Reform and Practice of Teaching *Automatic Control System of Electric Drive* under the Background of Engineering Education Certification

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Abstract: Automatic Control System of Electric Drive is a compulsory course for automation students, located at the system level of the curriculum system. It is an essential part of cultivating students' innovation awareness, improving personal ability, team ability, and global awareness. Considering the solidification of teaching content in the traditional teaching process, neglecting the output of students as the main body, and the single teaching method, which weakens the cultivation of students' abilities, this contradicts the concept of engineering education certification. The certification of engineering education follows three major concepts: result oriented, student-centred, and continuous improvement. Among them, outcome based education, also known as OBE, represents the mainstream direction of professional engineering education reform, clearly focusing and organizing each link in education to enable students to achieve expected results in the learning process. In the OBE concept, educators have a clear understanding of students' learning outcomes. Based on summarizing the shortcomings of previous curriculum teaching, this article introduces the concept of engineering education and proposes three reform plans. Good results have been achieved in the actual teaching process. It has certain learning and reference significance.

1. Introduction

Engineering education certification is an important measure to enhance the adaptability of engineering education talents to industrial development, improve the quality of engineering education, and enhance the international competitiveness of China's engineering education. The certification of engineering education majors follows three major concepts: result oriented, student-centred, and continuous improvement. Outcome oriented education (OBE), also known as competency oriented education, represents the mainstream direction of professional engineering education reform. It clearly focuses and organizes every aspect of education, enabling students to achieve expected results in the learning process. In the OBE concept, educators have a clear vision of student learning outcomes and promote and ensure that students achieve these outcomes by designing appropriate educational structures [1-4]. As a very important core professional course in the automation major stipulated in the National Standards for Teaching Quality of Undergraduate Majors in Ordinary Higher Education Institutions, "Electric Power Drive Automatic Control System" is located at the system level of the curriculum system and is an essential link in cultivating students' innovative consciousness, improving personal ability, team ability, and global awareness. Considering the solidification of teaching content in traditional teaching processes and the neglect of student-centred output, and the teaching method is single, which weakens the cultivation of students' abilities, this contradicts the concept of engineering education certification. Unable to adapt well to the requirements of engineering education professional certification. This article starts from the perspective of engineering education professional certification, in order to focus on student development and improve student abilities (i.e. OBE concept), analyse the shortcomings in the teaching of electric drive automatic control systems, propose three reform plans, and achieve good

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results in the actual teaching process. It has certain reference and learning significance.

2. Reform goals and key issues to be addressed

Guided by the OBE concept and relying on engineering education certification, we aim to reshape the curriculum and teaching content with a focus on results, transform the student-centred teaching mode, and reform the assessment method with a focus on output. We have completed the reform of the teaching content, teaching mode, and assessment method for the "Electric Drive Automatic Control System", deeply promoted the exploration of teaching reform and talent cultivation mode, and cultivated a large number of innovative abilities, high quality engineering and technical talents of various types that meet the needs of economic and social development, serving the country's path towards new industrialization, building an innovative country, and building a talent strong country strategy. The key issues to be addressed in this reform are as follows:

(1) Change the curriculum content system centred on textbooks and reshape the curriculum knowledge modules with a results oriented approach.

(2) Changing the teacher led single teaching mode to student-centred and innovative teaching methods.

(3) Changing traditional assessment methods, focusing on student output and exploring diversified assessment methods.

3. Curriculum reform plan

3.1. Reshaping the course knowledge modules based on graduation indicators Section

In the past teaching process, teachers showed a state of "100% freedom" in what they taught and how they taught. Different teachers, teaching methods, and objectives led to "different" students. The classroom is completely teacher-centred, teachers determining teaching content, class hour allocation based on their understanding of the curriculum, and what outcomes students can achieve through course learning is unknown or overlooked. This completely deviates from the results oriented concept in engineering education certification. The OBE concept requires teachers to answer the following four questions well [5-7].

(1) What do you want to teach students? (2) Why do you have to teach students these? (3) What methods do you use to help students learn? (4)How do you know that students learn these things?

