Teaching reform and practice of electrical and electronic practical training based on engineering education accreditation

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Abstract: Electrical and electronic practical training course is one of the most important practical teaching process for students majoring in science and engineering in colleges and universities. However, there are still some problems and deficiencies in the teaching principle, teaching content, teaching methods and teaching equipment of electrical and electronic practical training course in some local universities. Based on the requirements of engineering education accreditation, this paper puts forward the corresponding reform measures and puts them into practice, which effectively improves students' practical ability and innovation ability.

1. Introduction

To realize the mutual recognition of international engineering degrees, civil engineering professional groups from six countries - the United States, Canada, the United Kingdom, Ireland, Australia and New Zealand - initiated and signed the Washington Accord in 1989. In June 2016, China joined the Washington Accord and became a formal member, which greatly sped up the internationalization process of engineering education in China and meant that Chinese higher engineering education was truly integrated into the international engineering education accreditation system [1,2]. Engineering education accreditation mainly advocates three basic concepts: (1) Student Centering (SC); (2) Outcomes-based Education (OBE); (3) Continuous Quality Improvement (CQI). Among them, outcomes-based Education is also called capability-based education, and the capability is the goal, the starting point and the destination of education. The training program for outstanding engineers and the engineering education accreditation carried out by the Ministry of Education all emphasize the importance of cultivating engineering practice ability of engineering majors, and the construction of these abilities depends largely on the construction of practical teaching system and the implementation of practical teaching links [3,4]. As an important practical course involving many engineering majors, electrical and electronics training course needs to be reformed and improved by taking engineering education accreditation as the action guide, so as to adapt to the current situation of teaching and social needs [5].

2. Reform objectives of the electrical and electronic training course

With the training of students' practical ability and professional quality as the starting point and goal, through the integration of teaching resources, the optimization of teaching content, and the improvement of teaching methods and means, an electrical and electronic practical training teaching system suitable for engineering education accreditation is established to improve students' learning enthusiasm, initiative and creativity, and to realize the change from focusing on knowledge imparting to paying more attention to ability and quality cultivation, so as to improve the electrical and electronic practical training teaching level in our school.

3. Problems existing at present

(1) The teaching content is outdated and cannot keep up with the needs of the time

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The practical training programs are relatively simple and attach too much importance to basic skills, and some of these programs, having not been updated for many years, are not sensitive to the rapid development of science and technology and do not understand the requirements of the society for graduates. In addition, the training syllabus and training instructions used by all students of all majors are the same. There are no different training requirements for students of different levels, and there is no organic combination with students' majors thus cannot reflect the characteristics of the discipline.

(2) The single teaching method fails to stimulate students' interest in learning

Previous way of electrical and electronic practice teaching is teacher-centered, namely is organized with teachers, practical training classes and practical training materials as the center. Although this teaching mode gives full play to the guiding and the leading role of teachers in teaching process, it neglects the student's status, and is unfavorable to students' initiative. Driven by this teaching concept, each practical training is first assigned by the instructor, and then a simple explanation before the students operate, which is not conducive to give full play to the enthusiasm, initiative and creativity of students, as well as students' practical ability. On the other hand, although our school has a special electrical and electronic training center, the practical training projects that can be carried out are limited. Most of the existing practical training projects have low technical content and cannot stimulate students' interest in learning.

(3) The number of teachers is limited, and there are not many double-qualified and double-capable teachers

Most of the teachers in our school started working directly after graduation, and thus there are not many teachers with practical work experience in enterprises. They have solid theoretical knowledge but not strong practical ability. In addition, due to the pressure of school assessment on teachers, some teachers mainly focus on improving their degree, and conducting scientific research projects and academic papers, and thus do not put enough attention on practical teaching.

(4) The evaluation and assessment mechanism is not scientific and cannot objectively reflect the teaching effect

The evaluation of training effect is not comprehensive and objective, and do not develop detailed and quantitative scoring criteria; performance evaluation is simply conducted according to the result of training, and does not have comprehensive assessment on training process; there are no assessment requirements and indicators to put constraints on the instructor, which is not conducive to mobilize the enthusiasm of the instructor.

4. Implementation plan of electrical and electronic training reform

In view of the above problems, our school has made great efforts to gradually solve and continuously improve them in the past three years. The main measures are as follows.

