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Safety Engineering Personnel Training Model of PDCA Cycle under the Integration of Production and Education

Chengyu Xie, Cun Fu, Xiaolong He, Dongping Shi, Long Wang

School of Environment and Resources, Xiang tan University, Xiangtan 411105, China

Abstract: In order to solve the dilemma that the supply side and the industrial demand side of talent training are difficult to adapt to each other in terms of structure, quality and level under the background of the integration of industry and education in the new era, a safety engineering professional talent training model based on PDCA cycle is constructed on the basis of analyzing the existing problems of safety engineering professional talent training. The paper explains the four basic steps of PDCA cycle: making talent training program, improving students' practical ability, checking implementation effect, feedback optimization program and perfecting talent training system construction. The research results provide theoretical guidance and support for colleges and universities to transport high-quality talents with solid theoretical foundation and good professional ability of safety engineering to the society.

Keywords: Integration of Production and Education; PDCA Cycle Model; Safety Engineering; Personnel Training.

1. Introduction

Since the twenty-first century, China's education has made remarkable leaps and flourished, delivering a large number of high-quality talents for the construction of a socialist modernized power with Chinese characteristics in the new era. Despite the remarkable progress of China's education, multiple factors, such as system and mechanism, still lead to the mismatch between talent cultivation in terms of structure, quality and level and industrial demand. Therefore, with the full implementation of the innovation-driven development strategy, the integration of industry and education has become a strategic focus at the national level[1]. Industry-education integration is a teaching mode that closely combines the educational resources of schools and the industrial resources of enterprises, which prompts schools and enterprises to promote each other and develop together. In recent years, the severe reality of safety production in China has attracted great attention from the state, and the importance of safety production has become increasingly prominent [2]. Therefore, under the new situation, it has become urgent to strengthen the construction of the safety engineering profession and the cultivation of high-quality talents in safety engineering. Safety engineering is a cross-cutting and comprehensive discipline with a wide range of applications and equal emphasis on theory and practice[3]. By studying the interrelationships among personnel, environment, mechanism, and management, it can achieve the prevention of safety accidents as well as provide solid support and guarantee for the safety of human life and property. This paper takes Xiangtan University's safety engineering program as an example, based on the concept of integration of industry and education, and based on the PDCA cycle model, to form a highly efficient teaching system, to deliver more safety engineering talents to meet the actual needs of China's safety production as well as to help the country's economy develop steadily.

2. Safety Engineering Professional Personnel Training Status and Existing Problems Analysis

By analyzing the data from China Education Online platform, it is known that there are 155 colleges and universities with safety engineering majors, but the focus of each major direction is different, for example, there are disciplines such as chemical safety engineering, coal mine safety engineering and fire safety engineering. In recent years, Xiangtan University's safety engineering program, led by the national security strategy, is committed to cultivating talents with broad knowledge background, strong practical ability and solid basic theories of safety engineering and safety science. We aim to create composite senior engineering talents who are capable of working in the fields of safety engineering technology, scientific research, supervision and management. Graduates are not only able to work in safety technology, safety management and assessment in state agencies and institutions, but also have the ability to work in specialized fields such as emergency management, risk control and disaster prevention [4].

2.1. Talent Cultivation Characteristics are Not Prominent

The safety engineering profession involves more fields, and the undergraduate teaching stage tends to emphasize broad-bore cultivation, resulting in teaching not only more content but also dispersion, leading to the industry characteristics are not prominent, the interface with the needs of employers is not close, and the students' learning objectives are not clear [5].

2.2. Serious Lack of Practical Exercises for Students

In the teaching and training program for undergraduate students, the university arranges too few after-school practical activities for students. Students generally face a serious lack

of practical exercise opportunities in the educational process, which makes it difficult for them to really exercise and improve their practical hands-on skills. In the classroom, students often rely on the teacher's lectures and classroom demonstrations to learn knowledge, and lack the opportunity to do it themselves. Practical exercise is an important way to cultivate students' ability, only through practice, students can really understand and master the theoretical knowledge, in order to truly achieve the theory to practice in the process of experiments and internships.

2.3. Teachers have a Tendency to Emphasize Knowledge Over Methodology

Under the background of China's exam-oriented education, college students only emphasize the results but neglect the process of learning. Without expanding students' thinking, students will only stay on the surface of knowledge and lack the ability to analyze and solve problems. Teachers seldom really understand the needs of students, lack of thinking about students' motivation to learn, and only pass on knowledge in lectures, without really “teaching a man to fish”. Moreover, there is a lack of interaction and communication between teachers and students in the teaching process, and students only passively accept knowledge, and it is difficult for them to actively participate in practical teaching activities and lack their own thinking[6].

