Reform and Practice of Comprehensive Design of Automation Technology from the Perspective of Engineering Education

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Abstract—Engineering education plays an irreplaceable role in the process of national industrialization. The “Excellent Engineer Training Program” is also an important measure to promote our country change from a big country of engineering education to a powerful country of Engineering education. In this context, the reality is that many students have poor practical ability to solve practical engineering problems and lack of systematic view. Therefore, how to strengthen the design of teaching content and cultivate innovative engineering and technical talents with high quality, strong foundation, strong ability and wide adaptability has become a realistic and urgent problem in teaching reform. “Comprehensive Design of Automation Technology” is an indispensable link to test the professional technical knowledge reserve of students majoring in automation and to improve their personal ability, team ability and overall consciousness. Based on summarizing the shortcomings of previous design contents, this paper puts forward three reform schemes, which have achieved better results in the actual teaching process. It can be used for reference.

Keywords—Engineering education, Automation, Comprehensive design, Teaching reform

I. INTRODUCTION

“Excellent Engineer Training Program” is a major reform project for the Ministry of Education to implement the National Outline of Medium- and Long-term Education Reform and Development Plan (2010-2020) and the National Outline of Medium- and Long-term Talent Development Plan (2010-2020). It also promotes China change from a big engineering education country to a powerful engineering education country. And it has important demonstration and guidance for promoting higher education to meet the needs of society and improving the quality of Engineering Education in an all-round way [1-3]. In this context, colleges and universities have increased efforts to reform and innovate in the construction of professional curriculum system platform, the revision of training plans, the enrichment and perfection of professional curriculum content [4-5], in order to comprehensively improve the running level of schools and the quality of personnel training, and continuously export high-quality engineering professionals for the country.

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Nowadays, how to cultivate innovative engineering and technical talents is a hot topic in Colleges and universities[6-8], and the reality is that many students have strong ability to accept knowledge but weak capacity to solve practical problems; strong abstract and mathematical logic reasoning, but poor engineering practice ability and poor language expression ability, and so on. The reason is that the training measures of innovative engineering and technical personnel are not reasonable enough, especially the theory and practice teaching can not be closely integrated, so as to form a large environment for students to release their innovative personality and cultivate their innovative spirit. “Comprehensive Design of Automation Technology” is the last step for students majoring in automation to check all theoretical teaching. Therefore, how to strengthen the design of teaching content and cultivate innovative engineering and technical talents with high quality, strong foundation, strong ability and wide adaptability has become a realistic and urgent problem in teaching reform.

II. REFORM GOAL OF “COMPREHENSIVE DESIGN OF AUTOMATION TECHNOLOGY”

In view of the shortcomings of the original “Comprehensive Design of Automation Technology” such as too single teaching content, too theoretical course orientation and too unilaterally design process, this paper puts forward that the teaching content of “Comprehensive Design of Automation Technology” should be changed to systematization, integration and engineering, and the scientific research projects should drive practical teaching, In the highly integrated system between scientific research and practical teaching, we should build a practical teaching system to cultivate students' innovative ability. More further promote the teaching reform and explore innovative talent training mode, in order to train and bring up a large number of high-quality engineering and technical personnel with strong innovative ability to meet the needs of economic and social development, and to serve the country on the road of new industrialization, building an innovative country and the strategy of strengthening the country through talents.
III. REFORM CONTENTS OF "COMPREHENSIVE DESIGN OF AUTOMATION TECHNOLOGY"

A. Realize Systematization and Integration of Experimental Projects

When designing experimental projects, we should focus on the needs of various types of Engineering technicians, change the previous mode of divergence from single course (principle and application of single-chip computer, PLC, etc.) to the course group of automation specialty (process control direction, motion control direction, etc.) as the core to expand outward. The experimental items tend to systematize and integrate from the source. Cultivate students' overall view and the ability to integrate their basic knowledge. The transformation from students studying single courses to engineering talents with comprehensive professional qualities can be realized.

In the past, the content of "comprehensive design of automation technology" generally includes the following several design contents: one is the design of single-chip computer control system. This design is essentially based on the course "Principles and Applications of Single-chip Microcomputer" to realize the control of an actual controlled object (such as stepping motor control system, temperature control system, force measurement and control). The second is the design of PLC control system, which is based on the course of Modern Electrical Control and Application Technology of PLC to enable students to master the functions and selection methods of common low-voltage electrical appliances, the analysis and design methods of PLC control system, and the third is the design of process control system. The design based on the course of Industrial Process Control realizes intelligent control algorithm and advanced control strategy, and completes a computer control system. All the design projects mentioned above are essentially based on a certain course, and then take it as the core, connect relevant professional knowledge to realize the control of a controlled object. Although it has a certain degree of comprehensiveness, it is not conducive to cultivating students' overall outlook from a global perspective, and can not jump out of a certain course' limitations, then, this reform transforms the single course into the course group of automation specialty, such as the course group of process control direction ("Industrial Process Control", "Sensor and Detection Technology", “FieldBus Control Technology”, “Modern Control System Integration Technology”, “Computer Control Technology”, “Intelligent Control” etc.). Course group of motion control direction (“Motor and Drive Foundation”, “Electric Drive Automatic Control System”, “AC Speed Regulation”, “Control Motor”, “MATLAB Simulation of Speed Regulation System” etc.), Course group of software design of automatic control system ("Computer Hardware Technology Foundation", “C Language Programming”, “Principles of Single Chip Microcomputer Application”, “virtual instrument technology”, “system simulation”, “DSP technology” etc.). This will control the comprehensive and systematic from the source.

