



Optimization of Courses System for Mining Engineering Guided by Engineering Education Accreditation

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Abstract. Engineering Education Accreditation is an important part of the implementation of quality projects by the Ministry of Education. The necessity and significance of Engineering Education Accreditation were analyzed. Based on the Engineering Education Accreditation standards, and combined with training objectives, set the mining professional courses system. In order to strengthen engineering education for engineering practice, it is necessary to set up some courses that reflect the situation of mining industry and the technology of mining geological conditions of mine seams in the service area of graduates to improve the quality of professional education in mining, cultivate students' adaptability to the development of mining industry and promote professional international Mutual recognition, and promoting the transnational movement of mining professionals have a realistic meaning.

Keywords: Engineering Education Accreditation · Mining engineering
Quality control · Courses system

1 Introduction

Economic globalization has promoted the globalization of engineering and technical occupations and the transnational flow of engineering professionals, correspondingly, promoted the higher engineering education to adapt to the trend of globalization [1]. Due to the different system and conditions of engineering education in different countries and regions, how to define and evaluate the management level, the quality of personnel training, the implementation of national engineering education professional comparability and the equivalent of the Engineering Education Accreditation, is the common concern of engineering education and engineering problems [2]. This article combined with the Engineering Education Accreditation to explore how to set up Engineering Education Accreditation, the professional courses system of mining engineering, mining to improve the professional quality of education and cultivate students' development of the mining industry to promote the professional adapt ability and Industry international mutual recognition and enhance the professional international competitiveness [3].

2 The Necessity and Significance of Engineering Education Accreditation

Until 2016, there are more than 5 million undergraduate students enrolled in higher engineering education in China. Nearly all universities opened the engineering profession and the scale of the first in the world. However, the reality is that China is a large country of engineering education rather than a strong country in engineering education. There are still many problems in China's engineering education. The root cause is that there are too few engineering and technical education in engineering education in China. In order to improve the level of engineering and technical education that is geared to engineering practice and to go along with international education, the Ministry of Education has conducted many explorations. In 2006, the Ministry of Education jointly with China Association for Science and Technology, and hired engineering education and business experts to form a China Professional Committee of Engineering Education Experts, set the goal of engineering education Engineering Education Accreditation is to further improve the quality of engineering education. In January 2007, the Ministry of Education and the Ministry of Finance jointly issued a document calling for "actively exploring the reform of the professional assessment system, focusing on the pilot project of Engineering Education Accreditation in engineering, medicine and other fields, and gradually establishing a Engineering Education Accreditation system that meets the needs of the vocational system". In June 2007, the Ministry of Education issued "Several Opinions on Strengthening Undergraduate Teaching Work in Higher Institutions and Improving Teaching Quality", requiring "to establish an internal evaluation and certification mechanism for employing teaching units by employers, teachers and students" and again put forward Engineering Education Accreditation-oriented teaching quality monitoring [4]. The economic globalization will inevitably lead to the internationalization of engineering education. Engineering Education Accreditation is a special occupation of Engineering Education Accreditation: certification of professional specialized occupation education from Engineering Education Accreditation institutions for higher education institutions to offer implementation, together by special occupation Association in the field of education workers, provide quality assurance for the relevant personnel to enter the special occupation industry practitioners of preparatory education. The United States is the country that started Engineering Education Accreditation earlier. American Engineering Technology authentication (Accreditation Board for Engineering and Technology) is the most authoritative certification body of the engineering education. For the American public, only certified professionals certified by a reliable certification body are recognized professionals. For the profession, the certification is actually related to the living conditions of the profession or even the school, because only certified professional can attract students and attract investment; for students, if the professional did not pass the certification, obtain funding, scholarships, credits Other universities admit that they will encounter difficulties in accepting their degrees through other countries [5]. Therefore, in order to improve the quality of engineering education in China and cultivate the qualified talents recognized by both domestic and foreign countries, engineering education requires not only Engineering Education Accreditation but also relevant international certification agreements to

