Exploration and Practice on Teaching Reform of PLC Control Technology Based on CDIO

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Abstract. In order to carry out the pilot work of school reform and development in transition to the application of technology in higher education, the CDIO teaching mode is introduced into PLC control technology in the course of teaching, to establish the “teacher leading and students as the main body of the project as a carrier” teaching mode. Adding a new curriculum evaluation machine is to enhance students' learning enthusiasm, grouping teaching to cultivate students' teamwork spirit.

Introduction

Local Application-oriented universities as a vital force in the university front, only adhere to the connotation type development path, in order to achieve a new leap from big one to strong one, and provides strong talent guarantee and intellectual support for the construction of socialist modernization. Since 2014 our university has been approved restructuring and development for application-oriented universities. It is a rare opportunity for the college of electronic information, so all actively respond to the policy. The social demand continuously increases for engineering majors in the school of engineering specialty, greater supported by the university, while also facing challenges. Professional curriculum content and social demand are not consistent. The student capacity is not up to the requirements of the enterprise. It is bound to need teachers to teach the course to reflect on the summary and curriculum reform. As a front-line engineering teachers, the CDIO teaching mode is introduced into the PLC control technology in the course of teaching, combing the integration of teaching contents, adjusting teaching form, making full use of the existing training and training base training opportunities, relying on the project as a carrier, student-centered, teacher- leading teaching mode\(^[1]\), increasing the new curriculum evaluation mechanism to improve the enthusiasm of students and to strengthen the occupation ability, in the process of projects training. Students can learn to improve their ability of studying problems, analyzing problems, and solving the engineering application, at the same time, to enhance their professional accomplishment.

1. The Deficiency of the Traditional Teaching Mode

PLC control technology is a very practical course, focusing on training students to study the problem, analysis of the problem, and solve the problem of engineering application ability, so the curriculum practice is particularly important. The traditional teaching mode theory is light practice, and the theory and practice are out of touch. The training target is not clear, and the student body position is not accurate and so on.

1.1 Main Body Position of the Students

The school belongs to the local colleges, and students are mainly from the surrounding area of Huanggang. Most of the students come from the countryside, and they seldom contact the modern teaching equipment before entering the university with little computer knowledge, which should be mastered in senior high school syllabus. The university teaching syllabus has neglected the students' background's difference. The selected teaching material and the curriculum are the same with the key
university, but the class hour is less than the key university. This course of PLC control technology is arranged in the third year of University. Through the first two and a half years of professional learning, many students feel it very difficult, and they have lost confidence in their major, which is based on higher mathematics and computer knowledge. In previous teaching, between curriculum is out of line, especially the situations of the students before learning the course are grasped, such as, what extent the professional knowledge can be mastered, whether the syllabus for them is appropriate and the project settings can be completed. There are differences between boys and girls in the way of thinking. Abstract thinking and programming may be more suitable for boys, while generally process control analysis and the summary of technical files is more suitable for girls.

1.2 Disconnection of Theory and Practice

The teaching goal is not clear, and students' positioning, the syllabus and teaching arrangements are not reasonable. There are 36 hours in the theory of class, but only 12 hours in the experimental class. However, many problems exist in experimental teaching currently. Especially, the phenomenon of disconnection of theory and practice, separation of technology and teaching is strikingly common. Due to the limited class hours, experimental project is set up less, which can't help students to consolidate the theoretical knowledge, so that the teaching requirements can be completed. Students also did not upgrade their analysis ability, problem-solving skills, no to mention talking about the cultivation of innovative ability.

2. Exploration and Practice of the CDIO Mode

With the rapid development of social economy, the traditional mode of students can not meet the requirements of society. It is bound to carry out reforms. This paper introduces the concept of CDIO engineering education in the course of PLC control technology, which cultivates students professional talents to meet the needs of the community.

