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Exploration of PLC Application Technology Course Practical Training Teaching Design

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Abstract: This article in-depth analysis of the current "PLC practical training" teaching in the existing problems and importance, and put forward targeted reform strategies, aimed at solving the current "PLC practical training" teaching in the existing problems, improve the quality and effect of teaching, for the overall development of students and the future career to lay a solid foundation.

Keywords: PLC application technology; Course practical training; Teaching design

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1. Introduction

With the rapid development of information technology today, the field of industrial automation is also undergoing great changes. At present, whether it is the automatic control system of independent research and development, or the introduction of the automatic production line from overseas, PLC control technology is widely used as its core control component [1]. PLC control and the traditional electrical control have a lot of advantages; therefore, incorporating "PLC training" course into a variety of automation professionals, making it a comprehensive and practical combination of courses, to promote students to become the country's pillars of talent.

2. The importance of PLC application technology course practical training teaching design exploration

2.1. Improve students' practical operation ability

Students can deepen their understanding of PLC working principles and programming methods in the process of PLC programming and debugging, and improve students' hands-on ability and problem-solving ability. In this process, middle school students will also face a lot of practical problems, which will make them think independently, through the way of consulting information and other students to discuss, gradually learn how to analyze and solve these problems, cultivate students' patience in the face of problems, and the ability to use the knowledge to solve practical problems.

2.2. Promote the combination of theory and practice

In the teaching of theory, the teacher mainly tells the basic concept of PLC, working principle and programming method and other theoretical knowledge. However, society needs talents, is the need to combine theory and practice and apply to the actual operation to understand the application of PLC in the actual industrial production, so that they deepen the grasp and understanding of theoretical knowledge, but also the future career work needs.

2.3. Cultivate innovative thinking and teamwork ability

In the process of practical training, students will try different programming methods to solve problems, which can improve students' innovative thinking and cultivate their innovative consciousness and ability [5]. Teachers will also let students work in groups to divide the division of labor and complete tasks together, so that students can learn how to play their role in a team, communicate effectively with others and reach a consensus to promote students to better complete the practical training tasks and provide valuable experience for their future career development.

3. PLC application technology course practical training teaching design exploration of existing problems

3.1. Problems in PLC teaching

Most of the teachers who serve as PLC application technology courses are graduate students or above, and the characteristics of such teachers are in the process of studying for a high degree, probably most of the center is put on the knowledge, rarely on the educational methods and educational practice and other aspects of learning, which leads to some just in the teaching position of the teacher education theory may have some deficiencies [2]. There are also some teachers who do not work in the enterprise environment, do not have enough understanding of the latest developments in technology, and it is difficult to cultivate these abilities for students in teaching. The traditional teaching content may be more focused on a single module, and the practical content is all about the configuration of experimental equipment, as shown in **Figure 1**. Although this modular design is easy to operate, high reuse rate and low equipment loss, it is worth noting that the PLC equipment in the actual application of the enterprise is mostly independent entities, rather than pre-connected modules in the school laboratory. This can lead to a disconnect between practice and employment and hinder the development of students.

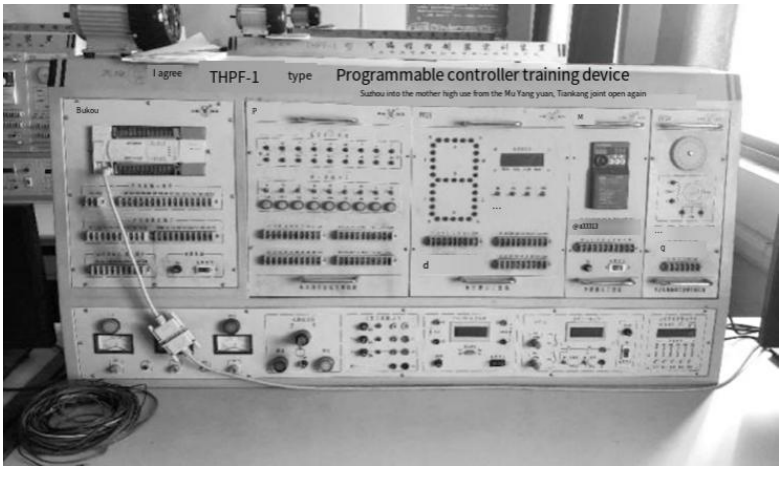

Figure 1. Traditional PLC practical training device.