promote Chinese engineering education to participate in international exchanges and achieve mutual recognition. At present, there are four agreements on mutual recognition of academic degree in engineering education such as “Washington Agreement”, “Sydney Agreement”, “Dublin Agreement” and “Seoul Agreement.” The “Washington Accord” is generally considered to be the most authoritative and international the highest degree of education system, a relatively complete system of mutual recognition agreement. The Washington Accord is an internationally recognized agreement on a bachelor’s degree in engineering. At the beginning of the contract in 1989, the agreement covers six countries on three continents: the United States, Canada, the United Kingdom, Ireland, Australia and New Zealand. At present, the Washington Accord has enjoyed a worldwide reputation and attracted the consortium of engineering consultants of the European Union covering 27 countries to negotiate the accession issue. China participated as an observer of the Washington Protocol System in 2005, 2007 and 2009, and at the International Union of Construction Project Conference held in Seoul, South Korea in November 2013, the “Washington Accord” plenum unanimously passed by accepting China as a signatory to the agreement and China became The agreement to organize the twenty-first member, which to some extent, shows that the scale of China’s engineering education achieved rapid development, ranking first in the world at the same time, the quality has also been recognized by the international community. In November 2007, mining engineering was certified at Central South University and China University of Mining respectively and passed, which shows that the training quality of the mining major in these two schools has reached the international standards of peers and at the same time indicates that the Chinese mining professional on the new course of integration with international education [6].

3 Engineering Education Accreditation Standards

The certification standard is divided into two parts: general standard [7] and professional supplementary standard. The general standard is the basic requirement for every engineering education major. The professional supplementary standard is the specific requirement based on the general standard and according to the characteristics of this specialty.

3.1 General Standard

The general standard contains seven aspects:

- (1) Students, including majors to attract excellent students, student guidance, students’ performance tracking and evaluation, transfer to professional, transfer and other systems.
- (2) Training objectives, including graduation requirements, training objectives revised.
- (3) Graduation requirements, including professional knowledge, basic knowledge, professional ethics, human science literacy, innovation and team spirit, international vision, lifelong learning and so on.

- (4) Continuous improvement, including teaching process quality monitoring mechanism, graduates tracking feedback mechanism, social evaluation mechanism.
- (5) Curriculum system, including mathematics and natural science, engineering foundation, professional foundation, professional course, engineering practice, graduation design (Thesis), humanities and Social Sciences, etc.
- (6) Teachers, including the number of teachers, teacher structure, business or industry experts as part-time teachers, teacher engineering background, teacher teaching time.
- (7) Supportive conditions, including classroom, laboratory and equipment training base, computer and network, and library resources, teaching expenses, construction of teaching staff, teaching management and service standards.

In the above general standards, the content of curriculum system is very vague. It only gives what courses for engineering education majors should be offered, and there is no specific course name.

3.2 Professional Supplementary Standards

Profession must meet the corresponding professional supplement standards. Professional supplement standard provides the corresponding professional in the courses system, teaching staff and support conditions of the special requirements. Mining professional supplement standards include three aspects. Mining professional courses system, divided into theoretical courses, practice and graduation design (Thesis).

- Theoretical courses, including:
 - (1) Mathematics and physics courses, including mathematical calculus should include calculus, space analytic geometry, ordinary differential equations, linear algebra, probability theory and mathematical statistics and other basic knowledge. Physical courses should include knowledge of mechanics, vibration, fluctuation, optics, molecular physics and thermodynamics, electromagnetics, mechanics of special relativity, and quantum physics fundamentals.
 - (2) The optimized talent training program, the graduates of mining engineering should have the following knowledge and ability.
Engineering basic courses, including elasticity, engineering mechanics, fluid mechanics, engineering drawing, electrical and electronic technology, computer and information technology foundation.
 - (3) Professional foundation courses, teaching content: Geology, mining machinery, rock mechanics and engineering, mining systems engineering, environmental protection and safety of mining.
 - (4) Professional Courses are divided into core and non-coal professional courses. Apart from the core knowledge of mine extraction, mine ventilation and safety, and roadway engineering, other courses of coal and non-coal specialties are allowed to have their own characteristics emphasis. The core content of coal must also hold should include mining pressure and strata control, slope stability and so on; the core content of non coal class students must master should also include drilling and blasting engineering.

