

Problems of Engineering Education in China

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Abstract—Chinese engineering education has achieved great successes in recent decades. However, the quality of engineering education is not very satisfactory especially under the situation of global economy. There are 3 problems of engineering education under the new situation in China: students' practice ability, university-industry cooperation, and qualified teachers.

Keywords— Engineering education, Practice ability, University-industry cooperation.

I. INTRODUCTION

WITH the development of industrialization and economy and higher education, China has the largest number of engineering undergraduates. Statistics show that there are nearly 30 million college undergraduates in China. Nearly 25 percent students are engineering college students[1]. So many major and notable engineering projects have greatly promoted the advancement of engineer education, such as China's Manned Spaceflight Project, the Three Gorges Project, High-speed Railway Project, Chang'e Project, the Big Aircraft Project, etc. With China's accession to the world trade organization, manufacturing industries are transferring from word to China. Cultivation of engineering talent influences the level of engineering and the speed of development, which decides national engineering competitiveness [2]. Therefore, it goes without saying that many excellent engineering talents are very important [3]. China is constructing innovative country with the weak industrial foundation and lack of engineers[4]. Also, research on Chinese engineering education is very important, because China is playing more and more importance to the word. However, the quality of engineering education is not very satisfactory. There are 3 problems of engineering education under the new situation in China: students' practice ability, university-industry cooperation, and qualified teachers.

To solve the above problems and challenges, the government and higher education workers should avoid neglect of engineering education. We need to explore to establish teacher-engineer effective mechanism on engineering education.

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Also, the government should encourage the business to participate the work. The Ministry of Education has launched a plan for educating and training outstanding engineers (PETOE) which is very important to improve the quality of engineering education. The plan aims to educate more than one million of engineers of high quality in the next 10 years, under which 61 universities have been approved on June, 2010.

II. THE PROBLEMS OF FOSTERING PRACTICE ABILITY OF ENGINEERING TALENTS

A. *The Importance of Practice Ability*

Engineering practice ability is the essential characteristics of engineering education[5]. Engineering education focuses on solving the practical problems of engineering project and industrial production and emphasizes practice ability, innovation ability, and capability. Engineers play a key role in transforming ideas and inventions into innovations that, by definition, create value for users[6]. Students received engineering education will probably be engineers after graduation. If college students lack engineering practice ability, only knowing thinking but not doing, their acquired engineering thinking can not be turned into reality. Engineering practice is the key for students to advance his practice ability and to probe into engineering. Therefore, practice is the most important in every aspect of engineering education. Nevertheless, most of colleges in China and college teachers understand practice as only practice, which virtually is very superficial. We need further understand the role and significance of engineering practice. Basing on above analysis, engineering practice education needs us to execute three shifts.

B. *Three Shifts of Engineering Practice Education.*

Basing on above analysis, engineering practice education needs us to execute three shifts.

Firstly, the idea of engineering practice should be shifted from skill practice to engineering education. The existing idea deems it only as cognitive practice and skill training, which is a lower-tier cognition and an embodiment of traditional educational theory, which stressing theory but neglecting practice. In fact, practice of engineering education is definitely not just skill training. Practice is the sole criterion for testing truth and the most important way to explore the truth. Also, practice is not only the test and verification of theory, but creative development and exploration for unknown fields.

Engineering education will be carried on effectively only practice is treated as the same important as teaching, and be closely interlinked to teaching.

Secondly, engineering education should be shifted from teacher-centered to student-centered[7]. For example, engineering training course and experimental course which are preset by the teachers the goal of experiment, the assigned equipment and experimental conditions, are helpful for the students to understand theory and do help to develop students' creative ability and initiative consciousness to some degrees. But the students are passive to accomplish the teachers' proposition thesis, because their initiative and creativity are not exercised. There are few students who settle the goal of practice to conduct practice on ones own initiative. Actually, students can really develop their innovation consciousness and innovation ability if they exert the dominant role and setting the goal actively in the practice of engineering education.

