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Research on Teaching Reform of Learning Centered 'Motion Control System' Course

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Abstract: At present, there are still many problems in the teaching content and teaching methods of professional courses in colleges and universities, so that students can not grasp the curriculum knowledge deeply. With the deepening of teaching reform of higher education in China, more and more colleges have paid attention to students' learning effect. The article takes the course of "Motion Control System" as an example to study the "student-centered" teaching management mode, design a curriculum reform plan, optimize the curriculum structure, teaching methods, and assessment and evaluation mechanism. Explore the application of the teaching philosophy combining Project Based Learning (PBL) and Outcome Based Education (OBE) in curriculum teaching, carry out teaching reform practices and effectiveness evaluations, establish a curriculum assessment and evaluation mechanism, and strengthen students' subjectivity in the learning process. The results of student learning indicate that curriculum reform can effectively improve students' learning outcomes, enhance their classroom participation and initiative.

Keywords: Motion Control System; Learning Centered; Project-Based Learning; Outcome Based Education

1. Introduction

With the development of education in the new era, society has put forward higher requirements for talent cultivation. In the process of comprehensively improving the quality of talent cultivation, teaching management methods play a crucial role. From the perspective of the characteristics of course learning in engineering majors, traditional teaching models are difficult to adapt to the talent cultivation needs of the new era, and there is an urgent need for curriculum reform. Against the backdrop of the construction of new engineering disciplines in universities, the traditional teacher centered teaching management model is no longer suitable for the current demand for talent cultivation. Against the backdrop of the construction of new engineering disciplines in universities, the traditional teacher centered teaching management model is no longer suitable for the current demand for talent cultivation[1]. Instilling classroom teaching affects students' knowledge mastery and ability improvement, and students' sense of classroom participation is not strong. Moreover, the study of professional courses itself is difficult, and students' knowledge mastery varies. These problems directly affect students' learning enthusiasm and initiative, which is not conducive to the mastery of professional knowledge and the improvement of practical abilities, resulting in students being unable to deeply grasp the teaching content of the courses. Therefore, it is of great significance to carry out the curriculum teaching reform of "Learning Centered"[2].

The teaching philosophy of "Learning Centered" has been borrowed from Europe and America[3], and has been used by the Ministry of Education as an assessment indicator for undergraduate education and teaching review and evaluation. It is guided by students' learning outcomes, emphasizes the learning process and results, and cultivates students' ability to learn actively and autonomously. By setting clear learning objectives and evaluation criteria, we ensure that all students achieve the expected learning outcomes, emphasizing the effectiveness and individual differences in the learning process. In recent years, more and more universities have begun to carry out teaching reforms, improve teaching methods, continuously optimize course content and structure, and explore the "Learning Centered" classroom teaching practice path. The

reformed curriculum system can reflect the requirements of practical teaching and cultivate students' innovative abilities[4].

Su stated that the motion control system course has been redefined based on the principle of engineering certification. According to the professional talent training objectives, reforms have been made in course content, teaching methods, and experimental teaching, resulting in significant improvement in students' ability to analyze and design courses[5].Chen stated that the organic integration of "Learning Centered" teaching and evaluation will achieve a dual improvement in the quality and effectiveness of practical education[6].

Based on the teaching philosophy of "Learning Centered", the article explores curriculum system reform, practical teaching, and performance evaluation. By adopting methods such as "group cooperative learning" and "blended learning online and offline", students' participation and initiative are improved while enhancing their learning effectiveness, promoting their comprehensive development.

2. The Current Status of Content and Teaching Mode in the Course of Motion Control System

The current course content of "Motion Control System" mainly focuses on theoretical teaching, with weak practical links and insufficient cultivation of students' hands-on ability and innovative consciousness. The teaching method mainly relies on classroom lectures, with low interactivity and student participation.

2.1 The Advantages and Disadvantages of Existing Courses

At present, many universities aim to cultivate applied talents. In the context of higher education with "education, technology, and talent", cultivating talents who can serve economic and social development should be the primary goal of current university curriculum reform. The current teaching content of the course "Motion Control System" mainly focuses on theoretical teaching, with relatively weak practical links, and insufficient cultivation of students' hands-on ability and innovative consciousness. The teaching method mainly relies on classroom lectures, with low interactivity and student participation. The motion control system is one of the elective courses for automation majors. The course has a strong theoretical basis and requires students to master the basic components, principles, and performance of motor speed control, with strong logic. With the continuous development of industrial production, higher requirements have been put forward for motion control systems in the context of new engineering disciplines, and the industry has huge development prospects. However, due to limitations in class hours and laboratory conditions, the practical teaching content is too simple, and the curriculum does not include relevant experiments or practical training projects; The course content is relatively outdated and lacks close connection with cutting-edge technologies in the industry; The teaching method is single and difficult to stimulate students' interest and initiative in learning; The evaluation method for grades is the final exam paper, which assesses students' mastery of knowledge points and ignores feedback during the learning process, which is not conducive to mobilizing students' enthusiasm and initiative for learning[7].

