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# *PLC Course Teaching Method Based on OBE Teaching Concept*

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***Abstract:*** Aiming at the problems of insufficient cultivation of learning ability of college students and weak transformation of knowledge into engineering ability, this paper proposes a PLC course teaching method based on OBE teaching concept with the goal of cultivating innovative talents with engineering simulation. This method adheres to the three concepts of student-centered, results-oriented and continuous improvement, and focuses on the teaching objectives of knowledge, ability and quality in the learning process of students, so as to improve the training quality of contemporary college students. Use this method to guide students to learn goal-oriented learning in the process of learning inquiry, so as to know exactly what to learn and how to learn. This paper studies the PLC course teaching method by combining concrete engineering examples and OBE teaching concept, showing that the new teaching method can not only arouse students' enthusiasm in learning theory and practice, but also achieve the seamless connection between students' classroom learning and practical engineering analysis, and further improve the teaching quality.

## 1. Introduction

With the rapid development of modern automation technology, Programmable Logic Controller plays an increasingly important role in the field of automation. Programmable logic controller (PLC) course is the basic course of electrical engineering and automation technology in universities at present. PLC control technology links the software and hardware of automatic control technology together [1-3].With the acceleration of domestic economic structure and industrial upgrading, the demand for PLC technical personnel in various industries is increasing. The students' poor hands-on ability cultivated by the traditional teaching mode in colleges and universities cannot be completed independently in the process of actual project construction. The traditional teaching mode emphasizes teaching over learning, emphasizing the knowledge impartation and ignoring the cultivation of students' comprehensive ability in the process. Of final evaluation emphasizes on the final exam as summative assessment, students at ordinary times in the process of performance has been used as a reference, but in the process of practical application is difficult to implement specific to each student, many colleges and universities for students grades evaluation only in attendance as the basis, as for the students in the learning process of specific learning, learn to not, how can be applied to the analysis of actual engineering examples, not fully understand the status of the

students' learning, thus ignoring students' learning process evaluation and the evaluation of comprehensive ability.

This paper proposes a PLC course teaching method based on OBE teaching concept [4-6], aiming at the problems of insufficient cultivation of learning ability of college students and weak transformation of knowledge into engineering ability and aiming at cultivating innovative talents with engineering simulation. This method focuses on the knowledge and ability objectives of each class, focuses on the students themselves, stimulates the students to analyze and solve problems actively, focuses on strengthening the process of self-inquiry in the process of knowledge learning, actively guides the students to learn purposefully, and pays attention to the feedback effect of teaching assessment.

## 2. Introduction to OBE Educational Philosophy

OBE (outcome-based Education) is a learning-oriented Education model, which emerged in the United States in the 1980s. It is a teaching model that organizes, implements and evaluates the teaching process based on the learning effect [7]. The biggest difference between OBE and traditional teaching mode is that OBE emphasizes on determining learning results according to students' graduation requirements and professional training programs, and then achieves the educational concept of learning results through directional design [8]. The assessment of students is an evaluation index to test the learning effect of students. In terms of the assessment of students, THE OBE is specific to each stage of the learning process of students, and it controls the learning status of students all the time.

The flow chart of OBE concept in the teaching process is shown in Figure 1.

It can be seen from the flow chart of OBE concept teaching that the first step to determine the learning outcome is to subdivide the tasks to be completed and then implement them step by step. It is not that students have no way to start with the problems, let alone stop at the starting line at the beginning. The second step is to construct the ability knowledge matrix, which is to show the ability to transform the learned content into the knowledge matrix through the specific course content, and then reflect the mapping relationship between the learning outcome and the knowledge content required to complete the outcome, so that students can clearly understand the relationship between the knowledge to be mastered and the structure of the learning outcome. The third goal setting, in the process of setting goals, according to the selected topic from the student choose different ability structure, the teacher will not impose any thought to the student in the process, students complete set itself to achieve the overall goal, in the process can stimulate the enthusiasm of students to learn thinking more, realize autonomous learning [9].The fourth step is the implementation of teaching. At present, college students are active in thinking and are full of infinite curiosity about various new knowledge and technologies. Traditional teaching mode cannot arouse students' interest in learning. In the process of teaching implementation, teachers can choose different teaching modes and conduct teaching according to the specific situation of students. The fifth step is the evaluation of learning effect. The evaluation of learning effect can give feedback to students' learning situation, and then modify the students' further learning plan according to the feedback, so as to realize the final learning outcome of students [10].