In order to better answer these questions, teachers are required to pay attention to the training objectives, graduation requirements, and curriculum objectives. Only by determining the final output can the teaching process be designed in reverse. The operation logic of reverse design is shown in Figure 1:

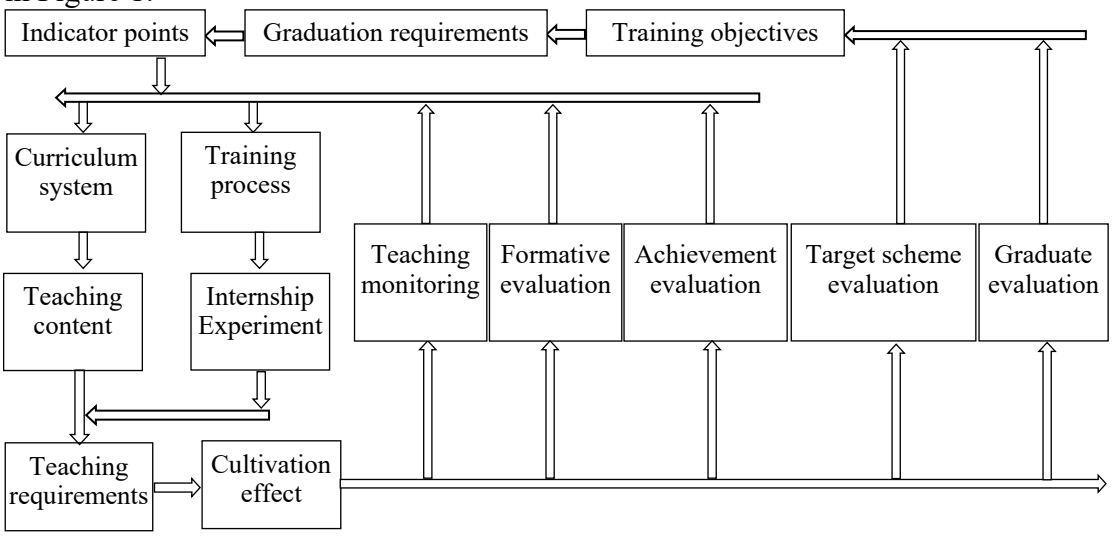

Figure 1 Reverse Design Logic Diagram

This article is guided by social needs, the professional training plan and graduation requirements

of our university's automation major students, the graduation requirements indicators decomposed into this course include three aspects:

(1) Master the professional knowledge of automation engineering, and apply the knowledge and the methods required for defining target problems, formulating and selecting solutions, designing and evaluating controllers, selecting control components, and integrating logic to solve complex automation engineering problems.

(2) Understand the concept of systems and their manifestation in the field of automation, consider the purpose requirements, research methods, models, and indicator analysis of complex automation engineering problems from a system perspective, and form effective conclusions.

(3) Master the professional knowledge of automation, provide design solutions for complex engineering problems in motion control, process control, and automatic control of rail transit, and demonstrate innovative awareness.

The knowledge structure system of the course was analysed and adjusted based on the graduation project indicators supported by this course, combined with the teaching plan. Expand downwards (basic) and upwards (comprehensive application) respectively, and integrated all course content to achieve refinement. In terms of specific operations, the teaching content mainly focuses on the following aspects:

(1) The most classic contents of the textbook, such as single closed-loop systems, double closed-loop systems, and digital control systems, have been retained.

(2) Removed the weak magnetic speed regulation part that is less commonly used in engineering applications.

(3) Considering the high frequency of using regulators and frequency converters in engineering design, this course has added the form of large assignments, students complete the work in groups, they learn relevant knowledge through online courses, data queries, and other means, and ultimately present their results.

(4) As a JiaoTong University, students have a high chance of employment in the rail transit industry. The characteristics of rail transit are a major highlight of our major and also our students. Therefore, the course teaching content has introduced the content of high-speed train traction system.

(5)Scientific research achievements and cutting-edge knowledge were integrated into classroom teaching activities timely.