2.2 Student Feedback and Needs Analysis

Through classroom questioning and post class interviews, students were very satisfied with the course content. In terms of teaching methods and practical aspects, students showed a lack of concentration and motivation towards traditional indoctrination based classroom learning. After the cancellation of the practical part of course design in the major, the course learning is mainly based on theoretical teaching. Students generally hope that the curriculum will provide more practical opportunities, enhance their hands-on skills, and improve their ability to solve practical problems. In addition, current performance evaluation methods overlook feedback on students' learning processes, and students in this major lack direction in terms of learning objectives.

3. Design of Curriculum Reform Plan for "Learning Centered"

Based on the teaching philosophy of "Learning Centered", exploration is carried out around curriculum teaching reform, practical teaching, and performance evaluation. By adopting methods such as "group cooperative learning" and "blended learning online and offline", students' participation and initiative are improved while enhancing their learning effectiveness, promoting their comprehensive

development.

3.1 Course Objectives and Learning Outcomes

The course objectives support three graduation requirements for automation majors: engineering knowledge, problem analysis, and engineering and society. Through classroom teaching, students are able to grasp knowledge and correctly describe the structure and principles of motion control systems, analyze the steady-state and dynamic performance of typical speed control systems, and design speed control systems. In terms of practical ability, design classroom practice content, incorporate project-based teaching exploration and practice, so that students can "do while learning, learn while doing", enhance students' innovative thinking and teamwork abilities.

3.2 Optimization and Updating of Course Content

Explore the application of OBE teaching philosophy in the course of "Motion Control Systems", with a focus on learning, closely integrating theoretical knowledge with practical applications, ensuring that each class has tests and student participation, measuring students' achievements through evaluation tools, and calculating them into their regular grades[8].The course knowledge is divided into two categories: DC speed regulation system and AC speed regulation system. It is further divided into open-loop systems and closed-loop systems, single closed-loop and double closed-loop systems, steady-state models and dynamic models of speed control systems. The combination of theoretical explanations and physical videos is adopted for the speed control system to enhance students' spatial thinking. After theoretical learning in class, students analyze the basic principles of the speed control system using circuit diagrams and mechanical characteristic diagrams. During class, the speed control model is operated through a simulation platform. By modularizing the course content, students can learn and master it in a targeted manner using PBL. At the same time as classroom learning, review the knowledge of three courses: motor, power electronics, and control theory, and further master the new knowledge of motion control systems. Use circuit analysis to explain and test students' mastery of classroom knowledge.

3.3 Reform and Innovation of Teaching Methods

Centered on student development, with the goal of cultivating high-quality applied talents, optimizing classroom teaching organization and implementation methods, and constructing a curriculum system guided by the concept of engineering education certification[9]. Through specific tasks of the speed control system project, guide students to actively learn, solve practical problems, evaluate teaching based on results, and construct a new classroom teaching structure - PBLOBE, as shown in Figure 1.The teaching structure consists of three parts: teaching plan formulation, curriculum design, and classroom teaching organization and implementation. Specifically, it is reflected in the following aspects. The development of teaching plans should refer to talent cultivation plans and course syllabi. Classroom teaching content and arrangements should be tailored to different learning contents and the characteristics of students at different levels. Diversified classroom teaching organization and implementation methods should be adopted to grasp teaching difficulties and key points, fully mobilize students' learning enthusiasm and initiative. Give full play to the leading role of teachers and the student-centered subject status. Add some assessment content related to innovative practices in course design, including engineering design projects[10], speed control system design, and course defense. Through specific project tasks to drive learning, students can draw circuit diagrams based on classroom knowledge. In the organization and implementation of classroom teaching, group discussions are conducted through methods such as "group cooperative learning" and "blended learning online and offline". Based on the homework assigned on the Learning App before class, communication and discussion within the group are carried out in class. On the one hand, it helps students understand and memorize the course content through internal group discussions and exchanges, and on the other hand, it enables students to learn from each other through inter group communication.

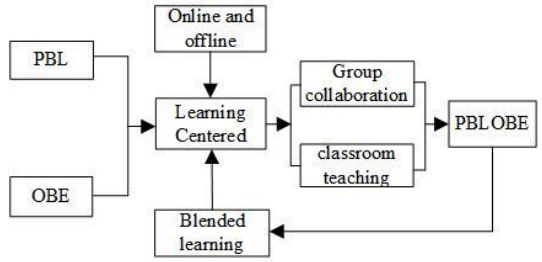

Figure 1. Structure of PBLOBE Teaching Model

3.4 Improvement and Diversification of Evaluation Mechanism

In order to enhance students' comprehensive quality and ability, there must be a scientific and reasonable curriculum assessment and evaluation mechanism. In the reform of curriculum teaching, the reform of the assessment and evaluation mechanism is the main task of the "Learning Centered" teaching reform. The assessment form and grade evaluation are divided into evaluation methods and evaluation standards. The proportion of each evaluation method is set according to the course objectives, and students are comprehensively evaluated through various forms such as daily assignments, group discussions, classroom interactions, and final exams. Adopting a combined assessment method of "formative evaluation" and "outcome evaluation", quantifying the assessment of students' learning process and results, introducing a digital evaluation mechanism, and implementing the evaluation method on data, fully utilizing the advantages of the Learning App.

