Practical Teaching Reform of Principle and Application Course of Programmable Controller Aiming at Employment Ability

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Abstract. In view of the current teaching situation of the programmable controller course and the different demands for graduates’ abilities in jobs, in order to reduce the time for graduates to adapt to jobs, a project teaching design aiming at employability is put forward. Through the whole process of project design, implementation and summary, stimulate the enthusiasm of students to participate, and combine with future employment, design different job tasks and implement them in groups, cultivate students’ social, technical and methodological abilities in the process of project implementation.

Introduction

As a general industrial control computer, PLC is industrial control equipment for industrial and mining enterprises. Its interface is easy, and its programming language is easy to be accepted by engineers and technicians. Graphic symbols of ladder diagram language are quite close to the expression and relay circuit diagram. The function of relay circuit can be easily realized by using only a few logic control instructions of PLC. It opens a convenient door for people who are not familiar with electronic circuits, computer principles and assembly language to use computers for industrial control [1].

In the 21st century, PLC will have greater development. From the technical point of view, the new achievements of computer technology will be more applied to the design and manufacture of programmable controllers, and there will be a variety of products with faster operation speed, larger storage capacity and stronger intelligence; from the product scale, it will further develop towards the direction of super-small and super-large; from the product matching point of view, the variety of products will be richer, the specifications will be more complete and perfect. Man-machine interface and complete communication equipment will better meet the needs of various industrial control occasions; from the market point of view [2-3], the situation that each country produces a variety of products will be broken with the intensification of international competition, there will be a few brands monopolizing the international market, there will be international common programming languages; from the development of the network, programmable controllers and other. The development direction of programmable controller technology is that industrial control computer networking constitutes a large-scale control system. Computer in the DCS (Distributed Control System) in the computer, and the programmed controller, and the component controller to the control of the control of the application of the network and the application of the the network and the application of the application of the index [4].

Project Teaching Reform

Project Meaning

Strengthening practical teaching and improving students’ practical ability are the key links to cultivate applied talents. Establishing a scientific and reasonable practical teaching system is not only helpful for students to understand and consolidate the theoretical knowledge they have learned,
but also helpful to cultivate students’ practical ability, engineering practice ability and innovation ability. In the traditional teaching process, it is customary to give priority to the explanation of the principles. It is hoped that the students can apply the basic principles in different ways after they have mastered them. When the focus of training objectives is shifted from scientific research to technology application, the setting of teaching content should also shift from emphasizing the integrity and logic of knowledge system to the cultivation of technology application ability. The mastery of theoretical knowledge should be selective and adequate. The students majoring in electrical engineering and automation have a wide range of employment [5]. The application technology of electrical control and PLC is widely used in the field of industrial control. The microcontrollers such as single chip computer and DSP penetrate into the fields of instrumentation and household appliances. The market also has a strong demand for students majoring in electrical engineering. But most employers want job seekers to have some experience, and they can’t take too long to start a new project. For most students who have just come out of college, it does have some difficulties.

According to the feedback from graduates, employers are more concerned about what practical projects you have done than what theoretical content you have learned. An expert interviewer can judge in a few minutes what project you have worked on and how deep you are in the project. For a student who is ready to engage in technical work, the amount of theoretical knowledge he has learned or learned is limited in the process of job hunting. What you can do, that is, to have expertise in a particular major, often plays a decisive role. Obviously, a student who has experienced the process from project analysis and demonstration to component selection, system design and comprehensive debugging will accumulate preliminary experience. Although the actual projects vary greatly, he takes over a technical project much faster than a student who lacks this process. Even in the current severe employment situation, it is not difficult to find that it is not easy for employers to find a suitable technology development and service personnel. When they meet experienced job seekers, they will try their best to attract each other, and most of the newly graduated students really need a long time to start a new job. Employers generally do not have the conditions for retraining University graduates. Because of staff mobility and other reasons, they also lack the subjective will to conduct systematic training for employees. To solve these contradictions, students are required to receive engineering training in a certain professional direction in school to meet the needs of society [6].

**Project Design**

In order to carry out integrated teaching, we should select some projects which can cultivate students’ interests and abilities in an all-round way, which are close to the working situation. The source of the project is based on the structural characteristics of the curriculum, and on the other hand, it is based on the characteristics of the post to select the project. When choosing the topic, we should consider many factors.

A student with strong sense of responsibility, strong learning and organizing ability and suitable personality should be the group leader. The team leader should be responsible for task division, project explanation and technical guidance before the project is officially started. This will help to enhance the team members’ sense of collective honor. In many different projects of the PLC course, each group of students can take turns to take different positions and exercise different professional abilities. After each new task assignment, they can also communicate within the group and between the groups, and find solutions to problems in the process of communication.