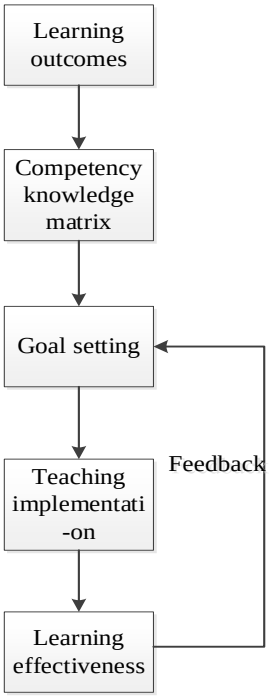


Figure 1: Flow chart of OBE concept teaching.

## 3. The Teaching Method of PLC Course under OBE Concept

### 3.1 Realize the Teaching of PLC by Using Achievement Orientation

In the concrete implementation of the concept of results-oriented education, teachers must clearly convey to students that the expected results can be achieved while enriching knowledge and improving ability through course learning [11-12]. In the course of PLC teaching, on the basis of students' mastering the basic principle of PLC and common instruction system, results-oriented students are required to basically have the ability to install, design and debug PLC control system in a small project through the study of PLC course. Before learning, we should have a clear understanding of the expected effect that a certain control system can achieve after learning, and then make preparations for the realization of the feasibility of the control system. Here, results-oriented learning can help teachers to develop a learning blueprint for each student to understand the effect of students' preview, which can play a guiding role in the design of students' next control system.

In order to achieve the expected results, the learning objective can be decomposed into the following aspects: First, I have the ability to analyze problems, analyze and summarize the problems that need to be solved in order to realize the control system according to specific engineering examples; Secondly, I have certain design and installation ability, and can deal with common logic problems and simple control in the process of design and installation. Finally，according to the theoretical knowledge to improve the design process of the shortcomings.

### 3.2 Student Centered

In the process of teaching, students are the main body of learning activities. Before the teacher starts the class, the first thing to do is to make the students understand the necessity of learning PLC technology. When teaching courses, teachers should always treat the problems encountered by

students in the learning process from the perspective of beginners and explain the knowledge points from the perspective of application, so that students can better understand and remember the knowledge points. In the whole teaching process, the difficulty of the course is gradually deepened to avoid the leap of knowledge logic and advance the CONTENT of PLC course step by step. Teacher way can be adjusted according to the students' feedback information, when the student for this chapter self-study effect is not good, the teacher should actively explain this chapter content, avoid the self-taught students themselves is not good, but also as a representative for everyone, so you can only cut our learn the enthusiasm. For some chapters that are not difficult for students to learn, the division of labor can be divided directly to each group. For those students who do not speak this chapter, they can randomly check and ask questions in class. The students' answers can be recorded in the assessment of their usual scores, which will serve as the criteria for the final scores.

### 3.3 Pay Attention to the Application of Virtual Simulation Technology in PLC Teaching

In the learning process of PLC courses, it is necessary not only to understand the hardware structure, but also to master the programming of the program. Especially when learning the usage of PLC instructions, it is difficult for students to understand and master the usage and functions of PLC instructions if they are purely theoretically explained in class. In the process of theoretical teaching, no matter how wonderful the teacher is in class, students are still not very clear about the specific application of PLC technology. The OBE concept adheres to the idea of continuous improvement. If virtual simulation technology is used in the teaching of PLC courses, and the computer simulation software is used to simulate the control system, the teaching effect will be greatly improved.

On the basis of proficient explanation of this course, the instructor can be proficient in software related to PLC technology. For example, using Kingview software in PLC teaching can use simulation to replace physical objects, and then through the configuration monitoring interface on the computer screen to monitor the system in real-time, and then check whether the PLC control results are correct, to achieve the equivalent of teaching with physical objects Effect. From the perspective of teaching, using computer simulation to simulate the objects in the control system can not only avoid the shortcomings of real objects, but also can carry out rich teaching content under limited equipment conditions. The application of virtual simulation technology in PLC teaching greatly enhances the teaching effect of PLC courses.

