementation, and effect feedback. The planning system to achieve the training goals of mineral processing disciplines is: (1) Teaching links The teaching process is implemented according to the teaching plan, such as theory teaching, experimental courses, curriculum design, various field internships, graduation design (thesis), etc., and extracurricular credits are obtained through a variety of extracurricular activities, such as social practice, scientific and technological innovation projects, etc. Achieve the realization of training goals. (2)The training plan consists of a revision group composed of backbone teachers of this major. After investigating the latest training plans of mineral processing engineering majors in domestic and foreign universities, and extensively soliciting the requirements of the employers on the training plan, the revision opinions are formed after discussion, and each course teacher will modify the plan accordingly. Carry out the revision of the course syllabus. (3)According to the feedback information in the teaching implementation process, including the rationality of the course setting, the adaptability and completeness of the course teaching content, etc., the training program is adjusted annually to ensure that the training program is closely focused on the goal and meets The requirements of social development.

2.2. Strengthening the Combination of Theory and Practice, And Build a Curriculum System That Meets the Training Goals

Taking the training of engineering design, construction, technology development and management capabilities as the starting point, we have built a curriculum system for excellent engineering education in mineral processing on the basis of the original mineral processing engineering professional curriculum system, focusing on strengthening the training of basic skills such as foreign languages and computers. Strengthen basic courses of engineering science such as mathematics, physics and chemistry; emphasize the professional foundation of mineral processing engineering, highlight the engineering practice characteristics of mineral processing engineering, and strengthen the basic professional courses of mineral processing.

After the course system is optimized and adjusted, the credits of practical teaching modules to strengthen the engineering application ability and innovation ability account for 22.5% of the total credits, which guarantees the engineering practice training in the teaching time. At the same time, in order to meet the individual needs of students for professional knowledge in engineering practice, we combine existing teaching resources to add 6 additional professional elective courses on the basis of the original 11 professional elective courses, which broadens students' engineering vision.

Among them, in order to ensure the training effect of engineering education, we have constructed a "three-level, five-module" practical teaching system, and arranged the practical links with the three-level "basic level, comprehensive level and innovation level" plan, and according to the five modules "practice module, experiment Teaching module, graduation design and course design module, scientific and technological innovation module, and quality development module" implement practical teaching, enrich the content of practical teaching, and strengthen practical training, so as to finally cultivate students' practical ability, basic practical skills and engineering integration The purpose of the ability [5].

2.3. Strengthening the Integration and Complementarity of Teaching and Practice to Ensure the Improvement of Engineering Practice

In view of the current weak links in the teaching of Chinese universities, the key points of implementing the teaching reform of international engineering education are: (1) Focus on the cultivation of international practical ability. Based on the training of outstanding engineers, focus on internationalized multi-directional teaching, focus on implementation methods, and focus on practicality, practice and innovation. (2) Guided teaching.

Teach students how to obtain the required information, how to extract and summarize information. (3)Strengthen hands-on ability. (4)Strengthen the cultivation of comprehensive ability.
In order to effectively improve the engineering practice ability of students and ensure the practical teaching effect, we have carried out extensive engineering practice teaching reform [6].

2.3.1. Increasing the construction of the engineering practice platform in the school.

In recent years, we have increased the construction of engineering practice teaching platform and capital investment on the basis of the original 3,500 square meter professional laboratory and 16.13 million yuan of equipment. It mainly includes: according to the actual situation, the school has added 1,600 square meters of excellent engineering training and experiment platform, and used the national and Hubei Province to support the construction of local colleges and universities, and invested 5 million in the purchase of equipment and laboratory maintenance and renovation.

2.3.2. Strengthening the construction of off-campus practice bases.

The internship base outside the school has strengthened the construction and improved the conditions for internship by co-construction and management, mutual benefit and win-win method. For example, in the Daye Iron Mine of WISCO Resources Group, an internship training center including accommodation and learning has been built, which provides a good basic guarantee for students' internships in enterprises [7]. At the same time, the university has signed school-enterprise cooperation agreements with many companies, such as Baowu Iron and Steel Company, Maanshan Iron and Steel Company, Liuzhou Iron and Steel Company, etc. These companies are involved in the development and utilization of mineral resources and the engineering technology and equipment of the iron and steel metallurgical process. They provide a large amount of engineering materials for the students majoring in mineral processing engineering, such as production workshops, engineering equipment, engineering drawings, operation manuals, etc., which are well satisfied The teaching needs of engineering practice.

2.3.3. Actively carrying out practical teaching reform.

The design of practical teaching links should be closely integrated with engineering practice: (1) Experimental courses, including basic courses and professional course experiments, through the integration of experimental course teaching content, the proportion of comprehensive and design experiments is increased to more than 80%, such as sintering Experiments and pellet experiments, by adjusting the syllabus and increasing the number of experimental hours, turned experiments that could only be demonstrated into experiments that can be designed, implemented, and completed by students, and improved their engineering experiment capabilities[8]. (2) Curriculum design, including basic curriculum and professional curriculum design, comprehensively train students' basic engineering skills through curriculum design; (3)Internship, including understanding internship, production internship, graduation internship, and through engineering training on the production line, increase students' familiarity with actual production experience; (4) Graduation design and graduation thesis, through the integration of engineering practice, cultivate students' engineering design and scientific research capabilities; (5) Extracurricular practice activities, through industry-university-research cooperation, participation in teacher scientific research projects and various scientific and technological activities on campus to create strong engineering practice and International atmosphere. (6) The training of outstanding engineers follows the "3+1 segmented overall planning" school-enterprise joint training model, that is, three years of school study and one year of joint training with enterprises. The main task of school learning is to learn basic theoretical knowledge, and the main task of enterprise training is to carry out engineering practice combined with actual engineering. By participating in the actual production and engineering projects of the enterprise, learning the advanced technology, equipment and corporate culture of the enterprise, and enhancing The engineering quality of the students enables them to quickly adapt to corporate work after they take up their jobs. The outstanding engineer education and training plan implements the tutor responsibility system, and the "double tutor" system is implemented in the enterprise learning stage.

