Research on the Training Mode of Practical Ability of Mechanical Talents for Engineering Education Professional Certification

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Abstract. With the strengthening of international exchanges and cooperation, talent flow and configuration become more international. In order to further improve the internationalization of Higher Engineering Education in China, the education ministry has proposed the important measure of the specialty authentication of engineering education. This paper analyzes the current situation of mechanical professional certification in domestic universities, within the background of engineering education quality certification, and the object of study is practical ability training mode of application oriented talents in higher education. The paper revised the training plan of Mechanical professional certification, discussed the reform of curriculum system with the improvement of practical ability. Finally, with the certification standards as a guide, the paper discussed the reform program of three aspects: curriculum system of the training program, practice teaching links and graduate design practice. It provides reference for the professional certification of mechanical engineering.

Introduction

In recent years, China's higher education has made considerable development, has adapted to the economic and social development of the country, its scale has reached the world's largest [1, 2]. However, there is a serious shortage of engineering practice education in engineering education in China. It is difficult for the graduates to meet the practical needs of the enterprise. Therefore, how to improve the quality of higher education, to cultivate students' innovation ability and the ability to adapt to industrial enterprises is the primary task of every university. In order to promote the reform of Engineering education. Our country joined the Washington agreement organization, its aim is to promote multinational working of engineers through bilateral or multilateral recognition engineering education qualification and engineer qualification. The standards of the engineering education and professional ability put forward by the agreement is the authority requirements for engineering graduates and engineers professional ability recognized by international engineering [4-5]. As the engineering education quality certification appeared in more and more domestic colleges and universities, there are higher requirements and evaluation criteria for the existing education training mode.

The current situation of machinery professional certification

Goal of engineering education professional certification is to develop Chinese engineers in line with international standards. At present, the automation and machinery manufacturing professional of three domestic colleges, Shanghai Jiaotong University, Harbin institute of technology and Huazhong University of science and technology, has passed the certification of engineering
education. By the end of 2012, there are total of 406 certified professional throughout the country\textsuperscript{[6]}.
The automation and machinery manufacturing professional of Harbin university of science and technology has a long history, founded in 1958, has become one of the largest and strongest comprehensive professional strength of Harbin university of technology. At present, its Comprehensive ranking in domestic universities is in 37th place, the graduates employment rate at a time has reached more than 95%, transport a large number of excellent mechanical application talents for our country's manufacturing each year.

The curriculum system of certification standards emphasizes that engineering education should be combined with the actual needs of enterprises, strengthen engineering training process, and strengthen the adaptability of the students to the enterprise\textsuperscript{[7]}. The curriculum system includes three aspects: curriculum, practice and graduation design, which is relatively weak link in the cultivation of our existing way. In order to let our students to go abroad and get the recognition of the world, in view of the engineering education accreditation standards, our school will the existing mechanical engineering personnel training mode and training scheme in the curriculum, practice and graduation design in three aspects of in-depth reform and exploration.

**Revision of undergraduate teaching training program**

Training target is also the core of the professional construction, engineering education professional certification for "goal orientation" put forward higher requirements. For certification standards, we according to the characteristics of the mechanical engineering and the social demand for education, to develop our professional training objectives: pay attention to cultivate and mold students' sound personality and social sense of responsibility, good humanities and social science literacy, critical thinking and innovation spirit, natural science, mechanics, mechanics, engineering materials, electrical and electronic and computer application technology theory of solid foundation, relatively broad mechanical engineering professional knowledge and good engineering practice ability, to meet the needs of science and technology, industrial progress and social development, can be engaged in technology development in the field of mechanical design and manufacturing and automation, engineering design, manufacturing operation, scientific research, marketing management work of high-quality engineering and technical personnel. Corresponding project of cultivating students also should have some changes; Plan to recruit for the professional certification, 2015 B direction, the direction of professional Settings for modern mechanical design, mechanical manufacturing automation technology, advanced processing technology and cutting tools, electrical control and automation and so on four directions, revised 2015 edition training scheme. The cultivation of the modified scheme has the following features:

**The outstanding professional characteristics.** In reference to the "made in China 2025" puts forward the development of the manufacturing planning, give full consideration to the professional characteristics and the future direction of graduate student's employment, at the same time, combining with the "excellence initiative" and "professional certification" training objectives and requirements.