## 4. Teaching Methods Display Combined with the Concrete Project Examples

### 4.1 Design of Greenhouse Monitoring System Based on PLC and Kingview

According to THE PLC teaching method under the OBE concept and based on the achievement orientation, we shall independently develop a temperature and humidity control system with strong timeliness, high accuracy, reliable operation and strong comprehensive processing capacity of the stable control system. In this stage, it is necessary to independently design and develop intelligent greenhouse configuration monitoring screen, fully discuss the required effect, deeply discuss the actual results, summarize the experience of predecessors, and realize the innovation of the new generation of temperature and humidity monitoring. The main research contents are as follows:

(1)Research the reasons that affect the changes of temperature and humidity parameters in the greenhouse, and analyze the methods of monitoring and regulating the temperature, humidity, ventilation, and other parameters of the greenhouse system.

(2)According to the research results of greenhouse system at home and abroad, a set of intelligent greenhouse monitoring system based on PLC is designed by using PLC technology, communication

principle, sensor technology, design and programming, etc. And through the configuration of King view to do simulation video.

(3)According to the influence of external environment on plants, the real-time monitoring system of crop environmental conditions and the intelligent greenhouse control system were selected. Detailed Panasonic PLC design scheme, through THE PLC equipment feedback to kingview, the effect will be intuitive display, at the same time through the temperature and humidity sensor accurately temperature and humidity parameters measured and stored data records.

(4)Develop intelligent greenhouse configuration monitoring screen.

Key problems to be solved:

(1)Solve the problem of greenhouse labor efficiency, reduce the use of labor, use modern technology and equipment to change the working mode, increase productivity, and adopt better environmental control facilities to help us realize the automation of irrigation, ventilation, and shading. Staff can manually adjust any area of the environment to keep precious labor away from more valuable factory care tasks and can be automated to save you time.

(2)To solve the problem of crop yield, when considering how to get more from the greenhouse, you can change the flowering cycle of the plants, which can be achieved by adjusting the light time.

(3)Change the crop production environment and adopt additional ventilation. Provides better flexibility for the growth environment of plants, reduces humidity, increases airflow, and helps harden plants.

## 4.2 Results Display

### 4.2.1 Temperature Control Center

The temperature control part is shown in Figure 2. By introducing the ambient temperature inside the greenhouse, we control the opening and closing of the greenhouse greenhouse skylight. Manual control part: In order to cope with different seasons, including rainy season, hot summer, frost and other disasters, we can open and close the skylight according to the wishes of the control personnel. Sometimes, different plants are planted in the greenhouse, their habits are not the same, so we should control the temperature well and create suitable climatic conditions. Automatic control part: When the temperature is higher than 35 degrees, the control center receives the temperature signal, sends instructions, controls the skylight to open, lowers the temperature, and replaces the air. When the temperature drops to about 20 degrees and it is suitable for plant growth, the skylight will automatically close to maintain the plant state of the greenhouse and keep its tightness good.

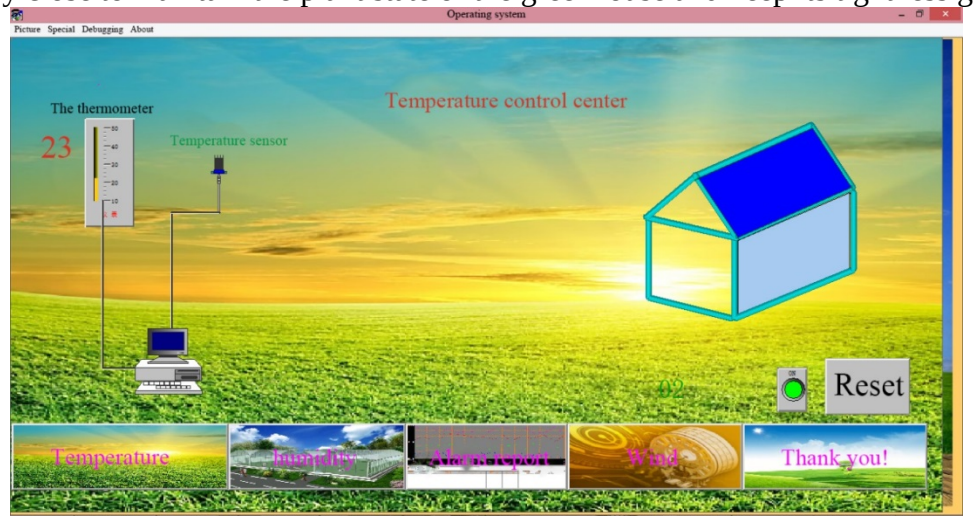


Figure 2:Temperature monitoring center.