4. Teaching Reform Practice and Effect Evaluation

In the first half of 2024, three classes of Automation major will start classes, one class of Robotics Engineering major and two classes of Electrical Engineering and Automation major will start classes in the second half of the year. The students are all senior students, and the main teachers are course team teachers. The teaching progress and exam content are consistent. Due to differences in students' basic mastery, learning abilities, and interests, their understanding of knowledge is not thorough enough. Therefore, diversified classroom teaching organization and implementation methods should be adopted according to the characteristics of different learning contents and levels of students, fully mobilizing students' learning enthusiasm and initiative.

4.1 Practice of Curriculum Teaching Reform System

Taking Automation Undergraduate Class 3 as an example, in terms of course design, according to the talent cultivation plan, the assessment standards for daily grades are designed, including pre class preparation, classroom lectures, and post class tests, and a summary is made. Guide students to focus on the learning objectives of each class, self evaluate their learning outcomes, and based on the student-centered teaching philosophy, increase the content of thematic discussions and stage tests to enhance the interactivity of classroom teaching and provide students with a sense of participation in course learning. In terms of teaching implementation, based on the student-centered teaching philosophy, blended online and offline teaching methods and group cooperative learning methods are adopted, fully utilizing the three time periods before, during, and after class to carry out classroom teaching of "Motion Control System". Design a classroom teaching structure that combines PBL and OBE. Before class, a special discussion will be held on the design and arrangement of various speed control systems. Specific speed control system project tasks will be set up, and group communication and discussion will be conducted in class. On the one hand, internal group discussions will help students understand and memorize the course content, and on the other hand, inter group communication will allow students to learn from each other. Based on project results, teaching evaluations will be conducted for each group to continuously promote students' mastery of basic knowledge of motion control.

In terms of evaluation mechanism, in order to enhance students' comprehensive quality and ability, and promote the cultivation of students' innovative consciousness and ability. By assessing the learning process and outcomes of students, we aim to strengthen their dominant position in the learning process. Establish a scientific and reasonable course assessment and evaluation mechanism based on the four course objectives of "Motion Control System". By guiding students to engage in self reflection and peer evaluation among team members, we promote continuous improvement in the learning process. Evaluate the performance of the

assessment points in Table 1 separately.

Table 1. Evaluation Methods and Proportion

Course objectives	Evaluation method and proportion(%)				Score ratio(%)
	Homework and formative test	Interaction	Thematic discussion	final exam	
objectives1	5	0	0	20	25
objectives2	3	2	5	20	30
objectives3	0	10	0	10	20
objectives4	2	3	10	10	25
total	10	15	15	60	100

4.2 Analysis of Student Learning Effectiveness

After one semester of course learning, students have received good feedback and achieved good results in classroom practice. They actively contact teachers for Q&A after class and prepare homework seriously after class. In terms of group discussions, communication and discussion within the group were conducted based on the homework assigned before class, resulting in good classroom participation. From Table 2, it can be seen that the distribution of students' grades is reasonable, and a comprehensive assessment of their learning process and results has been conducted. There are 8 students with scores above 80, accounting for 18.60%. 28 people scored 60-79, accounting for 65.11%. Seven students failed the exam, and judging from the answers on the paper, there is still room for improvement in their level of attention to detail. The teaching reform of "Motion Control System" in "Learning Centered" has achieved good results, fully mobilizing students' enthusiasm and initiative in learning. The comprehensive ability has been significantly improved.

Table 2. Statistics of Grades for Automation Undergraduate Class 3

evaluation criterion	Number of people	Proportion (%)
90-90 points or above	2	4.65
80-89 points	6	13.95
70-79 points	8	18.6
60-69 points	20	46.51
Below 60 points	7	16.28
total	43	100

5. Conclusion

The teaching reform of the "Motion Control System" course is based on the teaching philosophy of "Learning Centered", and explores aspects such as curriculum system reform, practical teaching, and performance evaluation.

1) In terms of teaching implementation, adopting the PBLOBE classroom teaching structure can drive students to learn professional knowledge, improve their enthusiasm, initiative, and creativity in learning.

2) In terms of teaching evaluation mechanism, establishing a course evaluation mechanism based on assessment points can effectively enhance the interactivity of classroom teaching, allowing students to have a sense of participation and achievement in course learning.

Future curriculum and teaching reforms can be further studied in promoting the cultivation of students' innovative consciousness and ability.

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