Study on the model of university-enterprise cooperation in cultivating applied mining engineering graduates

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Abstract. Due to society's biased perception of coal enterprises, Mining Engineering students' cultivation faces problems such as students' unwillingness to engage in mining work and the decoupling of graduates' abilities from job demands. The teaching and research team conducted in-depth research and exploration on the cultivation model of applied mining engineering professionals, and constructed a university-enterprise cooperation model for talent cultivation guided by the spirit of "hard work, innovation, unity and selflessness." This model effectively solves the bottleneck of mining engineering talent cultivation in local colleges and universities and meets the new requirements of the current era's development. After years of exploration and practice, mining engineering students not only love enterprises but also significantly improve their comprehensive innovation abilities.

Coal is an important guarantee of energy security, and energy enterprises urgently need a large number of applied technical and management talents who love their jobs and can adapt to the needs of modern industry development. However, the talent cultivation of mining engineering majors has faced problems such as the decoupling of graduates' abilities from job demands due to society's biased perception of coal enterprises [1]. The teaching and research team adheres to the educational philosophy of "demand-oriented, student-centered, and quality-based" and conducts in-depth research and exploration on the talent cultivation model of applied mining engineering professionals. With the establishment and practice of the practical teaching system for cultivating applied mining engineering talents and the construction of an intelligent mining engineering course system for regional coal industry transformation needs, the team has constructed a university-enterprise cooperation model for talent cultivation guided by the spirit of "hard work, innovation, unity, and selflessness."

1 Teaching problems faced by engineering majors

The mining industry is one of the key industries in many countries, and mining engineering major in universities is aimed at cultivating professionals for this industry.

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However, there are several problems in training students in mining engineering major that need to be addressed [2].

(1) Mining university students generally have insufficient professional identification, sense of professional mission, and social responsibility due to traditional professional understanding, and the teaching system construction is not yet perfect.

(2) Enterprise participation in talent cultivation is insufficient, and students' research literacy, innovation consciousness, and ability are weak. It takes a long time for them to adapt to job requirements, and their potential for career development is insufficient.

(3) The teaching resources for the transition from traditional mining to intelligent mining are relatively scarce, the teaching content is relatively backward, information technology and education have not been deeply integrated, and the course construction does not sufficiently drive the development of the profession. The teaching methods lack innovation, and there is a lack of evaluation methods for the effectiveness of talent cultivation through the integration of industry and education [3].

2 Solutions to teaching issues

To improve the quality and relevance of mining engineering education, we need to adopt a comprehensive and strategic approach that addresses the following issues.

(1) Establish a curriculum system that combines moral education with professional education, runs through the entire cultivation, and fosters a love for the industry. The curriculum system is designed from two perspectives: historical commonality and industry characteristics. Industry characteristics are based on professional attributes and school positioning, and constructing knowledge points that are the same as those of engineering education certification. The curriculum system runs through the four years of university and employment [4-5].

(2) Cooperate with universities and enterprises to cultivate students' scientific spirit.

University-enterprise cooperation builds research platforms, cooperates in tackling technological problems, and integrates achievements into teaching materials, courses, and projects [6-7]. To meet the needs of enterprises for intelligent transformation and upgrading, teaching resources such as intelligent mining simulation are developed, and an intelligent mining class is established.

(3) Cooperate with universities and enterprises to cultivate students' innovation consciousness and ability.

With representative enterprises, establish a professional construction guidance committee and build an "industry-university-research" innovation and entrepreneurship base to provide project sources for students' major innovation projects and subject competitions based on practical production problems [8]. By building a dual-tutor team through forms such as enterprise secondment training, scientific and technological envoys, and hiring enterprise experts, guide students to participate in activities such as the "Panjiang Cup" and compete with frontline production technicians.

3 University-enterprise cooperation in talent development practical process

(1) Universities and enterprises carry out extensive communication and cooperation to jointly cultivate engineering majors. The mining engineering major is closely aligned with the school's positioning and the needs of socio-economic development. Education experts in the mining engineering field and production management experts in coal mining enterprises were invited to revise and review the training plan.
The specific skills required by enterprises for engineering talents, as well as theoretical knowledge and engineering practical scenarios, are included as teaching content to enhance students' skills. The need of enterprises to solve engineering technical problems is used as technical research and development topics for teachers and students, which are closely related to actual engineering problems.

The laboratory is jointly built by the university and enterprise, and equipment is shared. A basic experimental platform is built, such as the mining pressure and rock control laboratory, rock mechanics performance laboratory, and well and roadway engineering laboratory. A virtual simulation platform is jointly built, such as VR laboratory, virtual simulation laboratory for coal mining and tunneling machines. A physics simulation platform is jointly built, such as physical models.

(2) Take the industry's difficult development process as spiritual belief and cultivate students' morality.