### 4.2.2 Humidity Control Center

This part is divided into two parts: water supply peripherals and watering control in the greenhouse. The first is the water supply part of the external water tank. From the figure 3 below, we know that the water tank is realized by using a water tower outside the oil to supply water. When the liquid level in the water tank is lower than the lower limit of the water level, the water tower is filled with water. At the same time, the purifier works to clean the water filled in the tank to ensure that we can spray clean water on the plants. Moreover, there is also regular cleaning control for the water tank, that is, the water in the water tank is replaced with a new one, initially set to clean the water supply tank once a week.

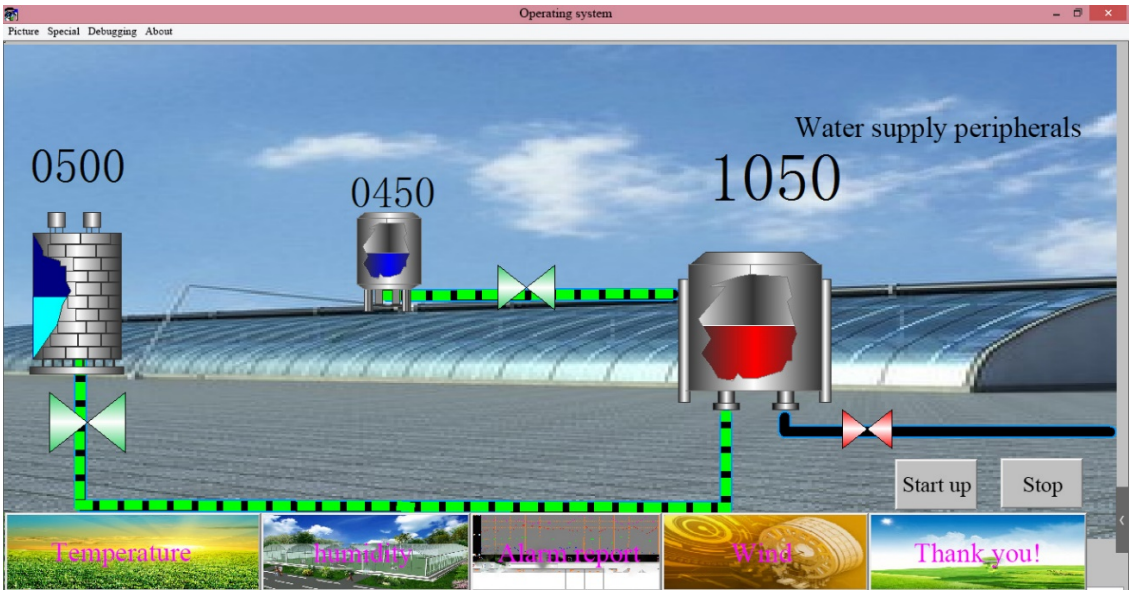


Figure 3:Schematic diagram of water supply peripherals.

Figure 4 is the indoor control part of humidity monitoring. When the host computer receives the drought signal in the greenhouse, that is, the humidity is lower than the suitable growth environment conditions for the plants, it activates the indoor control switch to irrigate the plants, and when the plants need nutrients for growth , The nutrient and water can be mixed through the mixing device, and then the plants can be sprinkled with water.