3.2. The traditional teaching method of PLC leads to poor teaching effect

As for the traditional teaching content of PLC, such as software and hardware characteristics and instruction system, the teaching method adopted is relatively backward, because students need to refer to knowledge in the form of memory and understanding, and practice according to the practical training plan designed by the teacher. This will cause students to lose their subjective thinking consciousness like a robot, and only execute according to the operational instructions. Resulting in the overall teaching effect of the course is not ideal.

3.3. The PLC practical training evaluation is single, hindering the growth of students

In the "PLC practical training" practical training, the teacher always measures the standard of students' learning progress according to the students' experimental reports and final grades. As a result, it is difficult to pay attention to students' practical achievements, which will also lead to low participation of students, so that students only pay attention to the results of the completion of the experiment report, but it does not mean that they will be interested in the practical content. This teaching evaluation method will hinder the progress of teaching and curb the growth of students.

4. PLC application technology course practical training teaching design exploration strategy

4.1. Change of teaching concept

Teachers should change their teaching concepts and use a more open and guiding way to stimulate students' enthusiasm for learning, cultivate their practical ability and innovative thinking, and promote students' all-round development [6]. In the practical training stage, teachers first let students understand the PLC programming logic, familiarize with the use of various sensors, actuators, and learn how to write an appropriate control system according to actual needs. Then the teacher can let the students design a simplified version of the automatic storage system model covering the basic processes of goods warehousing, storage and warehousing through PLC. This step can not only test the students' learning results, but also enable the students to check the gaps. After students have completed the design, teachers can also encourage students to try to incorporate new technologies on top of it, such as: The students proposed to use the Internet of Things technology, through the installation of sensors and cameras to achieve remote monitoring, but also real-time access to the storage system's operating status and cargo information, and these data are uploaded to the cloud server in real time, so that managers can remote management and decision-making; Can also put forward the use of big data analysis and machine learning technology, the data in the storage system for deep mining and analysis. Let students find out the bottlenecks and problems, and put forward the optimal plan to improve the sorting efficiency and optimize the placement of goods. After students put forward these problems, the teacher asked the students to think of ways to solve it. With the joint efforts of students and teachers, this task was completed.

If the management of higher vocational colleges wants to really improve the quality of PLC course practical training, they must train teachers and update their teaching concepts. Training is not only a supplement to the existing knowledge, but also the whole innovation and upgrade of teachers' teaching concepts. Therefore, higher vocational colleges can invite professionals with rich practical experience and deep theoretical foundation in the field of PLC technology to walk onto the campus and give technical lectures by way of speeches to help teachers solve doubts and unfamiliar places in their hearts regarding the application of PLC technology. Teachers can ask questions in teaching, so as to constantly improve themselves in interactive communication [8]. It can also

allow teachers to go off campus to study in the enterprise, truly participate in the practical project, intuitively understand the actual application scenario of PLC technology, to find problems in practice and solve problems. This "from practice, to practice" way of learning, teachers can jump out of the traditional teaching shackles, with a more open and forward-looking perspective to examine the teaching content, for students to bring the latest industry dynamics and technology policies, to promote the development of high-quality students.

4.2. Innovation in teaching mode

At the beginning of the training, the teacher can let the students understand the appearance of the PLC host and the function of each part of the device. After the students know the name of each device, the teacher will explain the basic knowledge. To deepen students' understanding, teachers can also build a PLC control system covering power supply, input/output modules, sensors and actuators and other hardware on the video platform, so that students will just talk about the knowledge on the platform for review, for don't understand the place, you can directly ask the teacher questions [9]. After understanding this hardware, the teacher will teach the students the basic logic instructions (such as and or, not), let the students control the input of the sensor and the output of the actuator. In the students' operation process, they can see how the PLC responds according to the input content, to learn more knowledge, to lay a solid foundation for the subsequent study of PLC programming and control system design.