2.4. Teaching Content Lags Behind Development

The safety engineering program should focus on current events and interdisciplinary, many important new contents cannot be or is difficult to timely in the practice of the textbook, if the lecture only teaching materials do not talk about current events and interdisciplinary, will directly lead to the students inevitably learn some of the knowledge that has been outdated.

3. School-enterprise Joint Cultivation of Safety Engineering Professionals Path

With the process of global economic integration and China's economic construction, more and more enterprises realize the importance of independent research and development capabilities, so as the main body of knowledge creation of colleges and universities can meet the needs of enterprises to a certain extent. Schools can also be in the process of cultivating talents to better understand the social development of the quality of the demand for talent, constantly update and upgrade their teaching methods and modes, to cultivate more in line with the needs of enterprises, society and the development of the country's high-quality talents.

The following pathways are used to develop safety engineering professionals with skills such as innovative thinking, leadership, general management and digitalization.

3.1. Foundation and Professional Competence Building

Students will be educated in basic disciplines such as math, physics, and chemistry to build a solid foundation for understanding safety engineering concepts. At the same time, through specialized theoretical studies and case studies, students begin to develop a sense of transition from performer to leader and learn how to take on leadership roles.

3.2. Technology Deepening and Digital Skill Enhancement

It focuses on deepening students' professional and technical skills, including security testing techniques and risk assessment methods, while introducing management knowledge such as project management and teamwork to develop comprehensive management skills. In addition, students will learn new technologies such as IoT and big data analytics, as well as information security management to adapt to the needs of digital transformation.

3.3. Practical Application and Continuous Personal Growth

Through corporate internships and participation in real-life projects, students link the theories they have learned to practice and accumulate work experience. At the same time, students are encouraged to engage in self-driven continuous learning, participate in industry exchanges, and develop a sense of lifelong learning in order to promote personal growth and professional development.

Through such a joint training path, we can ensure that safety engineering professionals have both solid professional knowledge and skills, as well as the ability to adapt to rapidly changing work environments, and the ability to innovate and engage in lifelong learning.

4. Overview of the PDCA Cycle Model

Dr. Deming, an American authority in the field of quality management, proposed the famous PDCA cycle model, which is widely known as the “Deming Ring”. The model follows the core principles of total quality management and consists of four closely interrelated phases: Plan, Do, Check and Action[7].The PDCA cycle is not only a highly effective management tool, but also capable of quickly identifying and solving problems in real time during the planning and implementation of undergraduate teaching. It significantly improves the quality and efficiency of teaching by comprehensively monitoring all aspects of the teaching process and ensuring that each step is carefully designed and optimized. This cycle of continuous improvement strongly promotes the benign development of teaching and lays a solid foundation for the continuous improvement of education quality [8].

5. Construction of PDCA Cycle Safety Engineering Talent Cultivation Model in the Context of Industry-Teaching Integration

Based on the PDCA cycle in the context of industry-education integration, schools and enterprises form an efficient teaching system to cultivate talents with correct natural outlook and methodology, solid theoretical foundation of safety engineering specialization, and good professional ability. Through the PDCA cycle, the students can keep up with the progress of the industry, and are able to be competent in the safety research, safety supervision, safety management, safety education and other aspects of the work for the mining, construction, transportation, civil aviation, chemical industry and other high-quality personnel.

5.1. P (Planning Stage): Oriented to the Goal of Mastering Theoretical Knowledge, The School and the Student Work Together to Develop a Personnel Training Program that Meets the Student's Individual Needs.

The planning stage is the beginning of the PDCA cycle model, which is mainly to carry out overall planning on a macro level, mainly combining the students' personal situation, the school's teaching objectives and teaching methods, and the school and the students themselves will work together to formulate their individual talent cultivation plans according to the students' personal situation as well as the needs of the society. Through the teaching and practice links of Civics and Political Science courses, public foundation courses, professional foundation courses, professional main courses, professional elective courses, academic lectures, social practice activities, production practice and internships, the graduates will be trained to become talents with general and professional in-depth knowledge of engineering technology and management, who will be able to skillfully use the available technology and tools to effectively identify, deeply analyze and properly solve complex problems in the field of safety engineering. This training approach aims to ensure that graduates have solid professionalism and problem-solving ability in the field of safety engineering[9].