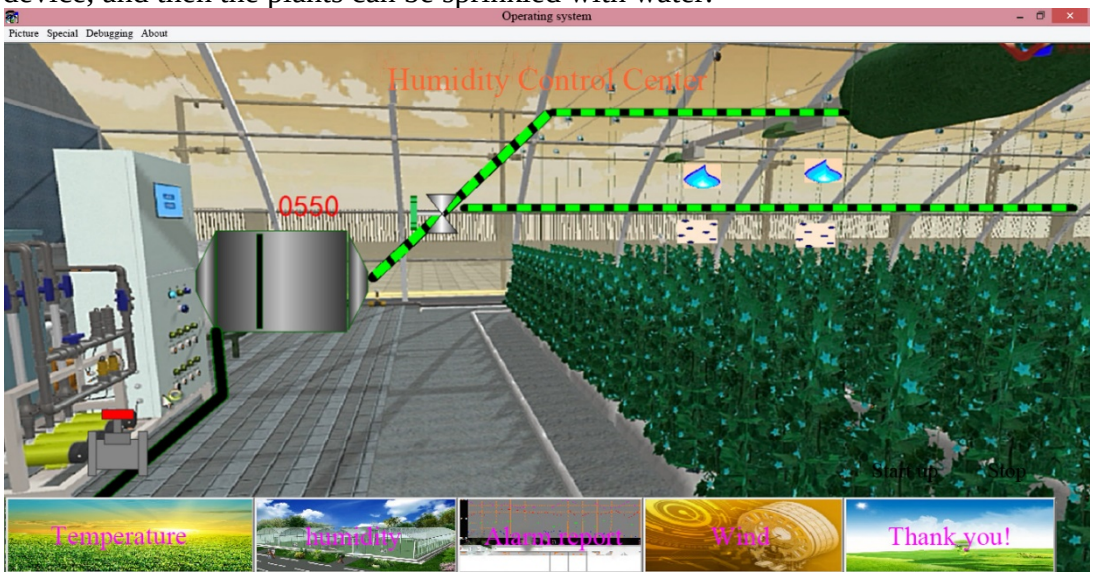


Figure 4: Irrigation inside the greenhouse.

For the humidity control part, we designed a complete set of greenhouse water supply, water storage and sprinkler systems. First, start with the water in the external water tower. When the water content in the indoor water tank is lower than the water level, open the valve of the water supply tower and use turbocharging to drive the water pump to mix the water in the water tower with the nutrients in the purifier. Add them to the water tank together. When the water tank is full of water or close the water valve on the water tower, when the indoor humidity alarm occurs in the control center, that is, the plants are in a water shortage state, the system automatically opens the water tank supply indoor water pipe valve, opens the sprinkler valve, rains the plants, and maintains the temperature condition. According to the current season, the humidity of the plant environment is qualitatively required to control the humidity.

### 4.2.3 Circulating Wind Distribution Center

The control screen of the circulating air is shown in Figure 5 and consists of two parts. The first is the fan room. We use three fans to control the indoor air circulation. Up to three machines can operate at the same time to circulate indoor air in all directions. In the strong wind mode, we can clean up the conventional garbage pollutants on the top of the room and the ground surface. The common phrase is to clean the room to the greatest extent after the plant growth cycle ends, while avoiding the damage of the plants by the strong wind. So generally speaking, if we start two of the fans, we can meet the air renewal during the plant growth cycle. In this process, we can clearly see the changes in the greenhouse through the temperature and humidity meter.