2.1 CDIO Model Introduction

CDIO is a new engineering education project developed ten years ago by four world-class universities including the Massachusetts Institute of Technology in America and the Chalmers Institute of technology in Sweden. Over the past ten years, many foreign universities and companies have been trying to narrow the gap as soon as possible between engineering education and engineering practice. Many large modern enterprises (such as Boeing) announced they expect graduates' personal quality, at the same time, the industry also expects engineer qualification to form a new consensus. Thus, CDIO engineering education mode came into being CDIO (Conceive), the design idea is (Design), implementation (Implement), operation (Operate) four English words abbreviations, which is based on the product development to the operation of the product life cycle as the carrier, and let students contact with organic curriculum content and the learning process. CDIO is competency-based training mode. It is the fundamental training mode that is different from the standard of subject knowledge. It is doing and focuses on project based on education and learning and abstract expression.

2.2 Teaching Objectives

The manufacturing and service industry need a large number of practical talents. At the same time, enterprises also put forward higher requirements for talents, mainly reflecting in the following aspects [2]: 1) positive work attitude, professional dedication and good team cooperation consciousness; 2) learning and professional ability, ability to solve problems; 3) with the development of the company, high working stability. Now the university should not only help students to obtain professional knowledge and skills, so that they can obtain employment, but also to train students' soft skills, such as occupation ethics, communication, teamwork, cooperation, responsibility, integrity, and professionalism, to help the students enjoy jobs.
The development and design of the PLC control technology focus on the industrial field, debugging and technical service post. In order to meet the market requirements of the position, the position of curriculum goals are: design, with PLC control system programming and debugging ability of graduates, maintenance of specific teaching objectives.

Now the curriculum theory and practice, and all are completed in the laboratory. The teaching in small classes, each class of 15 people, a group of 3 people, a total of five groups, mutual division of labor between team members, complete experimental projects and research projects after the break, writing experiment report and research report. The research task requires on-site commissioning and reply. It helps students to gain good occupation ethics and enhance teamwork ability, trains students to perform work procedures, strict work regulations, technical documents and safety operation procedures, to cultivate students' sense of responsibility and the strong dedication.

3. The Settings of Curriculum Content

Selection of teaching content, the integration of the teaching, the existing teaching materials as knowledge teaching, combined with the current provincial laboratory equipment condition, according to technical information provided by enterprises cooperation, breaking the traditional teaching order, the projects as the carrier, student-centered, teacher leading, theoretical and practical knowledge. Combined with the construction, the integration of curriculum and instruction. Teachers set up a project, and then teach the principle and the project related instructions, and then guide the students to practice, so that we can fully mobilize the enthusiasm of the students, mutual promotion of theory and practice, deepen their knowledge of theory and practice the students' practical ability. After the integration of content including electrical control (basic control line: move, moving, rotating, delay, buck, etc.) PLC software basic programming instructions (and, or, not, rising edge, falling edge, set, reset), the control system program design. Around these three aspects of content design, for example in the electrical control part, a motor provided the basic operation control project (including direct starting motor, indirect motor start, start delay), these projects will be combined with the actual project, such as lifting projection screen, auto start and acceleration of electric cooker the appointment system. The motor starts directly as an example, takes direct start long dynamic circuit analysis, which relates to voltage electrical components, electrical components of the relevant content, and these will be added. It is mainly used in the line contractor, relay structure and working principle, extended to the analysis of basic line, such as move, moving. Delay and Buck will supplement the motor and drive related knowledge. The whole process about a lesson, then, is to give students a demonstration experiment, and demonstrate summary demonstration while explaining the steps between the various electrical components of the connection. Students practice demonstration experiment, experimental summary, from perceptual knowledge to rational knowledge. The teacher then offers a projection (screen lifting control project), organizing classroom teaching for students, guiding methods and ideas, the students completed the study according to the task, scheme of the project design, implementation, summary, and realize the interaction between teachers and students.