5.2. D (Doing Stage): Schools and Enterprises Cooperate with Each Other to Enhance Students' Ability to Link Theory with Practice

The most important task in the Doing stage is to combine experiments, cognitive internships and graduation internships with the actual classroom teaching management according to the objectives and requirements of the program, so as to optimize the quality of teaching. In the practical teaching link, especially in the experiments of specialized courses, cognitive internship and graduation internship, it often focuses on the direct explanation of the established theoretical knowledge by the teacher or enterprise tutor, and the students usually carry out the practical operation after the class, which often leads to the difficulty for students to think independently and explore independently in a timely manner. Therefore, teachers and business tutors need to focus on and actively carry out heuristic teaching, only when students are interested in learning, can they develop the ability to think about problems, explore problems and solve problems in a timely manner. Secondly, in the curriculum of the safety engineering professional training program, the practicality of the course should be highlighted and its proportion should be increased. You can jointly open classrooms with schools and enterprises, invite experts in the field of safety engineering or engineers from relevant enterprises to carry out engineering teaching, and give full play to the engineering background experience of the experts on the basis of lectures given by the teachers in the school, so as to connect the problems that will be encountered in the actual engineering with the textbook contents of the specialized courses. At the same time, the opening of cross-disciplinary safety engineering practice is increased to improve the construction of students' cross-knowledge discipline system, so as to teach according to their abilities. In addition, the practicality of the course is characterized significantly, which helps students to master the theoretical knowledge and practical skills required for the application of engineering practice closely related to their own research direction.

5.3. C (Checking Stage): Promoting the Quality of Teaching and Learning on the Basis of Diversified Evaluation

The checking stage is to summarize the Doing stage and propose improvement measures. The effective implementation of an excellent teaching model must rely on a set of practical and efficient teaching evaluation mechanism. Therefore, it is very important to construct diversified evaluation. Evaluation should be done by the direct organizers, direct feelers and participants of talent cultivation, i.e. schools, students and enterprises. When students have completed the systematic theoretical knowledge learning, experimental practice in school, and entered the enterprise to complete the graduation internship, they will be evaluated through the three evaluation subsystems of teacher's evaluation, student's self-assessment, and enterprise's assessment, which are the basic guarantee for the checking stage to be able to operate. Secondly, in the process of teaching implementation, it is also necessary to carry out periodic evaluation of multi-dimensional aspects such as teachers' teaching performance, students' learning progress and teacher-student interaction. This can quickly identify potential problems in the teaching process and then propose corresponding improvement strategies to promote the continuous improvement of teaching quality[10].

5.4. A (Actioning Stage): Focusing on the Continuous Development of Talent Training with the Linkage of Regularization and Improvement

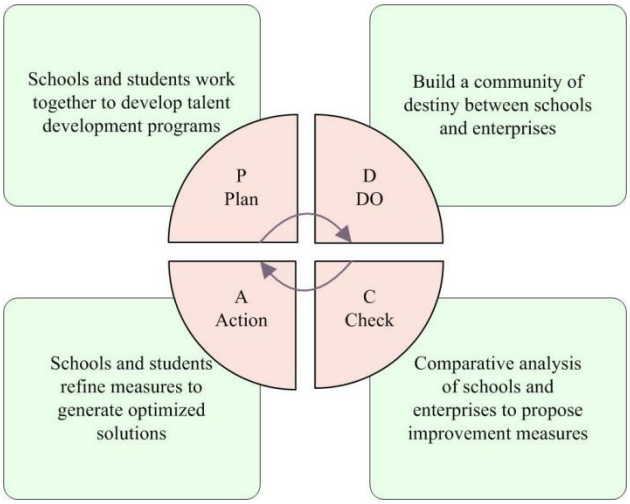

Fig 1. Talent cultivation model of safety engineering based on PDCA cycle

Actioning stage is the sublimation of PDCA cycle model. For safety engineering personnel training, for the checking stage whether to achieve effectiveness to summarize, form experience, to normalize the improvement of the quality of the next PDCA cycle of the teaching process to play a linking role. First of all, the school should summarize and feedback in time whether it is contingent or actual. For the beneficial experience can continue to apply with the next cycle, while the part that needs to be improved to find out the reasons for

timely adjustment, the optimization program will be implemented in the next cycle[11].

Applying the PDCA cycle to the education and training of safety engineering majors can achieve optimal teaching and learning results. This cyclic system works through the closely interconnected links: planning, execution, checking and action, and it ensures that the whole process of teaching management is constantly optimized, so that the quality of education is continuously improved in the cycle. This provides a solid guarantee for the cultivation of human resources with a high level of professionalism.

6. Conclusion

Through the construction of the PDCA cycle-based safety engineering professional talent cultivation model in the context of industry-teaching integration, the talent cultivation program is continuously optimized, adjusted and improved to consolidate the students' theoretical knowledge and improve their practical skills, and the four steps of the PDCA cycle are elucidated: formulating the talent cultivation program, improving the students' practical ability, checking the effect of the implementation, optimizing the program, and perfecting the construction of the talent cultivation system, respectively. Safety engineering professional talent training is a tedious, complex, professional systematic work, colleges and universities, teachers and students, as well as enterprises only in the continuous process of practice, spiral adjustment program, in order to better apply to the actual classroom teaching and management situation, constructed PDCA cycle model with a view to effectively solve the problem of talent training.

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