**Increase students' autonomous learning time.** New training program to change the traditional teaching mode, reducing the theory and practice, the total credits to the total class hours were changed from the original 198 credit hours and 198 hours of 176 credit hours and 2366 hours and curriculum total number to 62, increase students' autonomous learning.

**Increase practice "autonomous learning".** Training scheme to effectively integrate various curriculum teaching content, delete obsolete content knowledge, increase the practical teaching link, to open a "mechanical products of surveying and mapping", "mechanical innovation practice", "creative thinking and innovation design" and "mechanical and electrical drive controller and application" and so on practical teaching courses, in order to improve the students' ability of engineering practice.
An increase with the new technological manufacture for elective courses. Increase the 3D rapid design and molding technology, intelligent design, intelligent manufacturing and three-dimensional design advanced application technology and other new courses so as to stimulate students' learning interest in new technologies in the elective platform, debased on the characteristics and expertise in the related research field.

Curriculum system reform characterized for improving the practical ability

The curriculum system in professional certification standards emphasizes that engineering education should be combined with the actual needs of enterprises, and strengthen engineering training, take the cultivation of the construction quality and innovative spirit throughout the classroom teaching, practice and graduation design and other aspects. In order to fit the bill of the engineering education of professional certification, the three aspects are reformed, which not only courses setting for mechanical design and its automation specialty, but also the practice teaching and the graduation design.

Curriculum system settings. The curriculum is composed of two major systems, general course and professional course, each of which is composed of a compulsory module and an elective module, as shown in Figure 1. The course of this project is to establish the basic curriculum of general knowledge, which is mainly reflected in the cultivation of students' comprehensive quality. Through the general knowledge, the students will be more deeply understand the requirements of professional ethics, and cultivate a good engineering ethics.

Figure 1. Curriculum system settings.

Professional course is divided into two major courses and professional core courses and professional courses, the core curriculum is divided into subjects, professional basic courses and professional courses. Subject basic course is to cultivate students' understanding of the basic course of the relevant majors, to understand the basic application of the strong correlation between the students, and to expand the students' knowledge and expand their horizons. Professional basic course is to develop students' professional quality. In this scheme, the course syllabus and teaching plan to jointly set by industry experts and teachers.
Professional platform for the professional platform to reflect the characteristics of professional training, strengthen students' engineering practice ability. This school has set the combination of A, C, B, D four professional optional modules, respectively, corresponding to mechanical design, mechanical manufacturing, tool development and mechanical and electrical integration. To highlight the professional characteristics and improve the students' practical ability, the computer application of basic elective courses, engineering mechanics elective courses, professional quality and innovation and entrepreneurship elective courses and mechanical basis. To further stimulate students' interest, highlight the professional characteristics, and to adapt to advanced manufacturing technology, increase the professional optional courses, such as rapid design and molding technology, manufacturing technology and industrial robots, such as the characteristics of the Chinese manufacturing characteristics of elective courses.

Practice teaching reform. Professional certification standards of practice teaching link of the high requirements, in addition to develop practice teaching in the school, the school also actively cooperate with the enterprise and launch enterprise training and practice, provide students with more opportunities to participate in engineering practice. So that the students in independent and hands-on, comprehensive, experiment and innovation ability and so on to get some exercise. Around this point, we build a set of practice teaching systems from fundamental to professional in our training scheme, include course experiment, course design, case teaching, flip the classroom, comprehensive training, graduation design practice, and appropriately increase the period of practice teaching. At the same time, we encourage and guide students to actively participate in various competitions inland and abroad out of the teaching period, using games to promote teaching; Actively participate in the teachers' scientific research project, begin from the sophomore year undergraduate students training plan, the period of one year, to participate in scientific research and practice, which implements a whole ability training from the practice of foundation to high-end chain, embodies the training goal emphasize "outstanding practical skills, quality education" in the cultivation of the characteristics. The practice teaching link shall be carried out in accordance with the five platform Settings, as shown in figure 2.

The first layer experiment platform for theory courses, including four modules, mechanical basic experiment module, digital design and simulation module, machinery manufacturing and mechanical and electrical system control module. The experimental modules can strengthen student's understanding of theory, experimental verification of the content of the course of knowledge, and increase the students' ability of combining theory and practice.