B. Realize Engineering of Experimental Background

Changing the traditional curriculum-oriented, exploring scientific research projects as the driving force, and realizing the teaching content of “comprehensive design of automation technology” tends to be more engineering. Provide more background and environment for students. Cultivate high-quality engineering and technical personnel that meet the needs of economic and social development.

In the past, the design was always guided by curriculum, and students still could do nothing without textbooks in the process of design. As a result, students stayed on books all the time, and it was difficult to integrate theory with practice. Based on this, the reform changed the practical content originally the basis of various courses into a typical scientific research projects, through the design of a practical project, from the formulation of the plan, equipment selection, to the price evaluation, results testing and other project implementation links, all the departments enable students to understand the essence of the various courses, bring together all the individual parts of the courses. For example, we choose the actual project "Design and Implementation of Boiler Automatic Monitoring System Based on CAN FieldBus" as a part of our comprehensive design. Of course, due to time constraints, a large project was divided into several sub-projects, such as steam boiler drum water level control system. The steam pressure control system, the negative pressure control system of steam boilers and so on. In the design process, the students start from the customer's needs, through inquiring the relevant information of the subject, determine the control scheme of the system, select the hardware of the control system, and design the corresponding program to complete the specific control tasks. Completes the design of man-machine interface through applying industrial configuration software, Although the tasks of subsystems are simple, but students need to connect more than 10 specialized courses of Automation Specialty in series to complete the whole process from Plan formulation, implementation and commissioning. The overall conception and detail realization will enable students to deeply understand our preface theory. What is the use of teaching and how to use it? Understand the essence of all courses and form a comprehensive knowledge.

C. Realize Globalization of Experimental Contents

The biggest disadvantage of engineering education is theory-to-theory. It is difficult for students to apply their knowledge to practice through theoretical study in Colleges and universities. New Engineering and Technical Disciplines puts forward that the ability framework of new engineering talents should be reconstructed from three dimensions: individual ability, team ability and global consciousness. Specifically, individual competence refers to the knowledge, skills and accomplishments that an individual possesses, including the ability to learn and apply knowledge, the ability to think, judge and analysis, the ability to design and engineering practice, and the ability to create and innovation. Team competence refers to the ability that an individual shows when working with others in a team, including ability to express and communicate, teamwork, emotional control and management, etc. Global awareness includes interdisciplinary thinking ability, cross-border integration ability, global vision, leadership, systematic thinking ability, etc.
In order to enable students to quickly integrate into the future work environment and develop their abilities, in the design process, it was emphasized that students should consider the project-related engineering and technical specifications. For example, "Low Voltage Distribution Design Standard", "Boiler House Design Standard", "Power Supply and Distribution System Design Standard ", "Power System Cable Design Standard" and so on, through the study of these standards, it helps students to establish industry design norms consciousness. At the same time, in the design process, under the premise of completing the system function design by using automation professional knowledge, students should be guided to apply the series of economic and management theories such as Industrial Enterprise Management, Economic Principles and Technological Economics to the design process, so as to help students gradually establish correct production, economical, technological and overall viewpoints. And ensure that the project was completed on the premise of the correctness, economy, safety and standardization. This is a very important link in the process of engineering practice, which is missing in theoretical study.

IV. APPLICATION AND CONCLUSION

The reform plan put forward in this paper has been successfully applied in the course of “comprehensive design of automation technology” in the autumn semester of 2018. Through this reform, students' comprehensive utilization ability of professional knowledge has been greatly improved. At the same time, students' industry vision has been expanded and perfect standardization sense and overall awareness have been established.

From the perspective of engineering education and guided by the "Excellent Engineer Training Program", this paper aims at improving students' ability to innovate engineering practice and technology. By changing students' traditional learning from a single course to thinking and solving various problems in the direction of automation specialty, it aims to cultivate students' overall outlook and synthesis ability to use the basic profession knowledge. And promote students' transformation to engineering talents with comprehensive professional qualities. At the same time, scientific research projects were integrated into practical teaching to establish the experimental teaching and training system for automation major in our university. It can not only enrich the theoretical basis of innovative engineering and technical personnel training, but also play an important role in its improvement of the quality of engineering education personnel training. It has good application value and guiding significance.

REFERENCES