Thirdly, the content of engineering practice should be shifted from campus practice to enterprise and social practice. At present, most of colleges in China usually strengthen the students' practice ability by several means: increasing class hours of training program, establishing engineering training center, offering engineering course and social practice course and so on. But practice has actually not been implemented in enterprise in most cases, although it is stressed by the training program, because there are many difficulties. Actually, engineering practice in enterprise cannot be replaced by practice course and colleges' engineering training center, because only practice in enterprise can students contact real engineering environment and really exercise their initiative. Engineering practice can be carried on not only in enterprise and engineering training centre, but also in society, which are more important[8]. In fact, students' social responsibility, communicative competence and overall quality will be cultivated and developed very well if they receive engineering education from enterprise and society.

III. THE PROBLEMS OF UNIVERSITY-INDUSTRY COOPERATION ON CULTIVATING ENGINEERING TALENTS

Practice is the soul of engineering education. University-Industry cooperation is the important characteristic and essential requirements of engineering education. University-Industry cooperation contributes to changing the original idea of 'appreciating theory and neglecting practice,' establishment of idea of engineering education, to meet industry and enterprise' need, improving the students' engineering practice ability. Through university-Industry cooperation, the colleges can grasp the demands of enterprise and foster students meeting the enterprise' complicated and multiple need. To the enterprise, it can recruit many talents from colleges who are qualified and having rich engineering experience.

A. Three Problems on Cultivating Talents

PETOE aims to establish new mechanism of university-industry cooperation on cultivating talents to solve the problems of cooperation. The industry can grasp its industry's

trend, be familiar with frontier technology's progress and talent demand. The enterprise has the most advanced production equipment and technology, real engineering environment and experienced engineers, which are very important to foster engineering talents. But there are many problems in the aspect of cooperation on cultivating talents.

Firstly, Most of enterprises consider colleges' main duty is to cultivate talents, while the business itself is utilizing talents. Also, enterprises think it is not their responsibility to cultivate talents, but the colleges'. In the practice, the reason why the enterprises shoulder the responsibility to foster talents is most for the sake of politics or friendship between the colleges and the enterprise, although it thinks itself can benefit little from the University-Industry cooperation.

Secondly, the connotation of university-industry cooperation on cultivating talents is not enough. The most common cooperation way to cultivate talents between college and industry is training interns. There is little cooperation in several aspects, such as drawing up training scheme and teaching plans, controlling and evaluating students' quality, etc.

Thirdly, university-industry cooperation on cultivating talents is faced with many practical difficulties. For example, it is very difficult for the enterprise to provide accommodation for so many interns. Additionally, there are two "s" problems harassing the industry: the first "s" is safety, namely the safety of students during the internship. The second s is secret, namely the secret of enterprise's technology and patent. Moreover, the Chinese Enterprises, especially small and medium enterprises, have not established the trainees system and deep cooperation mechanism between colleges and industries.

B. There Ways to Solve Problems

To solve above problems, we should renew our ideas to cultivate the enterprise's social responsibility to cultivate talents. At the same time, some measures should be taken to improve university-industry cooperation.

Firstly, the government should strengthen legislation and make policy to encourage college-industry cooperation. The society should propaganda that it is enterprise's social responsibility to cultivate talents. For example, such measures can be taken into consideration, which encourage the enterprise to recruit interns from colleges by reducing or remitting taxes, etc. A Policy "Several proposals on the encouragement of industry-university-research cooperation" issued in Beijing, which arranges at least 50 percent technology projects funds to support industry-university-research cooperation. Additionally, the enterprise should shoulder the responsibility to cultivate talents, to explore how to develop students with colleges actively.

Secondly, university-industry cooperation on cultivating talents should not be confined to accepting interns only. The connotation of cooperation should involve the following aspects: In the part of cultivating standard, the educational circles should set cultivating standards with the industry and

enterprise to meet the business' basic need, following the rules of engineering education[9]. In the part of setting teaching objectives, the colleges and enterprise should draw up training scheme and teaching plans, supervise and evaluate students' quality together. In the part of cultivating period, the college and the enterprise are responsible for the student's study together which consists of two periods: studying at campus which is mainly responsible by colleges and studying in enterprise which is mainly responsible by enterprise.

