Education Reform and Development, 2025, Volume 7, Issue 7
https://ojs.bbwpublisher.com/index.php/ERD
Online ISSN: 2652-5372
Print ISSN: 2652-5364

Exploration of Practical Teaching Path for Mining Engineering under the Background of Damage-reducing Coal Mining

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Abstract: The theory and technology of damage-reducing coal mining have become one of the important development directions in the coal industry. It is necessary to explore the innovative path of practical teaching for mining engineering based on promoting teaching through research. Aiming at the current situation of the practical teaching links of mining engineering, this paper analyzes the importance of the practical teaching path of promoting teaching through research from three aspects: the construction of an innovative practical teaching faculty, teaching and research platforms, and the practical teaching model of promoting teaching through research. It also explores the innovative path of practical teaching for mining engineering under the background of damage-reducing coal mining. Based on the above conclusions and combined with the existing practical teaching conditions of mining engineering, a practical teaching model of promoting teaching through research centered on the cultivation of students' innovative abilities is constructed. This model gives full play to the complementary relationship between teaching and research, gradually forms the educational concept of integrating science and education and combining competitions with teaching, and has achieved good talent cultivation results.

Keywords: Promote teaching through research; Mining engineering; Green coal mining; Practical teaching model

Online publication: July 28, 2025

1. Introduction

Coal plays the role of a "stabilizer" and "ballast" in China's energy structure system. Nine of China's 14 large-scale coal production bases are distributed in the Yellow River Basin, with an annual output accounting for about 70% of the national total [1,2], strongly supporting China's economic development and energy security. However, large-scale and high-intensity coal mining has triggered a series of ecological and environmental problems, such as surface cracks and subsidence, groundwater level decline, and land desertification, which seriously threaten the ecological environment of the Yellow River Basin [3–5]. At present, the ecological protection and high-quality development of the Yellow River Basin have become a major national development strategy [6]. The theory and

technology of source-based coal damage reduction mining have become an important development direction of scientific coal mining [7–9]. Against this background, mining-related institutions of higher learning, as the cradle for cultivating professional and technical talents in the coal industry, should actively respond to the demand for green and damage-reducing mining of coal and cultivate first-class mining engineering talents with scientific mining concepts for the industry. In recent years, scientific research achievements related to source-based damage reduction and ecological restoration have gradually become abundant. It is necessary to transform advanced scientific research achievements into materials for cultivating high-quality mining engineering talents [10]. Teaching and scientific research in institutions of higher learning are complementary and an integrated whole. Promoting teaching through research and combining competitions with teaching are important components of the construction of first-class universities and disciplines. Teaching and research are mutually influential [11]. The training models that only focus on teaching while neglecting scientific research or only focus on scientific research while ignoring the importance of teaching can no longer meet the current development needs of intelligent, green, and damage-reducing mining in the coal industry. Coal enterprises have put forward higher requirements for the basic professional qualities of mining engineering professionals [12,13]. As a characteristic and advantageous major of the university, in the process of the university's construction of first-class universities and disciplines, it is urgent to explore a practical teaching system for mining engineering students that adapts to the current green development trend of coal enterprises [14,15]. Giving full play to the demonstration and promotion role of scientific research achievements is the key to promoting the cultivation of high-quality talents [16–19].

Scientific research achievements are an innovative development of the existing knowledge in textbooks. Through the practical teaching path of promoting teaching through research, the comprehensive cultivation of the innovative thinking and practical operation ability of mining engineering students can be achieved. Therefore, exploring the practical teaching path of mining engineering based on promoting teaching through research is of great significance for cultivating compound scientific and technological innovation talents under the background of green and damage-reducing coal mining.

2. The foundation of the practical teaching team and platform for promoting teaching through research

2.1. The cultivation of the experimental teaching team and the construction of resources

Under the background of green and damage-reducing coal mining, based on the scientific research achievements accumulated by mining engineering teachers in the field of green mining, teaching cases are sorted out and summarized and expanded into the teaching resources of mining engineering to strengthen the role of practical teaching and improve the level of practical teaching.

The cultivation and construction of the practical teaching faculty for promoting teaching through research are mainly carried out from the following two aspects. In teaching, the current training method of laboratory teachers is changed from mainly spoon-feeding teaching to mainly inquiry-based teaching in practical teaching. In scientific research, laboratory teachers are encouraged and urged to apply for and participate in more scientific research projects related to green and damage-reducing coal mining. Representative scientific research achievements are transformed into practical teaching cases, and students are taught through inquiry-based teaching methods. Students are encouraged and guided to deeply participate in scientific research projects to stimulate their innovative thinking and scientific research inspiration, providing support for cultivating students'

concepts of green and damage-reducing coal mining.

To meet the requirements of practical teaching for promoting teaching through research in mining engineering under the background of green and damage-reducing coal mining, a teaching team is established by selecting compound practical teaching teachers with strong scientific research capabilities and new teaching methods. Members of the practical innovation group for promoting teaching through research are selected from students to deeply participate in the experimental content of project research.