- Practice links, including:

- (1) Experimental courses: rock mechanics, mine pressure and rock control, blasting engineering, mine ventilation and safety, slope stability experiment selected at least three experiments.
- (2) Curriculum design: the design of open-pit and underground mining, the basic course design of mechanical design, and the selection of at least two in the design of mine ventilation safety.
- (3) Field practice: cognition practice, production practice and graduation practice, and establish a relatively stable practice base, and closely cooperate with industry, University and Research Institute, so that students can understand and participate in production practice.
- (4) Science and technology innovation and other forms of practical activities.

In the graduation project (thesis) a requirement that topics should be consistent with the professional training objectives and engineering design-based. It needs a clear application background.

Teachers team, there are two requirements. First, the teachers engaged in the teaching of the main course of the major must have a master's degree and a doctorate in engineering, majoring in mining engineering. Some teachers have relevant professional learning experiences. The second is for professional teachers with engineering background, which is engaged in the professional teaching (including experiment teaching) above 80% teachers should have at least 6 months experience in mining enterprises or engineering practice.

Support conditions, including professional information, experimental conditions and practice base.

First, professional information requires a variety of high-quality (including the latest), adequate textbooks, reference books and related Chinese and foreign books, periodicals, tool manuals, electronic resources and other information, including the typical mining design at home and abroad Case.

The second is the experimental conditions, one is required to complete the experimental equipment, adequate, excellent performance, to meet the needs of various types of teaching experiment, and the laboratory layout is reasonable and safe, and second, require a sufficient number of experimental technicians to guide students in rock mechanics, mining Pressure and rock control, ventilation and safety, mining methods, slope stability and other experiments.

Third, the practice base, need to have an in-school and internship base, production and research cooperation base and outside the school-based mining practice base. It can be seen from the above-mentioned common standards and supplementary standards for mining professionals that the courses system is the basis for training objectives and that the teaching staff is a teaching quality monitoring system and guarantee system that can guarantee the realization of the curriculum objectives. The supporting conditions are the supporting systems for the teaching of courses, To promote the training objectives, faculty building and other aspects. Therefore, to achieve the goal of training students to graduate, the most basic is to strengthen the courses system.

4 Courses System Construction

Jiangxi University of Science and Technology is located in the old revolutionary base areas in China, is to cultivate China's non-ferrous metal industry and steel industry typical characteristics of colleges and universities, the mining engineering course system in China's mining universities have a certain representation. The following course system construction content with its 2016 version of talent training programs as an example.

4.1 To Train the Target for the Refinement of Standards, the Courses System

Training Objectives for Mining Engineering: To cultivate the all-round development of moral, physical and mental development and to master the basic theories and methods of metal mining, and to be engaged in mineral resources exploration, development, planning, design, consulting, management, environmental protection and other institutions and research institutes Development planning, mine design, mine safety technology, mine engineering supervision, production technology management and scientific research. About 5 years after graduation, it can independently solve the practical problems of mine engineering, with strong innovation consciousness, innovative ability and international perspective Of the composite application personnel.

Mining Engineering Training Standards: The major students mainly learn the basic theories and basic techniques of foreign languages, mathematics, mechanics, computer applications, mining geology, surveying, blasting engineering, mining engineering and mine safety, and accept the basic training of mining engineers.

Graduates should acquire the following knowledge, ability and quality:

- (1) Have good humanities and social science literacy, strong sense of social responsibility and good engineering professional ethics.
- (2) Have engaged in engineering work required for the relevant mathematics, natural science knowledge, master the economic and management knowledge of mining enterprises.
- (3) Master the basic theoretical knowledge and professional core knowledge related to the exploitation of metal deposits, have systematic experience in engineering practice and understand the current situation and trend of the forefront of the development of the profession.
- (4) Have engaged in mining engineering design and related engineering experiment capabilities, and be able to analyze the experimental results.
- (5) With innovative awareness and advanced concepts, with the initial ability to carry out technological innovation and new technology, new technology research, with the ability to design systems and processes using a combination of theoretical and technical means, the design process can take into account economic, environmental, law, safety, Health, ethics and other constraints.
- (6) Have the basic ability of computer application, master the basic methods of document retrieval, data inquiry and use of modern information technology to obtain relevant information.