Thirdly, from the view of colleges, colleges should set the goal of cultivating talents for industry and enterprise, which need to develop students practice ability incessantly. Only the students' practice ability has been developed and is adapt to take part in the enterprise' engineering project, can the enterprise be willing to cooperate with colleges to cultivate the talents, besides accepting interns. Furthermore, colleges should not just focus on large state-owned enterprise to send interns which can not accept so many interns from so many colleges. It is wise to cooperate with private enterprises and medium-sized or small enterprises, many of which are high-tech and promising.

IV. THE PROBLEMS OF TEACHERS TEAM IN THE ENGINEERING EDUCATION

Teachers are very important for engineering education. The quality of teachers decides the level of engineering talents fostered by colleges. Only the teachers with international vision, following the laws of education, with rich experience in teaching, can cultivate excellent engineering talents.

A. Three Problems for the Teaching Staff in the Engineering Education

At present, there are three existing problems for the teaching staff in the engineering education in China.

Firstly, most of teachers lack experienced engineering practice and are not much familiar with engineering practice. Although many teachers' degrees are master or doctor, they are not much qualified to conduct engineering education for students. Few of college teachers have received good and systematic engineering education as a result of neglect of practice in China. Therefore, teachers with little experience on engineering education cannot foster excellent engineering talents.

Secondly, colleges in china, especially prestigious universities, attach much importance to scientific research more and more. It is no exaggeration to say teachers' most important goal is to publish scientific paper. When Colleges recruit new staffs, they pay much attention to the level of applicants' scientific research and the quantity of papers, but little to experience of engineering practice or ability to teaching. Colleges rarely recruit the applicants who are from the enterprise, although Chinese industry never lacks talents with international vision and rich engineering experience, who are competent at teaching.

Thirdly, the existing education evaluation and incentive mechanism, which includes evaluation mechanism of college

education and teachers, is a disadvantage for engineering education. Although it is well known that teaching, scientific research and social services are three main functions of universities[10], scientific research is regarded as the most important function, which is closely related to college ranking and officials' promotion. Furthermore, the existing evaluation and incentive mechanism pays little attention to teaching level, which emphasizes scientific research and funds. The teachers' incomes and promotion are tightly closely with level of research works.

B. Three Ways to Solve Problems of Engineering Education.

Firstly, cultivating talents should be set up as the central task for colleges. Scientific research is not college's ultimate goal. Germany famous philosopher Kant put forward that people is the highest purpose. In a word, anything is served for people. Scientific research is only an important way and basic means to cultivate talents, through which country trains personnel. Cambridge University and Oxford University are acting on such an idea: the reason why scientific research is so important, because it can replenish and renew the contents and ways of teaching. Therefore, cultivating talents is the college's core task.

Secondly, colleges should reform present evaluation and incentive mechanism and take teaching as the same important as scientific research. Emphasis should be shifted from scientific research paper to product design and development, intellectual property, utility patent, industry-university-research cooperation, technology service, etc. Some colleges have carried out reforms in recent years. For example, there are two types of professors in some colleges: research-oriented professors and teaching-oriented professors, which has encouraged many teachers to take effort to teach, to improve the quality of talent cultivation by improving the content of courses, teaching method, etc.

At last, measures should be taken to strengthen teacher's engineering ability. For example, establishing the system of qualification for teaching, by which teachers have to spend some days to be trained for engineering education. Many teachers can be trained in enterprise if it permits. Also, establishing the system of teachers working in enterprise[11], by which teachers can take part in the enterprise's engineering project, which can greatly improve teachers' engineering ability. Also, colleges can recruit experts and senior managers from business who have rich experience in engineering practice. They can be recruited to be full-time teachers, or part-time teachers, or part-time tutors, who can teach students or instruct students to do the graduation design and engineering project.

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