(1) Optimize the teaching syllabus and practical training project

Our electrical and electronic training course for automation, machinery manufacturing and automation, material forming and control engineering and energy and power engineering. And there are differences in the focus of theoretical knowledge among students of different majors, and their specific learning conditions are also different, which leads to great differences in practical training. Based on the above situation, our school has revised the teaching syllabus for different majors, optimized and integrated existing practical training programs, paid attention to the organic combination with professional background, further integrated teaching resources, and built comprehensive practical training platforms of different types and levels for students. Furthermore, the research and development of the multi-level and modular practical training teaching system including "basic-integration-extension-innovation" have been carried out to achieve the ideal effect of practical training, so as to improve students' basic skills and cultivate students' innovative ability.

(2) Enrich teaching means and teaching resources

Teaching means are multimedia, video and pictures combined, and teachers themselves make or play videos to demonstrate the standard operating procedures. Intelligent education platforms were integrated from many respects; "Internet + education" was popularized; electrical and electronic

training content, training steps, instructions of instrument and meter, electronic products technology, production process of printed circuit board, the application of new technology, etc. were included into the training content; complex troubleshooting and other videos and PPT were uploaded to the campus network, and network resource library for electrical and electronic training and teaching was established for students to download at any time, so as to facilitate their independent learning.

(3) Open the electrical and electronic training room to promote the cultivation of students' practical ability

In addition to the time occupied by the teaching tasks arranged by the school, the electrical and electronic training room has been open to students during the rest of the time, and the equipment and tools needed for training have been provided, so that the resources of the training room can be maximally utilized. Students can reasonably arrange their own time in the training room to design and make electrical and electronic products they are interested in, and can also carry out practical operation and skill training. According to the existing conditions of the training room and the actual situation of students, the college has designed some open practical training projects, so that students of science and engineering in the school can choose at their will, at the same time, teachers can arrange appropriate time for answering questions. By completing the design, manufacture, debugging, operation and maintenance of specific projects individually or in teams in their spare time, students can have fully enthusiasm for learning and innovation consciousness, and be equipped with practical ability and comprehensive quality of teamwork and so on. We have encouraged outstanding students to actively participate in various extracurricular scientific and technological activities and competitions, broaden their horizons, enhance their desire for and exploration of new knowledge and new technologies, and cultivate their scientific thinking ability and innovation ability.

(4) Strengthen school-enterprise cooperation and broaden training channels

The main purpose of setting up electrical and electronic practical training course is to train students' practical operation ability, so that students will have relatively high professional skills and quality after beginning to work. School-enterprise cooperation is an effective way for students to improve their professional electrical and electronic skills. Our school has carried out a lot of work in school-enterprise cooperation and made great progress. On the one hand, our school has extensive and in-depth cooperation with enterprises in Loudi City and surrounding areas to arrange some students to the training of enterprises, and to participate in the specific project of enterprises, so students can come into contact with certain practical work in the process of training, have a deep perceptual understanding of the differences between practical work and theoretical knowledge, strengthen their comprehensive application ability of theoretical knowledge, and strengthen and improve training for their own weaknesses. On the other hand, our school also actively invited engineers from some enterprises to guide students' practical training, help students understand the development direction of future career, guide students to formulate career goals and development plans in the process of learning, and achieve the goal of truly cultivating high-quality engineering talents for the country and society.

(5) Vigorously train double-qualified and double-capable

In order to strengthen the practical level of teachers, our school specially formulated the Implementation *Measures of Teachers' Off-Campus Practice Training in Hunan Institute of Humanities, Science and Technology* to ensure the smooth implementation of teacher training at the system level. Every year, more than 20 teachers are selected by the school to work in enterprises for training, the shortest time is 3 months, and the longest time is 1 year. In addition, our school also actively encourages teachers to obtain a variety of relevant vocational qualifications. After several years of efforts, about 70% of the teachers in the four majors of our college have been identified as double-qualified and double-capable teachers.