2.2. Platform foundation

The Comprehensive Experimental and Training Center for Coal-related Majors of the university is a project of "Strengthening the Basic Capabilities of Universities in Central and Western China" by the state. It is a large-scale public platform and base for students to conduct internships, training, experiments, and extracurricular scientific and technological innovation. The center is equipped with an intelligent digital mine dispatching system, underground mining and excavation face equipment and automatic control systems, underground power supply and distribution systems, and ventilation and transportation systems, providing important support and a foundation for the university to cultivate compound scientific and technological innovation talents in mining engineering and for the construction of first-class universities and disciplines. At the same time, relying on the National Teaching Demonstration Center for Mining Engineering, the Shaanxi Provincial Collaborative Innovation Center for Safe, Green, and Efficient Development of Coal Resources and other teaching and research platforms, a solid foundation is laid for the innovative practical teaching model of mining engineering based on promoting teaching through research under the background of green and damage-reducing coal mining.

In addition, according to the different requirements of practical teaching for mining engineering, off-campus internship bases for green and damage-reducing coal mining are jointly established with coal enterprises that focus on green ecological development. The practical teaching projects and contents of each internship base are clearly defined, such as water-conservation mining, land reclamation, and coal gangue filling and utilization. Internship guidance manuals are jointly developed with enterprises to ensure the smooth progress of practical teaching tasks for promoting teaching through research.

3. The innovative practical teaching model for promoting teaching through research

3.1. Analysis of the innovative path of practical teaching

Before designing the practical teaching courses for green and damage-reducing coal mining, a full investigation is carried out on the knowledge, skills, and attitudes of the participating students. Adhering to the student-problem-oriented approach and taking the basic knowledge of green and damage-reducing coal mining as the background, students' learning enthusiasm is stimulated through new discoveries and innovation points in scientific research projects. A high-quality model that goes beyond the basic knowledge of textbooks is formed to cultivate the practical operation ability and innovative thinking of mining engineering students. In this process, the cultivated students can continue to participate in their teachers' scientific research projects, integrating students' innovative thinking with the innovation points of scientific research projects, and finally forming a virtuous cycle in which teaching and scientific research complement each other [20]. The basic framework of the practical teaching model for promoting teaching through research is shown in **Figure 1**.

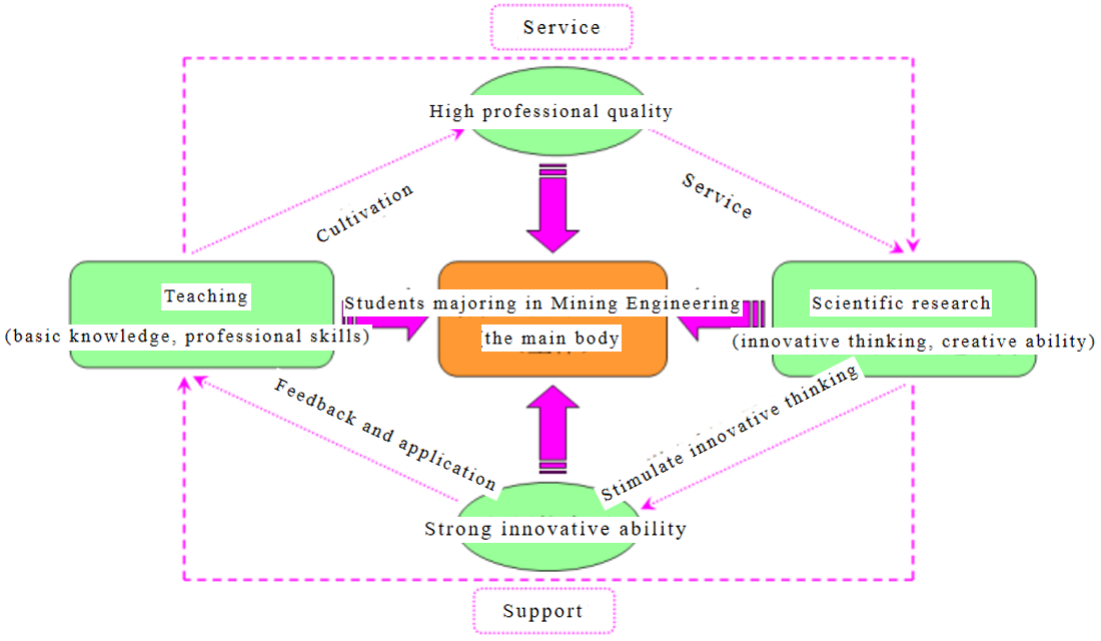

Figure 1. The practical teaching path for promoting teaching through research.