- (7) Understand the principles, policies, laws and regulations related to the design, production, safety, research and development, environmental protection and sustainable development of mining engineering, and correctly understand the impact of Engineering on the objective world and society.
- (8) Have certain production organization and technical management skills, with good expression skills and interpersonal skills and good teamwork skills.
- (9) Have a correct understanding of lifelong learning, with the ability to continuously learn and adapt to development.
- (10) With international perspective and cross-cultural exchange, competition and cooperation ability.

4.2 Based on Engineering Education Accreditation Standards, the Course System Settings

An important part of Engineering Education Accreditation is to emphasize students' practice. In response to this requirement, it is necessary to strengthen engineering and technical education that is "oriented toward engineering practice", and can set up various kinds of curriculum design and internships to train students' hands-on and practical skills. Therefore, in addition to the theoretical courses system, practical courses should also be set up, such as geological internship, mine cognition internship, mine production internship, mine graduation practice, mining area curriculum design, ventilation safety course design, roadway engineering course design and such as rock mechanics, Mine pressure and rock control, blasting engineering, mine ventilation and safety aspects of the experimental class. In addition, in the conditions of mines, construction of a number of production and research base for the practice of class to provide a practical venue.

A notable feature of Engineering Education Accreditation is that enterprises or industry experts are required to participate in teaching students as part-time teachers. Teachers from the field feedback to the industry the situation and needs of the development so that students learned can really solve the needs of the scene. Therefore, some courses reflecting the industry situation can be set up as elective courses such as mine digital mapping, special mining, soft rock roadway support, engineering inspection and monitoring as elective courses for students to learn.

In addition, mining is a subject of engineering, in addition to some such as the introduction of some basic concepts such as Marxism, Mao Zedong Thought and the theory of socialism with Chinese characteristics, modern Chinese history outline, ideological and moral training and legal basis, mental health education and guidance of university students must Humanities and social science courses outside. It is also necessary to set up basic mathematics, mechanics and informational basic courses in accordance with the General Standards for Engineering Accreditation and the Supplementary Standards for Mining Professionals such as Higher Mathematics, Linear Algebra, Mathematical Statistics and Probability, College Physics, Theoretical Mechanics, Materials Mechanics, Elastic Mechanics, Fluid mechanics, electrical and electronic technology, computer and information technology foundation.

4.3 Graduates Serve the Regional Industry Features, the Courses System Settings

The basic idea of Engineering Education Accreditation reflects the basic conditions and basic requirements, is the lowest standard of the same type of professional training objectives and specifications to achieve the lowest threshold of professional construction quality. Professional and characteristic construction is to encourage the development of professional personality, reflect the diversity of professional construction, strengthen the characteristics, highlight the ability to explore the needs of different types of talents in the community personnel training model for the community to provide high-quality specialized personnel.

The following Table 1 is in accordance with the above three aspects of the curriculum to achieve the realization of the matrix profile.

Table 1. Realize matrix introduction (Part)

Professional standard	Knowledge and ability requirements	Curriculum and teaching
Has a good humanities and social science literacy, a strong sense of social responsibility and good professional ethics	Cultivate a correct world outlook, understand the theory of socialism with Chinese characteristics, cultivate students to establish a correct outlook on life and the legal system	Introduction to the Basic Principles of Marxism, Mao Zedong Thought and the Theoretical System of Socialism with Chinese Characteristics, Ideological and Moral Cultivation and Legal Basis
	Understand the modern history of China and the current situation and policies at home and abroad	Outline of Modern Chinese History, Situation and Policy, Military Skill Training
	Develop strict discipline and hard-working spirit, understand the theory of national defense and military affairs, enhance personal physique and master the correct physical training methods	Military Theory, Physical Education, Celebrities and Experts Patriotic
	Understand the modern college students should have the humanities, social, economic and other comprehensive quality, understanding as a modern college students and engineering and technical personnel should have a sense of social responsibility and professional ethics	Safe Education, Career Guidance for College Students, Introduction to New Students and Career Planning
Have engaged in the engineering work required by the relevant mathematics, natural science knowledge, grasp the economic management of mining enterprises, knowledge	Have the mathematical, physical knowledge necessary to solve most engineering problems	Higher Mathematics, Linear Algebra, Probability and Mathematical Statistics, College Physics, Experiment of College Physics
		Materials Mechanics, Fluid Mechanics