**Project Implementation**

The content of the project comes from the needs of the enterprise. Through the investigation of the products and technology needed by the enterprise, the content of the project is finally formed. In the process of practical teaching, project implementation is divided into three parts: project preview, project execution and project summary. The main purpose of project preview is to let students know the project in advance, and complete the project plan design, feasibility report and related hardware circuit design by consulting relevant information; project execution is based on the division of labor
among team members, each person completes corresponding modules according to the requirements of enterprise products, and finally realizes the debugging of the whole system; project summary is in addition to the report project. The implementation and results, more importantly, summarize the problems and solutions encountered in the project process. In the whole process, students constantly improve their practical ability and employment ability.

The task of experiment preview mainly includes four aspects. The important task is to analyze the feasibility of production route by synthesizing various factors. Students should not only consult a large number of relevant literatures, but also think independently whether these industrialized productions conforms to the principles of product design, whether they meet the requirements of economy, environmental protection and other aspects, whether they conform to the laws and regulations of the state in this respect. This link urges students to contact with practical engineering problems in advance. The problems that should be considered in engineering design are of great help to cultivate students’ practical engineering ability.

**Project Assessment**

After each project is completed, the evaluation is very important. Project-based teaching guides students to apply knowledge to the corresponding positions and experience each link of need personally. In the process of implementation of each project, results are more important than processes. This can not only improve the enthusiasm of students to participate, but also enable students to master relevant employment skills in the process of learning, such as project management, project design, project implementation, team management, etc. Finally, the assessment of teaching project adopts the method of "Module + Basic Skills", aiming at 40% of the basic skills, 40% of the assessment, and 20% of the experimental theory assessment.

In order to further enhance students’ interest, we can set up scientific and technological innovation groups to prepare for participating in various related competitions. Among them, the assessment and evaluation methods of practical ability should let students understand their abilities and the actual needs of their jobs, and see which aspects are well done and which aspects need to be further improved. The contents of design assessment are shown in Table 1.

| Project classification | Examination contents                          | Self rating | Group score |
|------------------------|-----------------------------------------------|-------------|-------------|
| Knowledge ability      | Input and Output Port Distribution            |             |             |
|                        | Electrical wiring construction                |             |             |
|                        | Control cabinet panel design                  |             |             |
|                        | Control cabinet wiring                        |             |             |
| Skills and abilities   | PLC programming                               |             |             |
|                        | Debugging and troubleshooting                 |             |             |
|                        | Upper computer operation                      |             |             |
|                        | Technical Report Writing                      |             |             |
| Quality and ability    | Electrical Module Cognition                   |             |             |
|                        | Teamwork                                      |             |             |
|                        | Innovation in Task Process                    |             |             |

The continuous improvement system of the teaching quality of the principle and application of programmable controller is a subsystem of the continuous improvement system of the teaching quality of mechanical and electrical specialty. Therefore, the continuous improvement system of the teaching quality of experimental courses for mechanical and electrical specialty should consist of internal and external systems. The external improvement system refers to the improvement of the teaching objectives, curriculum objectives and teaching activities of the experimental course with the change of the training objectives, graduation requirements and teaching activities of the electromechanical specialty; the internal improvement system mainly focuses on the internal
improvement of practical teaching under the condition that the external improvement system remains unchanged, mainly around the relationship between teaching objectives, curriculum standards and teaching activities. The degree of matching is shown in Figure 1. Explain the process of continuous improvement in the following figure, inspect whether the teaching objectives and curriculum standards meet the requirements, if they meet, continue to implement teaching activities, otherwise improve teaching activities, while refining the teaching objectives and curriculum standards requirements, and enter the next cycle.

![Figure 1. Curriculum cycle.](image)

**Summary**

Through the practice teaching reform of this course, students can not only acquire the frontier knowledge and engineering practice experience of the specialty, but also increase the opportunity of Engineering practice, enhance the engineering practice ability, broaden the breadth and breadth of employment. The teaching of the instructor is integrated with the needs of the enterprise, and improve their professional level and scientific research ability.

Through a survey of 100 students, the students' abilities have been improved to varying degrees before and after the reform of practical teaching, which is mainly manifested in theoretical understanding, programming ideas, hardware circuits and team management, as shown in Figure 2.

![Figure 2. Improvements of Students' Ability.](image)

Through the practical teaching reform of this course, the students' close-book examination scores have been generally improved, and at the same time, students of different foundations have confidence and enthusiasm in the practice of many follow-up courses after the training of this project.
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