The second platform for curriculum design, include the design of mechanical principle, mechanical system design, hydraulic system design and tool design. The link of each course design will use the three weeks to complete a relatively complete structure and system design, to improve students' comprehensive ability to apply the course knowledge to solve practical problems.

Third level platform for the engineering practice, this link is the use of the school of engineering training center, the technology and equipment of the national demonstration center in Harbin University Of Science And Technology, with professional teachers and the engineering and technical personnel to guide the students to complete the training skills together, enable students to master the advanced design and manufacturing methods, understanding the forefront of machinery manufacturing.

The fourth floor platform for the enterprise practice, through cooperation with the enterprise such as The First Auto Works (FAW) in Changchun, establishing stable practice base, hire experts as an intern teacher in enterprises, for three weeks of production practice, the principle of integrating theory with practice, deeply understand and grasp the professional mode of production and technological process, deepen understanding and grasp of this subject knowledge and comprehensive ability training project, understand the development direction of this professional production technology.

Fifth floor platform is a team to participate in the scientific research. This practice is based on the students' interests and the future career orientation freedom to choose to participate in. College has
nearly 15 scientific research teams, can provide project practice for undergraduates, filing patent applications to participate in the research, and writing research papers, etc., laying the groundwork for future research and work. For students, who are capable of innovative thinking and innovative they can join design competition groups and entrepreneurial teams to improve their practical ability and to achieve the purpose of to promote learning. We hope that the further development of engineering ability of students, guiding them to participate in various forms, all levels of competition. To the students who want to develop scientific research ability, we guide them to participate in the project of all kinds of scientific research of teachers.

![Settings of Experiment link](image)

**The graduation design practice**

Graduation design is a test of the undergraduate study, professional certification standard requirement for undergraduate course graduation design is "graduation design (paper) subject as far as possible close combination of the professional engineering practical problems, which enables students to solve practical problems in the process of learn to apply my knowledge", "Enterprise or industry experts should be invented to participate in the topic selection of graduation design (paper), guidance and assessment should".

1. Open a graduation design topic selection and the opening exchanges. In order to guarantee the student to the graduation design are fully understanding, before the graduation design for a semester, to carry out the online graduation design topic, two-way choice is between teachers and students. Students choose teachers and graduation design topic according to their interests and career. The school can invite companies with senior engineering and technical personnel to guide experience, such as lectures, teaching methods and techniques of engineering design, to strengthen the teachers' and students' engineering quality and improve the students' enthusiasm.

2. More innovative design subject are needed in graduation design topic selection. We need develop incentives through the reform of graduation design grading standards and assessment system for college. On the one hand, we strengthen the professional engineering practical problems of innovative topics, according to the enterprise actual demand. On the other hand to encourage
teachers to devote their own scientific research achievements to the graduation design topic selection, which make the students contact industry that situated in the forefront of science and technology, and create conditions to foster innovative research ability.

(3) Build a "double division type" graduation design teachers team. Make full use of Harbin University of science and technology and enterprise cooperation and communication foundation, to cultivate young teachers to study and practice, the enterprise guiding the students' graduation design, can exert students' initiative and the practicability of design topics. For part of the graduates have to sign the employment agreement, we encourage them directly to enterprise to complete the graduation design, between joint instruction, which make students adapt to their jobs as soon as possible. For the teachers’ guidance model alone, we will hire experts to participate in the review and reply, comprehensive enterprise experts score as the final result of the school teachers. Through business participate in the evaluation, to make benign combination of graduation design and engineering application demand, improve the quality of graduation design.

Conclusion

The higher engineering education professional certification is the focus work of attention of current colleges and Universities. The professional certification is an effective way to improve the quality of engineering education, also is an essential path. The major of enginery transports a large number of engineering and technical personnel to China every year, has been the essential power of “made in China”. Consequently, the research on the training mode of mechanical talents' practical ability for international engineering education professional certification is of great significance. Adjust the training objective for international certification standards, reform the existing curriculum system, research and explore a new innovative talent training mode of practical ability, conduct the reformation of the contents, methods and methods on practical teaching, introduce advanced engineering design and manufacturing technology, support the advanced experimental teaching equipment, carry out practicing teaching by divided stages and modularity ,inspired the students' creative thinking, improve students' professional ability, to better play the adaptability, timeliness and innovation of the enterprise's demand for talents.

References


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