(continued)

Table 1. (continued)

Professional standard	Knowledge and ability requirements	Curriculum and teaching
	To master the relevant professional applied mechanics and natural science knowledge	Elasticity Mechanics, Electrotechnics
	Master the basic economic analysis techniques and systems engineering professional analysis methods	Mine Design Principles, Mining Engineering, Mining Economics
	Have a certain degree of modern enterprise management quality, mine safety and other environmental safety standards and management system	Security Analysis and Management of Tailing pond, Mine Managing Production, Mine Environmental Protection and Reclamation
Master the basic theoretical knowledge and professional core knowledge related to the exploitation of metal deposits, have systematic experience in engineering practice, understand the current situation and trend of the forefront of the professional development	Grasp the basic theoretical knowledge of metal mining	Mining Geology, Rock Mechanics, Rock Drilling and Blasting Engineering
	Master the professional core knowledge related to mining	Tunnel Project, Underground Mining
		Open Pit Mining, Mine Ventilation and Safety
	Possess the ability to solve practical engineering problems with professional basic theory and professional core knowledge	Professional Comprehensive Practice, Design for Graduation, Rock Drilling and Blasting Engineering, Tunnel Project
		Open Pit Mining, Mine Ventilation and Safety
	Experience with mining companies practice learning	Professional Comprehensive Practice, Design for Graduation, Rock Drilling and Blasting Engineering, Tunnel Project
Can understand the research status and development trend of mining science	Underground Mining, Open Pit Mining, Mine Ventilation and Safety	
Have engaged in mining engineering design and related engineering experiment capabilities, and be able to analyze the experimental results	Master the basic knowledge of design engineering experiment	Observation in Workshop, Production Training, Graduation Practice
	To understand the basic methods of scientific experiments, master the principles, methods and skills of related geotechnical experiments and consolidate the knowledge they have learned. To train students to master the principle, method and technical implementation of rock slope stability test of mine slope, mine underground roadway and stope.	Department of New Mining Technology, Graduation Practice, Digital Mine

(continued)

Table 1. (continued)

Professional standard	Knowledge and ability requirements	Curriculum and teaching
	Verify the theory, consolidate the knowledge and deepen understanding, and improve students' ability to analyze and predict the stability of mine rock mass	
	Through the course experiment to enable students to master the basic process and implementation process of roadway construction, engineering blasting initiation network connection, the determination of blasting equipment parameters, to master the measurement method of meteorological parameters in the mine and the correct use of equipment	Drilling and Blasting Engineering Course Experiment, Mine Ventilation Course Experiment, Tunnel project Course Experiment
	Deepen students' understanding of theoretical knowledge, enable students to master the basic theoretical knowledge of metal mining more intuitively, explore the basic skills related to mining design, and general techniques of mine production management, and enhance their practical ability and ability to solve practical production problems	Underground Mining Course Deposit Experiment, Filling Theory Course Experiment, Open Pit Mining Experiment
	Master the basic knowledge of engineering drawing and methods, in the process of solving professional problems, be proficient in using modern computer information processing technology, with a certain degree of programming and computer graphics capabilities	Machinery Drawing, Programming in Computer Language, Mining Engineering CAD, College Computer Foundation, Mining Machinery

5 Conclusion

Engineering Education Accreditation is an important part of the implementation of quality engineering by the Ministry of Education. Through Engineering Education Accreditation, it is of great importance to improve the quality of China's higher engineering education, promote engineering education and international standards, and cultivate the qualifications recognized at home and abroad. To Engineering Education

Accreditation-oriented, from the training objectives of the mining profession, the Engineering Education Accreditation standards for the courses system and graduate service area of the mining industry, the three aspects of the courses system set up to improve the quality of mining professional education and training students in the mining industry development Adaptability, promote professional international mutual recognition, to enhance the international competitiveness of mining talent is not only realistic but also Engineering Education Accreditation-oriented teaching quality monitoring needs.

Acknowledgments. The authors gratefully acknowledge the financial support from the Project supported by Educational Commission of Jiangxi Province of China (JXJG-17-7-8); Excellent Engineer Training Program of Jiangxi Province of China.

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