Exploration on Practical Training Mode of Excellent Engineers in Safety Engineering Specialty of Applied Undergraduate Colleges

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Abstract. Under the condition of the rapid development of the demand for safety engineering professionals in China, the problems reflected in the training of innovative engineering talents have become increasingly prominent. The Excellent Engineer Training Program is a major reform project for higher engineering education in China. Implementing the “Excellence Plan” in applied universities, innovating the talent training model, adjusting the personnel training structure, improving the quality of personnel training, will lead the engineering education reform and cultivate a large number of outstanding backups. Engineers to meet the needs of society for multiple levels and types of engineering and technical personnel. Based on the analysis of the development status of the safety engineering majors in China's colleges and universities, this paper makes an in-depth analysis on the training connotation, ability structure, practical teaching training mode and method approach of the implementation of the excellent engineer program in the application-oriented undergraduate colleges. The solution to the corresponding problem was put forward.

Introduction

After years of rapid development, China has already owned the world's largest higher education system, trained tens of thousands of engineering and scientific talents, and greatly supported the rapid development of China's social economy, providing a good situation for China's current reform and opening up. However, the current education level of the quality of science and technology and engineering talents in China still lags behind many developed countries. With the rapid advancement of China's economic and industrial upgrading and urbanization, a large number of more excellent engineering and scientific talents are urgently needed. How to cultivate engineers with excellent quality is not only a subject of research in all countries in the world, but also an urgent need for solving higher engineering education in China problem. In June 2010, the Ministry of Education launched the “Excellent Engineer Education and Training Program” (referred to as the “Excellence Plan”), aiming at cultivating a large number of high-quality engineering and technical personnel with strong innovation ability and adapting to the needs of economic and social development. It is an important demonstration and guiding role to promote the cultivation of talents in China's higher education for the needs of the society and to comprehensively improve the quality of engineering education personnel training [1].

In recent years, more than 100 colleges and universities in China have opened undergraduate majors in safety engineering, which has led to the development of safety engineering higher education. However, at present, the undergraduate education of safety engineering in various colleges and universities generally has a situation in which the professional direction is not clear, the personnel training mode and the standards are chaotic. Therefore, it is of great significance to study undergraduate level institutions, especially application-oriented undergraduate colleges, to train outstanding engineers in safety engineering.
The Safety Engineering Professional Personnel Training and Practical Teaching Status

In recent years, the safety engineering majors of various colleges and universities in China have maintained a steady and rising development momentum in terms of the scale of schools, the number of enrolled students, and the strength of teachers. However, there are obvious deficiencies in the teaching systems implemented by various universities, especially the practical teaching systems. The phenomenon of deviating from social needs focuses on the line of theory and light practice [2]. The cause is mainly due to the following aspects:

1. There is a lack of uniform standards and consensus in the curriculum system.
2. The laboratory hardware conditions are lacking.
3. The effect of practical teaching is difficult to guarantee.
4. The teaching staff of practical teaching is weak.

In addition, in recent years, some graduated safety engineering graduate students have been enriched into the teaching staff. These young teachers have difficulty in strengthening the practical teaching effect to a certain extent because they have just left the campus and lack engineering practice experience.

Application-oriented Excellence Engineer Undergraduate Talent Training Basic Theory

Application-oriented Excellence Engineer Defines the Core Concept of Undergraduate Talents

Applied undergraduate education is the development of higher education for undergraduate-level applied talents. It has the commonality of undergraduate education, but it is different from ordinary undergraduate education, which emphasizes practical and applied characteristics. Compared with the talent training mode of general academic education, the cultivation of applied talents has its own characteristics.

The Difference between Excellent Engineers and Traditional Applied Undergraduate Talents

The “Excellence Plan” puts forward the concept of “classification implementation, various forms, and pursuit of excellence”, emphasizing various types of colleges and universities, adopting various education and teaching methods in the professional fields with advantageous characteristics, and pursuing excellence in the cultivation of different types of engineering talents. [4]. Therefore, different levels and types of engineers should be differentiated from their “excellent” positioning.