3.2. Innovative teaching model

Scientific research achievements are an innovative development of the existing knowledge in textbooks. Through the practical teaching path of promoting teaching through research, the comprehensive cultivation of the innovative thinking and practical operation ability of mining engineering students can be achieved. The traditional practical teaching model based on knowledge content is transformed into a practical teaching model based on knowledge application and practical innovation output. The method of "pairing teachers and students" is adopted to establish "science-teaching" innovation groups, enabling students to deeply participate in scientific research projects highly relevant to the teaching content undertaken by teachers. In the process of research and exploration, students' understanding of the course content is deepened, and their innovative practical ability is tempered. At the same time, it promotes teachers' thinking about the integration and mutual promotion of scientific research and teaching, continuously improving teachers' teaching and scientific research levels.

3.3. Specific measures

3.3.1. Strengthen the dominant position of students

Reform the indoctrination-style teaching, strengthen the dominant position of students, combine scientific and technological innovation and engineering practice cases, strengthen the discussion-based teaching with students, guide students to think and analyze, and cultivate students' ability to solve practical problems.

3.3.2. Enrich the teaching materials of case-based practical teaching and strengthen the green intelligent experimental platform

Adhering to the principle of "cutting-edge perspective and practical implementation", and taking the scientific research projects of green coal mining as the background, the practical teaching content is continuously updated, and a scientific and reasonable practical teaching system is set up. Tracking the development of green intelligent coal mining, it is required to enrich the practical teaching case database related to green intelligent mining and

accelerate the transformation of the experimental platform towards green intelligence to cultivate students' practical innovation ability.

3.3.3. Take multiple measures to strengthen the practical link relying on high-quality teaching and research platforms and support the cultivation of practical innovation ability

Centering on students, relying on key scientific research laboratories, focusing on the cultivation of practical ability and the stimulation of innovative potential. Relying on rich scientific research cases of knowledge innovation, comprehensive and design-based experiments are strengthened. Through "lecture + group discussion", students are guided to carry out exploratory learning independently. Aiming at improving practical ability, a course practice path of "extracurricular practice + internship and training" is established to strengthen students' practical innovation ability in multiple aspects.

3.3.4. Accelerate the innovative reform of case-based teaching and layout the development of mutual promotion between teaching and research

Accelerate the transformation of the case-based teaching method in which teachers provide materials and explain them. Try to adopt the method of "pairing teachers and students" to establish "science-teaching" innovation groups, enabling students to deeply participate in scientific research projects highly relevant to the teaching content undertaken by their teaching teachers. In the process of research and exploration, students' understanding of the course content is deepened, and their innovative practical ability is tempered. At the same time, it promotes teachers' thinking about the integration and mutual promotion of scientific research and teaching, continuously improving the teaching and scientific research levels and truly achieving the mutual promotion of teaching and research.

4. Analysis of the implementation effect of promoting teaching through research

Through the innovative practical teaching path of promoting teaching through research, in recent years, the college has gradually formed a practical teaching case database for the transformation of scientific research achievements, such as "Mining Science," "Mine Pressure and Strata Control," and "Safe Mining and Control under Three-Under Conditions." Centering on the cultivation of students' innovative abilities, the educational concept of integrating science and education and combining competitions with teaching has been continuously implemented. Students majoring in mining engineering actively participate in extracurricular academic competitions such as the "Challenge Cup" National Extracurricular Academic and Scientific Works Competition for College Students, the China International University Student Innovation Competition, the National Mining Engineering Student Practical Works Competition for Colleges and Universities, and the Shaanxi Provincial College Student Innovation and Entrepreneurship Training Program. They have achieved excellent results. The quality and quantity of students' awards in extracurricular scientific and technological competitions have steadily increased, effectively guaranteeing the quality of talent cultivation.

5. Conclusions

(1) The previous teaching method mainly based on spoon-feeding is gradually transformed into a practical teaching model mainly based on inquiry-based teaching. Laboratory teachers are encouraged and urged

to apply for and participate in more scientific research projects related to green and damage-reducing coal mining, and students are guided to deeply participate in scientific research projects to stimulate their innovative thinking and scientific research inspiration, providing support for cultivating students' concepts of green and damage-reducing coal mining.

(2) "Science-teaching" innovation groups are established by the method of "pairing teachers and students", and students are encouraged to deeply participate in scientific research projects highly relevant to the teaching content undertaken by teachers. High-level scientific research stimulates students' innovative thinking and innovative abilities, and the cultivated students give full play to their talents in scientific research projects, forming a virtuous cycle in which teaching and scientific research complement each other.

(3) Through the implementation of the practical teaching path of promoting teaching through research, the educational concept of integrating science and education and combining competitions with teaching for mining engineering students has been continuously implemented. Students actively participate in various extracurricular academic competitions, achieve excellent results, and effectively guarantee the quality of talent cultivation.

Funding

Industry-university Collaborative Education Project of the Ministry of Education, "Exploration of Innovative Paths for Practical Teaching in Mining Engineering Majors Aimed at Green Damage-reducing Coal Mining" (Project No.: 241203242100008)

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