After leaving a research topic, such as automatic garage door control system design (using ultrasonic switch and photoelectric switch to complete,) when teaching, guiding students to analyze the control requirements, the source of the garage door motor starting and stopping, through the timing diagram analysis, inspiring students to think: exploiting the ultrasonic switch to detect the front vehicles the beam into the door, blocking the photoelectric switch to the vehicle, the door has been opened. Then the door should be closed, when to start action? How to realize the instruction? This is the understanding of system requirements and key control program. The system is installed, how to choose the installation position of the sensors and the motor, please mention the investigation out of their own design ideas. The project teaching intention is to let students in the project to promote the process, experience design—Design—Implementation—operation of new product/ system of the whole process. In the teaching process, teacher uses heuristic, discussion method, rather than directly talk about the PLC program, or I/O address allocation results the wiring way, encourages students to study on their own programming, allow yourself, get some incomplete or even erroneous program or circuit for continuous improvement.
The schedule of the whole course is as shown in Table 1:

<table>
<thead>
<tr>
<th>Time arrangement</th>
<th>primary coverage</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1~2 hours</td>
<td>Task arrangement, control requirements, examination, knowledge point explanation, experimental demonstration</td>
<td>Class hours</td>
</tr>
<tr>
<td>3~8 hours</td>
<td>Familiar with the relevant knowledge, needs analysis, find the relevant information, design procedures, procedures for debugging</td>
<td>Extracurricular hours</td>
</tr>
<tr>
<td>9~10 hours</td>
<td>Program operation, group defense</td>
<td>Complete in class</td>
</tr>
<tr>
<td>11~12 hours</td>
<td>report writing</td>
<td>Finish after class</td>
</tr>
</tbody>
</table>

4. Learning Evaluation

The quality evaluation system of the traditional teaching mode, teachers highlight the central position, and the traditional PLC theory course evaluation is: "usually 30%+ final 70%", to the final examination; PLC examination is given according to the traditional student achievement test report. Students often only pay attention to writing the report, do not pay attention to the cultivation of knowledge and understanding and practical ability, but also the existence of plagiarism, fraud and other undesirable phenomena. This evaluation can not guarantee the quality of students' learning. The project teaching embodies the concept of CDIO, and takes the students as the main body. The integration of theory and practice of teaching evaluation, the students in the learning process tracking evaluation, the implementation of personal evaluation, group evaluation, comprehensive evaluation of teacher evaluation and final exam combination scheme, performance evaluation such as Table 2 shows. The evaluation results and timely feedback to students, to help students improve. Through practice teaching for two years, this evaluation means to mobilize the enthusiasm of the students, enhance the students confidence. Students will consciously participate in the PLC project in the process of training, and adhere to the completion of task group cooperation, common experience the joy of success.

<table>
<thead>
<tr>
<th>Evaluation project</th>
<th>evaluation criteria</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement (10 points)</td>
<td>According to the guidance of teachers, students' attendance, usually performance</td>
<td>Given before the respondent</td>
</tr>
<tr>
<td></td>
<td>By this group of students scoring each other, and finally signed by the leader of the instructor, focusing on the students in the process of the entire project contribution to the size of the competition (A=18 points, B=16 points, C=14 points)</td>
<td>Given before the respondent</td>
</tr>
<tr>
<td>Group student score (20 points)</td>
<td>According to the results of the test to determine whether to meet the requirements of the control and the respondent, the instructor gives the score (A=18 points, B=16 points, C=14 points)</td>
<td>Given before the respondent</td>
</tr>
<tr>
<td>Experimental results and responses (20 points)</td>
<td>Organize and write Research Report</td>
<td>After the respondent (teacher evaluation)</td>
</tr>
<tr>
<td>Research Report (20 points)</td>
<td>A closed book</td>
<td></td>
</tr>
<tr>
<td>Final exam (30 points)</td>
<td>A closed book</td>
<td>terminal</td>
</tr>
</tbody>
</table>
Conclusion

The teaching reform of the PLC curriculum based on the concept of CDIO, is an effective way to cultivate students' ability of engineering application. Through the practice of the two students that made great achievements at the same time, it is conducive to the construction of teachers team. Only give fully play to the team spirit of collaboration and fought, with a new teaching idea, it will effect teaching reform of the course.

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References