3.2. Constructing a multi-dimensional and three-dimensional feedback teaching model

The traditional teaching process is mainly based on teacher lectures, with low student participation and poor teaching effectiveness. This reform will change the traditional teacher-centred cramming teaching method, and build a student-centred teaching model which based on ability cultivation and industry demand oriented. According to the course content, graduation indicators, and course requirements, the following various teaching modes was established:

(1) Teacher teaching: For abstract content that has a certain theoretical depth or is difficult to understand, teacher teaching should be the main approach. During the teaching process, the attention should be paid to fully and thoroughly explaining the essence of the teaching content itself and the extension of knowledge, laying a good theoretical foundation for students to analyse and solve problems.

(2) Flipped classroom: the basic knowledge, typical example and exercises that students have the ability to understand, they are assigned to teach. Through lesson preparation and design of teaching processes, students can fully understand the knowledge, enhance teacher-student interaction, and improve their language expression and classroom organization abilities.

(3) Group discussion: group discussions were used for easily confused content, after the topics was proposed, through group discussions, it can stimulate student thinking, distinguish right from wrong, and enhance the ability to comprehend teaching content, deepen the depth of understanding, and expand the breadth of knowledge.

(4) Introduction of comprehensive example: By selecting or designing in-depth and

comprehensive example, students can exercise their ability to comprehensively apply what they have learned to solve problems, achieve a comprehensive understanding of the course and even related course content, and improve the course content.

(5) The application of multimedia teaching methods: Widely using classroom interactive tools such as Rain Classroom, Micro Teaching Assistant, Classroom Pai, etc., to expand communication with students.

(6) Dynamic teaching mode: Guided by phased output, reform the integrated feedback teaching method. Reverse design and forward implementation, during the implementation process, the stage feedback and real-time modification of teaching modes, teaching methods, and teaching progress form a dynamic teaching mode, that is, what to talk about and how to talk about should be timely corrected based on the real-time feedback results of students.

3.3. Reform curriculum assessment methods based on student output

Changing the grading method through a set of test papers, as it cannot fully reflect the degree of knowledge mastery of students, it may often reflect their short-term memory ability. Therefore, under the guidance of the results oriented concept, the ultimate focus is on the improvement of students' core abilities. Therefore, on the basis of the traditional paper-based exam method, the course assessment method adopts a diversified mode in addition to the final exam [9-10]:

(1) Classroom Q&A and quizzes: Through classroom Q&A and quizzes, teachers can not only timely understand students' mastery level, but also urge them to review their homework in a timely manner, and only by reviewing past experiences can they learn new things. Only by mastering the content of the textbook can we understand more extensions.

(2) After class homework: In addition to completing the basic homework of the textbook itself, design some comprehensive homework to enable students to connect the content of several chapters and better grasp the curriculum content system and context. Facilitate knowledge improvement in the future.

(3) Comprehensive homework design, presentation, and defence: For comprehensive content such as regulator engineering design, programming and implementation of regulator algorithms, in addition to mastering the content of this course, other related courses are also required to support. In this way, students can group together to complete the comprehensive homework design and report. Through group completion of the design, they can not only learn the relevant content of the course, but also improve their organizational and collaborative abilities. Reporting can also exercise students' language expression ability, and the defence section can better test their understanding of knowledge. At the same time, it can also exercise their critical thinking ability, achieving a significant improvement in both learning knowledge and overall ability.

In diversified assessment methods, the expected output value of students in this course is highlighted by assigning different weights. Accurate quality monitoring provides data assurance for continuous improvement in the future. Provide direction for continuous improvement..

4. Practice and Conclusion

We hope you find the information in this template useful in the preparation of your submission.

The reform plan proposed in this article has been successfully applied to the "Electric Drive Automatic Control System" course of the 2020 automation major in our school in the spring semester of 2023. Based on the OBE concepts, this article enriches the teaching practice content of the course under the engineering education certification and training system of our school from the perspective of engineering education. Integrate the OBE concept throughout the entire teaching activity. It can effectively improve the comprehensive quality of students, better meet the requirements of course objectives and graduation indicators under the engineering education certification environment, and has good application value and guiding significance.

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