Through the "commonality of history" and "characteristics of the industry," the curriculum design for ideological and political education with the "five development goals" of morality, intelligence, physical fitness, aesthetics, and labor education was completed. Based on the outcomes-based education (OBE) concept, a set of indicators were formulated, and the entire curriculum became the main channel for education, enhancing the organic integration of knowledge transmission and value guidance. This meets the training goal of "attracting and retaining students to study mining and work in the mining industry," and effectively realizes the goal of nurturing talent silently and promoting moral education. Five years after graduation, the employment rate in the industry is as high as 60%, leading the country, and the major has been rated as a five-star first-class applied major in China.

(3) We have constructed an integrated curriculum system and teaching platform that combines teaching, research, and training, to integrate scientific research with professional education.

We have collected a large number of typical coal mine-related case materials, including preliminary mine design, geological data, training videos on responding to the major disasters in mines, advanced mining machinery.

In response to the requirements of intelligent mining, we have added relevant courses such as unmanned mining technology, constantly updated the core course content, and developed lecture notes on mining and mining machinery and equipment that are tailored to the characteristics of coal mining in Guizhou. We actively carry out teaching reforms, select high-quality textbooks, and use online and offline mixed teaching methods such as MOOC to develop an intelligent mine virtual simulation training system and build a first-class curriculum.

Research results are continuously fed back into teaching content and teaching methods, and teaching methods such as "interactive communication, case-based discussion, and virtual simulation training" are used to achieve a "student-centered" approach. Student course design, graduation design, and practical works are all based on the actual production of coal mining enterprises, and students' scientific literacy and lifelong learning abilities are enhanced.

(4) We have constructed a progressive innovation and practice teaching platform and competition system, realizing the integration of innovative education and professional education.

Focusing on improving students' practical innovation ability, we have gradually built a four-level competition system including department-level, school-level, provincial-level, and national-level competitions, to cultivate students' professional basic skills, comprehensive abilities, and innovative abilities. We guide students to participate in various academic competitions and innovation and entrepreneurship competitions to further enhance their practical and innovative abilities.
Through this practice and competition system, we have achieved a comprehensive and progressive training of practical skills that are interconnected and mutually reinforcing. By participating in the "Panjiang Cup" coal mine safety regulations and measures competition, students' professional abilities to analyze and solve complex engineering problems have been further developed. Students' innovation and entrepreneurial awareness have significantly improved, and they have maintained first place in the school for years in participating in academic competitions and innovative projects, ranking at the forefront of the southwest region.

4 Talent cultivation effectiveness

4.1 Significant improvement in talent cultivation quality

The sense of professional identity and social responsibility of students has significantly improved, and graduates are willing to engage in related work in the challenging mining industry. According to third-party employment quality reports, the first-time employment rate of graduates has maintained a leading level in the past four years. A survey of graduates 5 to 7 years after graduation showed that a large proportion of them are still engaged in the mining industry, ranking among the top in the country, and have reached the promotion standards for intermediate professional titles, with a significant increase in their average salary compared to their initial employment.

Students' innovative and practical abilities have significantly improved. Students have strong practical abilities, and many outstanding graduates have emerged who are proficient in production work and have become technical backbone of their respective industries, earning high praise from enterprises. Students have expressed that it is because of the education provided by their alma mater and the leading examples set by their teachers that they came to understand, love, and ultimately devote themselves to the coal mining industry, leading to their current achievements.

4.2 Outstanding achievements in discipline and specialty construction

Since the application of these achievements, the only academician workstation in the mining engineering field of local universities in Guizhou province has been established. The construction of the discipline research team has made significant progress, with the introduction of multiple doctoral students, and many individuals being awarded the title of outstanding teacher, innovation and entrepreneurship mentor, innovative talent, "double-qualified" teacher, and other honorary titles.

4.3 Significant demonstration effect

Since the application of the achievements, special reports have been made at academic conferences to introduce and promote the results, and multiple domestic academic exchanges have been attended. A monograph on innovative and practical interactive teaching methods, "Interactive Teaching Method Innovation and Practice," has been published. The achievements have been borrowed and applied by multiple universities, playing a good demonstration role. The school has tailored the mining engineering major to local conditions and has developed characteristics and advantages through school-enterprise integration. Multiple news media platforms have reported on the effectiveness of applied talent training, and batches of excellent mining professionals with high-quality skills have emerged from here and gone out into society.
5 Summary

Focusing on the modern energy industry and the new demand for high-quality applied talents in the automation and intelligent upgrading of regional coal pillar industries, and facing the practical difficulties in training mining engineering students in a challenging field, the university has explored and practiced a talent cultivation model through collaboration with enterprises, based on the current educational situation, the construction of new engineering disciplines, and innovative talent cultivation. This has effectively solved the teaching difficulties such as the insufficient professional identity and sense of mission of students, inadequate scientific literacy and innovation awareness, lack of information teaching resources, and weak innovation in teaching methods. The cooperation has significantly improved the level of talent cultivation and professional construction, and explored the successful path for local universities to train applied talents in challenging majors.

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