In the practical training, the teacher can explain the typical cases in industrial production through the traditional single simulation experiment, so that students can learn the important role of PLC in the automatic production line and how to realize the automatic control function of the automatic production line. After the students have a preliminary understanding of the basic knowledge, the teacher can divide the students into different groups, each group is responsible for different topics. For example, some groups are responsible for the configuration of hardware, and some groups are responsible for the logic of programming. Let the students in their choice of the program shine, so that students in the process of completing the task not only understand the knowledge of many, but also guide the use of PLC technology, so that they better into the training, improve their participation.

In the PLC application technology course, comprehensive practical training occupies a pivotal position. And in the comprehensive practical training, the comprehensive practical training content has a very important position. Therefore, teachers should play the role of mentors and guides for students. Too simple practical training content may make students feel unchallenged, but too complicated practical training content will make students unable to start. Teachers should according to the actual situation of students to develop including the physical and mental development of students practical training teaching content, to better stimulate students' interest in learning, improve students' learning ability, so that students understand the significance of PLC.

4.3. Reform of teaching content

PLC course practical training teaching plays an important role in cultivating students' practical ability and innovative thinking, so higher vocational colleges can extend the opening hours of the training room, but also equipped with advanced PLC equipment and professional software for the training room, to ensure that each student can have enough opportunities to practice. On this basis, the area of the training room can also be divided to adapt to the development of different levels. For beginners, it may only be necessary to consolidate the basic knowledge, so you can set the beginner area, indicating that the area is in the simulation of an industrial control scene, focusing on the learning of basic instructions and simple program writing. Let the students who choose this area master the basic operation of PLC. For students who have mastered the basic knowledge, they can

set up self-challenging areas for them to explore the advanced applications of PLC in the fields of automated production lines, intelligent building control and so on [11]. In this way, the students in the basic area can also see the students with strong ability, so that the learning is more energetic, so that the students in the beginner area can ensure that the students master the basic knowledge, so that the excellent students can realize the need of advanced knowledge. Higher vocational colleges can also set up PLC technology application interest groups and scientific research and innovation teams, recruit teachers and students of the whole school, attract a large number of students who are enthusiastic about PLC technology to join, so that students here can not only participate in scientific research projects guided by professional teachers, but also participate in various competitions [12]. For example: a team in the participation of industry professionals and enterprise representatives as a jury, teachers for guidance, to achieve a PLC-based automation control operating system outside the competition, through the simulation to solve a practical problem in production, to achieve excellent results. The students took the following efforts in the whole process: after announcing the competition requirements, students and other students used spare time to debug and optimize the control logic repeatedly in the training room. For the questions that they did not understand, they first asked their counterparts at home and abroad through the network platform, but for some practical operations that they did not understand, they asked the instructor. In the end, the team was highly praised for its novel proposal and easy implementation process, and won the award. Through stratified regional teaching and competition, vocational colleges have successfully built a student-centered PLC course practical training teaching system that focuses on practice and innovation, to improve students' teamwork ability and let students understand the real workplace environment.

4.4. Reset the evaluation system

In today's higher vocational education, higher vocational colleges should actively respond to the call of The Times, pay attention to practical teaching, effectively improve the teaching quality of PLC courses, and innovatively build a comprehensive "PLC practical training" evaluation and assessment system, enhance the core position of curriculum practical teaching, and realize the diversification and comprehensive teaching evaluation [14]. Taking the PLC practical training course of electrical engineering as an example, at the beginning of the course, the teacher made it clear that the composition of the evaluation system is: attendance and homework account for 10% of the total score, which aims to urge students to maintain good learning habits and ensure that each student can participate in class learning and review after class on time; Group discussion and class performance account for 15% of the total score. Teachers can encourage students to actively participate in group cooperation through discussion and communication, deepen the understanding of PLC principle, and improve the ability of classroom expression and team cooperation; Question session also accounted for 15% of the total score, this part requires students to dare to classmates or teachers to ask questions or answer questions, active thinking, to stimulate their thirst for knowledge and the spirit of exploration; The stage test accounts for 10% of the total score. Teachers can check the learning results of students through regular quizzes, so that students can check the gaps and fill up the knowledge with better coherence. The final practical performance is set to account for 50% of the total score. At this time, students need to complete a comprehensive project design based on PLC control from all aspects, such as demand analysis, program design, program writing, hardware connection, to system debugging [15]. Such teaching design can make students dare to put forward their ideas, dare to put forward systematic problems, actively participate in every practical training activity, pay attention to practical operation and skill improvement, stimulate students' learning interest and creativity, improve their professional skills, and cultivate talents who meet the market demand.