Connotation Analysis and Ability Composition of Undergraduate Talents of Application-oriented Excellence Engineers

The concept of the type of engineer has gone through five generations, from the versatile first generation, the specialized second generation, the over-specialized third generation, the fourth generation of the background of the major engineering to the fifth generation characterized by “interdisciplinary”. [5]. With the advent of the global economic integration knowledge economy, cross-disciplinary disciplines, marginal disciplines, and interdisciplinary disciplines have emerged in large numbers. The undergraduate applied engineer talents required to be trained must not only have a broad and relatively deep foundation in academic theory, but also benefit the future of such talents.

“In terms of value orientation and talent orientation, excellent engineers must be competent, comprehensive and highly qualified senior professionals.” [6]. The German-French model focuses on the cultivation of engineering practice skills and trains engineers' finished products. As the sponsoring and signing organization of the Washington Accord, the American Engineering Education Technology Accreditation Council (ABET) requires engineering graduates to have 11 capabilities [7]. The Federation of European Engineers (FEANI) has proposed 12 European engineers' competence standards [8]. China's engineering education professional certification standards (for trial implementation) proposed that engineering graduates must meet the knowledge, ability and quality requirements of 10 aspects [9]. In summary, the capabilities of application-oriented engineers can be
summarized into four aspects: (1) professional skills and innovation capabilities; (2) management and business skills; (3) human qualities and social behavior; (4) occupations Responsibility and forward-looking awareness. To this end, we have built a Diamond model of superior engineer capabilities (shown in Figure 1) to clarify and evaluate the standards of superior engineers and other levels of applied talent.

![Figure 1. Diamond model of engineer's ability.](image)

**Construction of Practical Teaching Mode for Excellent Engineers in Applied Undergraduate Colleges**

After years of development and accumulation, engineering education in developed countries has formed some very useful practical teaching experiences and training models [11]: Judging from the requirements of the Ministry of Education to implement the “Excellence Plan”, the key link in the development of excellent engineers is how to effectively carry out practical teaching and training. Through this link, students can have theoretical connection with practice and better engineering comprehensive ability. According to the order of knowledge logic system and learning and development, the engineering ability training model of excellent engineers can be summarized into a main module composed of four stages and two capacity support modules, namely the “one body two wings” flying bird model shown in Fig. 2. The four stages of the theme module are: (1) Basic engineering training phase. Emphasis is placed on cultivating students' basic theoretical cognitive abilities and basic operational skills, initially establishing engineering concepts and establishing engineer spirit and awareness. (2) The stage of professional technical application ability training. It is closely integrated with the theoretical knowledge of professional courses, focusing on cultivating students’ professional knowledge application and development ability, so that they have the skills to solve technical problems by applying professional knowledge and operational skills in a certain engineering environment. (3) Engineering comprehensive ability training stage. With the actual or simulated engineering objects as the background, it focuses on cultivating students to comprehensively apply relevant knowledge and self-learning ability to solve systemic engineering problems in a systematic engineering environment, form an independent analysis and organize team's ability to solve problems, and have preliminary scientific research. ability. (4) Engineering innovation ability training stage. Taking the current actual engineering problems as the background, it focuses on cultivating students' ability to seek solutions under certain conditions of technical difficulties, so that they have certain levels of modern innovation capabilities such as technology development, product
innovation, system integration and system construction. These four stages correspond to the four levels of talent development, namely: understanding level, skill level, system level and innovation level.

![Diagram](image)

Figure 2. Excellent engineer engineering practice ability training mode.

Training Objectives

With the goal of excellence in safety engineers, we will cultivate engineering talents with sound personality, reasonable professional knowledge structure, outstanding innovation ability and practical ability, and adapt to the needs of safety production and social safety management in various industries.

Training Mode

In accordance with the Ministry of Education's "Excellence Plan", it is recommended to adopt the "3+1" school-enterprise joint training model. However, the simple "3+1" tends to fall into the two skin conditions cultivated by the school enterprises, and it is difficult to complete systematic practical teaching and training. Therefore, it is necessary to adjust the existing teaching system, carefully design and implement a systematic and consistent practice training system, and follow four stages, namely, the theoretical learning stage, the practical cognitive stage, the professional experimental stage, and the comprehensive application stage of the engineering.