2.4. College Students' Technological Innovation and Extracurricular Instructor System

Innovation is an essential attribute and core goal of engineering education. In this regard, we actively expand the second classroom platform for on-campus practice, and actively guide students to participate in the "Challenge Cup" National College Student Extracurricular Academic Technology Competition, "Creating Youth" National College Student Entrepreneurship Competition, National Colleges and universities mineral processing engineering students practice works competition, national college students energy conservation and emission reduction social practice and science and technology competition, college students English competition, college students mathematical modeling competition and other professional science and technology competitions. For

professional scientific and technological innovation activities, every student is required to be able to participate in them, and in this way to increase students' enthusiasm for professional learning. Professional teachers are responsible for the specific guidance of students to participate in various types of scientific and technological innovation competitions, training plans and scientific and technological innovation plans at all levels, and are responsible for the guidance and consultation of professional internships. Effectively enhance students' practical ability, thinking ability and innovation ability, and form a joint training model inside and outside the classroom that teaches theoretical knowledge through multiple teaching, consolidates theoretical knowledge through experimental classes, and strengthens operational skills through an extracurricular innovation platform. In the past three years, undergraduates majoring in mineral processing engineering have applied for national, provincial, and school-level innovation projects in the past three years and won a total of 22 projects; won 4 national first prizes, 9 second prizes, and published 26 papers in total, 63 student patent applications were authorized.

2.5. Promoting the Construction of the Teaching Staff, Expand the Diversified Exchanges and Research of Teachers and Students.

The construction of the mineral processing faculty team attaches importance to the introduction of off-campus and overseas talents, and pays more attention to the cultivation and improvement of in-service teachers' international vision capabilities. There are 25 registered teachers. Among them, 9 are professors, 10 are associate professors, 6 are lecturers, and 20 have doctorate degrees. Among them, 2 teachers have obtained doctorate degrees from well-known foreign universities. There are currently 1 Chutian Scholar Distinguished Professor and 3 Chutian Scholars. More than 50% of professional teachers have working experience in industrial enterprises, and 90% of teachers have long been engaged in scientific research topics closely integrated with engineering. A team of teachers with a reasonable structure and capable of providing sufficient knowledge reserves and quality assurance for high-level engineering education has been formed. In the past 5 years, at least one teacher has been dispatched to visit or study abroad every year. Employ engineering and technical personnel from the practice base to serve as mentors for off-campus companies to guide learning practice and extracurricular scientific and technological activities. The college also actively participates in international education exchanges and cooperation, co-training undergraduates and postgraduates with world-renowned universities such as the University of Queensland in Australia, the University of Alberta in Canada, and the University of Saint Louis in Mexico.

3. CONCLUSION

In recent years, the mineral processing engineering discipline of Wuhan University of Science and Technology has implemented the school-running idea of training outstanding engineering talents for international engineering education. By scientifically constructing a professional curriculum system, focusing on the cultivation of students' engineering practice ability, innovation ability and internationalization ability, the university have built and practiced the training model of outstanding mineral processing talents for international engineering education. The engineering practice ability and innovation ability of students have been greatly improved, and remarkable talent training results have been achieved.

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REFERENCES

[1]Sun Hui, Xia Jianguo. International engineering education certification and its enlightenment to my country's higher education reform [J]. Vocational Education Forum, 2010, (07): 33-35. (In Chinese)

[2]Lin Jian. Engineering education certification and engineering education reform and development [J]. Higher Engineering Education Research, 2015, (02): 10-19. (In Chinese)

[3]Zhou Shenghua, Ye Youxiang, Dong Yanyan, et al. Teaching reform of electromagnetic field and electromagnetic wave course under the background of engineering education professional certification [J]. Science and Technology Innovation Herald, 2016(35):181-182. (In Chinese)

[4]Liu Youping, Yang Weihan. Comprehensive reform and practice of civil engineering based on the demonstration of engineering education [J]. Shanxi Architecture, 2017, 43(25):217-218. (In Chinese)

[5]Gong Yuan, Cheng Guangwen. Research on the reform of teaching management in colleges and universities oriented to the demand for talent training[J]. China Electric Power Education, 2014 (5): 36-37. (In Chinese)

[6]Zhu Shufang, Qian Gongming, Chen Tiejun. Reform and practice of experimental teaching mode

for mineral processing engineering specialty[J]. China Educational Technology and Equipment, 2013 (3): 142-143. (In Chinese)

[7]Zhang Hanquan, Zhu Qikun, Chen Jinyi. Geology and minerals majors collaborate to create an engineering practice education base[J]. Higher Education in Chemical Engineering, 2013 (4): 50-52, 84. (In Chinese)

[8]Qian Gongming, Chen Tiejun, Zhou Wenbo, etc. Comprehensive reform and practice of excellent engineer training system[J].University Education, 2016(12): 15-17. (In Chinese)