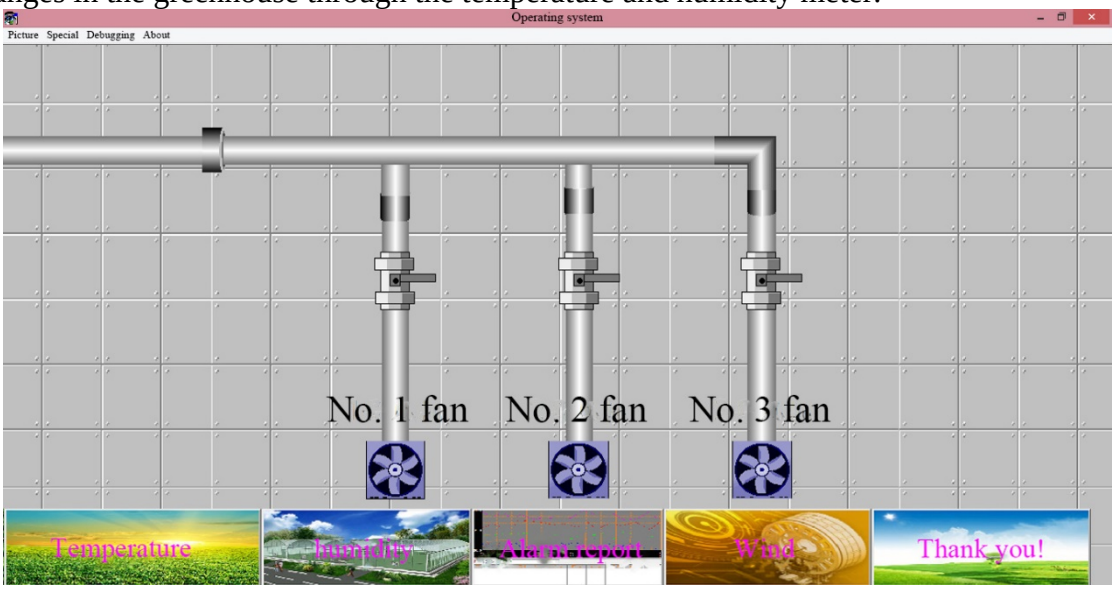


Figure 5: Schematic diagram of fan room work.

### 4.2.4 Alarm Report Summary Screen

The alarm report screen is shown in Figure 6, where each part of the detection system changes, including temperature and humidity change curves, temperature alarm events, and fan operating conditions in the circulating fan room. In addition, it may also include event handling, the release of alarms, and the operating cycle of the system. The historical alarm curve can also see changes in various periods of the plant growth cycle.

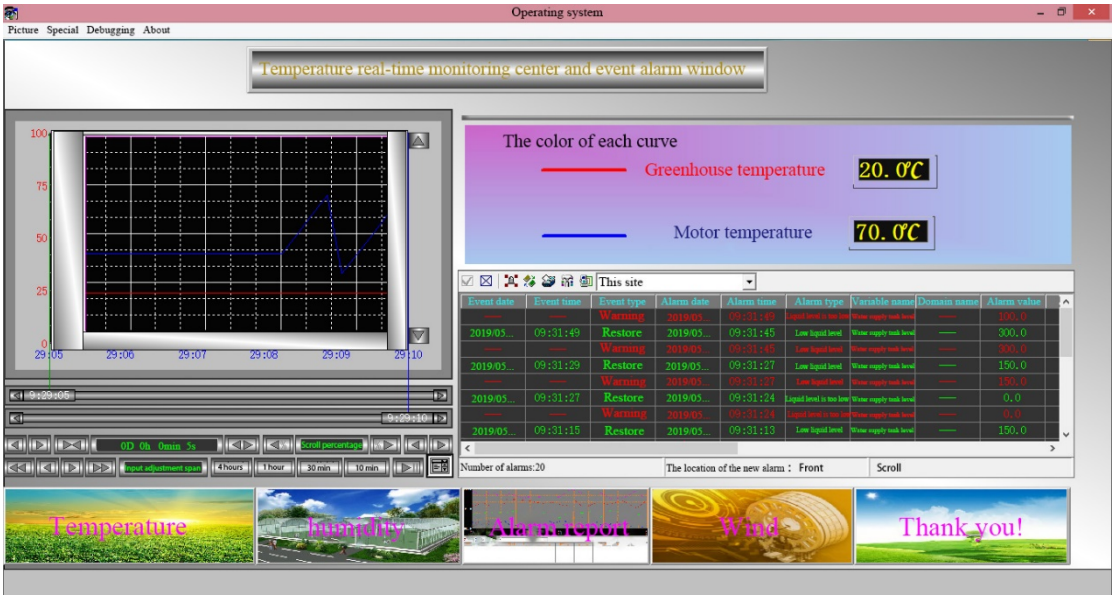


Figure 6: Alarm report display statistics area.

## 5. Conclusions

Based on the research of the PLC course teaching method based on the OBE concept, this paper will focus on the OBE teaching concept and implement the result-oriented thinking through the entire PLC teaching process, with the goal of cultivating students' PLC practical engineering application ability, combined with virtual simulation software to carry out the PLC control technology course To verify the feasibility of this teaching method through specific engineering examples. In the future teaching, it is still necessary to continue to explore and research, to find more effective teaching methods, to improve the modern education level in the new era, and to maximize the comprehensive quality and ability of applied talents.

## Acknowledgements

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