Training Methods and Ways

1) Implement a dual tutor system for joint school and enterprise training. That is to say, the joint guidance mode of “school tutor + corporate tutor” is implemented, so that students can get in touch with the actual project and participate in the research work of the tutor as soon as possible, and give full play to the advantages of the instructors at home and abroad to conduct academic research, research projects, and enterprises.

2) Project-based teaching mode. In the course of engineering basic courses and engineering professional courses, the research teaching mode based on actual safety engineering projects should be comprehensively explored, and problem-oriented, large-scale operations, special research reports, literature review reports, research experimental reports, etc. should be adopted.

3) Implement integrated training of production, education and research. On the one hand, it is a combination of off-campus production, study and research, fully mobilizing the enterprise, engineering and domestic and foreign resources; second, the combination of production, education and research within the school, making full use of the school's research base, engineering center, laboratory and school-run industry, etc., will be scientific research, The experience and results of the social service process are integrated into the teaching.

4) International training. On the one hand, it is to “go out” through various channels to improve the proportion of students internships in foreign companies. On the other hand, it is actively "bringing in".

5) Build a faculty team that is compatible with engineering education. The cultivation of "excellent engineers" is a system in which not only the cultivation of students, but also the training and
continuing education of teachers, the teachers' business and practical training mechanisms. A double-skilled faculty team who understands both modern scientific theories and rich engineering practice experience.

**Conclusion**

Under the conditions of rapid development of the demand for safety engineering professionals in China, the problems reflected in the cultivation of innovative engineering talents have become increasingly prominent. The Excellent Engineer Training Program is a major reform project for higher engineering education in China. Applied universities implement the “Excellence Plan”, innovate the talent training model, adjust the personnel training structure, improve the quality of personnel training, and lead the engineering education reform and cultivate a large number of outstanding backups. Engineers to meet the needs of society for multiple levels and types of engineering and technical personnel. Based on the analysis of the development status of the safety engineering majors in China's colleges and universities, this paper makes an in-depth analysis on the training connotation, ability structure, practical teaching training mode and method approach of the implementation of the excellent engineer program in the application-oriented undergraduate colleges. The solution to the corresponding problem was put forward. It is believed that with the continuous development of higher education and the joint efforts of all universities, the training of engineers in the safety engineering profession will certainly be gradually improved, enriched and improved.

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**References**

[1] Wang Baozhen. “Thoughts on Implementing the ‘Excellent Engineer Education and Training Program’”[J]. University Education Management, 2012, (1): 15-19.

[2] Xu Feng, Zhang Guohua, Zhu Lihua. Discussion on the problems existing in the training of undergraduate talents in safety engineering[J]. Journal of Chongqing University of Science and Technology(Social Sciences Edition), 2010, (16).

[3] Lin Jian. On the implementation of the “Excellent Engineer Training Program” caused by several changes [J] China Higher Education, 2010, (17): 30-32.

[4] Lin Jian. Development of General Standards for “Excellent Engineer Education and Training Program” [J]. Higher Education Research, 2010, (4): 21-29.

[5] Liu Xila. Looking at the engineering education in the 21st century from the field of civil engineering[J]. Higher Education Research, 2006, (3): 8-14.

[6] Li Decai, Wang Jun. Some understandings on training "excellent engineers" [J]. Graduate Education Research, 2011 (3): 54.

[7] ABET. Criteria for Accrediting Engineering Programs [EB/OL]. Http://www.abet.org/.

[8] FEAN. Competence of Professional Engineers/EUR ING [EB/OL]. Http://www.feani.org/.

[9] National Engineering Education Professional Certification Expert Committee. Engineering Education Professional Certification Standard (Trial) [Z]. National Engineering Education Professional Certification Workbook, 2009.4.
[10] ICE. Routes to Membership (MICE) - Institution of Civil Engineers [M]. ICE 3001A, v3, Dec 2010.

[11] Li Shulin. Research on the teaching system of technical undergraduate education practice [D]. East China Normal University: East China Normal University, 2009.