(6) Integrate professional code into the education

The engineering education accreditation takes the professional code as the eighth of the 12 general standards for the graduation requirements of engineering education, which indicates that the engineering talents at all levels should have good professional ethics, the attitude of pursuing

excellence, the spirit of hard work, patriotic and dedicated, a strong sense of social responsibility and good humanistic quality. The "craftsman spirit" was integrated into the practical training teaching design to cultivate students' professional quality and professional ethics. The professional code requires that engineers should also put ecological responsibility and social well-being in a prominent position, be responsible for the natural environment and public interests, integrate the ecological awareness of green, sustainable and high-quality development into professional courses, and enhance the sense of environmental responsibility. Therefore, electrical and electronic practical training teaching should also become the platform of engineering professional standard education for students, and integrate socialist core values into engineering practice.

(7) Establish a brand new evaluation mechanism

The purpose of setting up and improving the scientific, reasonable and objective electrical and electronic practice evaluation system is to motivate students to learn, help students understand the target of each training link, test students' efforts, exert the principal role of students, at the same time also urge instructors to constantly improve the teaching method and optimize the training content, so as to achieve the total target of improving the teaching quality. The evaluation and assessment system mainly starts from two aspects. On the one hand, in respect of the evaluation of students, it focuses on the evaluation of the practical training process. It evaluates not only students' basic knowledge and skills, but also their potential professional qualities, such as labor and discipline, environmental protection and safety awareness, operation standardization, and innovative thinking ability, etc. In the practical training of each module, a dynamic score record sheet of students was established to record students' practical training at any time, and ensure that there was an effective record of their performance in each practical training link and the progress of each practical training project, at the same time, students' self-evaluation, mutual evaluation and other links were added to help students to improve themselves. On the other hand, in view of the evaluation of instructors, it provides feedback of teaching effects through questionnaires from students and other ways in time, so that it can give play to the examination and promotion function of the evaluation by enable teachers to draw lessons from it, and spur teachers to constantly improve their teaching capacity.

(8) Develop a continual improvement mindset

"Continual Improvement" is one of the three basic principles of the international engineering education accreditation, and has a deep influence on engineering education. The standards of the international engineering education accreditation especially emphasize that teachers and teaching administrators should evaluate students' learning outcomes and apply the evaluation results to promote continuous improvement in all aspects of the talent training system. Continuous improvement is a dynamic process, which requires quality improvement and promotion of all links of talent training. Continuous improvement of engineering education quality can be realized through the cycle of "clear objectives -- implementation -- effect evaluation -- improvement -- effect reevaluation".

Teaching of electrical and electronic practical training itself is also a systematic and dynamic project, which requires teachers to continuously improve the various links involved in the process of teaching practice based on the characteristics of the course and combined with the actual situation of students. Through the continuous improvement of training objectives, graduation requirements, curriculum objectives and other links, a relatively comprehensive and systematic guarantee mechanism for continuous improvement of engineering education is formed in each link of the output of results, and the quality of engineering education is finally improved. Only in this way can we give play to the advantages of the teaching of electrical and electronic practice and fundamentally promote the improvement of the teaching level.

5. Effect of electrical and electronic training reform

In the teaching reform and practice of electrical and electronic practical training course, our school has adhered to the requirements of engineering education accreditation as the guidance, has gone along with the practical training strategy of "attaching importance to the basis, combining the

specialty and ability cultivation", and has put this concept into practice in the actual teaching link. Through the questionnaire survey of more than 200 students majoring in automation of Grade 18 and Grade 19, it can be seen that students recognize the teaching methods and teaching effects of electrical and electronic practical training courses in our school. The school also used electrical and electronic practice platform to guide students through taking part in some competitions, such as college students' innovative entrepreneurial training program, the national college students "challenge cup" competition, "Internet +" contest of college students' innovative ideas and so on, and in which students obtained good results, fully illustrating the feasibility of electrical electronic practice curriculum. It has enriched the teaching content of practical training, stimulated students' learning interest and enthusiasm, and enabled students to put themselves into the design of practical projects and improve their practical ability in the process of practical training. Meanwhile, students' teamwork has been cultivated and the communication and common progress among students has been further strengthened.

6. Conclusion

The rapid development of economy and society has increasingly high requirements for talents, and thus the traditional education principles and methods have been unable to meet the current teaching needs, which requires schools to build a new teaching system of electrical and electronic training according to the engineering education accreditation and combined with their own characteristics, so as to gradually improve the practical ability of students. Eventually, students' ability to analyze and solve problems will be further improved.

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