5. Conclusion

With the continuous progress of current social technology, programmable controller technology has been widely used in various fields, and continues to evolve in practical application, giving birth to many new theories, new processes, and new technologies. This means higher learning requirements for PLC students. Therefore, in the teaching practice, teachers should emphasize the value of PLC course practical teaching, especially for the practical teaching reform and its existing problems for in-depth analysis and research, aimed at improving students' practical ability, innovation ability and other comprehensive qualities, help students grow into meet the needs of modern society high-quality skilled talents.

Disclosure statement

The author declares no conflict of interest.

References

[1] Zhou Y, 2024, Research on the Application of Loose-Leaf Textbook in PLC Programming and Application Technology Training Course. Paper Making Equipment and Materials, 53(5): 216–218.

[2] Liu G, 2023, Design of Siemens S7-1200PLC Assessment System Based on C#. Journal of Hubei Polytechnic, 36(4): 82–84.

[3] Shi S, 2023, Research on Teaching Reform and Practice of Project-Based PLC Practical Training Course Under the Background of Curriculum Ideology and Politics. Times Automobile, 2023(12): 120–122.

[4] Geng R, Zhao X, Yan X, et al., 2023, Application of Mini-CEX in the Practical Teaching of Optometry Technology Course Based on the Training Base of Integration of Production and Education. China Modern Educational Equipment, 2023(7): 172–174 + 177.

[5] Meng J, 2023, Research on PLC Online Practical Training Teaching Based on Online Virtual Simulation Training Platform. Journal of Baotou Vocational and Technical College, 24(1): 58–61.

[6] Wang Y, Li Z, Wang L, et al., 2023, Research on Reform and Practice of Engineering Practical Training Course for Automation Specialty – Taking Electrical Control and PLC Integrated Design and Practical Training Course as an Example. Computer Knowledge and Technology, 19(5): 166–168.

[7] Liu B, 2023, Exploration on Practical Teaching Design of PLC Application Technology Course in Full Virtual Environment. Journal of Tianjin Vocational Colleges, 25(1): 71–76.

[8] Fu R, Chen Q, 2022, Design of Comprehensive Practical Training Course of "PLC and Configuration Monitoring" Based on CDIO. Journal of Electrical and Electronic Teaching, 44(5): 187–190.

[9] Liu W, Han Z, Zeng X, 2023, Reform and Practice of Ideological and Political Education in the Course of "PLC System Comprehensive Design and Practical Training". Journal of Shaoguan University, 43(8): 96–100.

[10] Wang Y, 2022, Research on Practical Training Device of Electrical Control and PLC Control Technology Course. Agricultural Engineering and Equipment, 49(3): 43–45.

[11] Cao Z, 2022, Exploration and Practice of PLC Application Technology Comprehensive Practical Training Course Reform Under the Background of Integration of Industry and Education. Science and Technology Vision, 2022(14): 140–142.

[12] Hu R, Zhang Q, Deng J, et al., 2022, Research on Online and Offline Hybrid Teaching Practice of PLC Precise Positioning Control. Agricultural Machinery Use & Maintenance, 2022(5): 145–147.

[13] Shi X, 2022, Research on the Application of Blended Teaching in Secondary Vocational Training Courses, thesis, Tianjin Vocational and Technical Normal University.

[14] Mou D, Yang Y, 2022, Construction and Practice of Online Open Course Teaching Resource Base – Taking PLC Advanced Programming Training as an Example. Journal of Kunming Metallurgical College, 38(1): 117–121.

[15] Jin Q, 2021, Design and Application of PLC Virtual Training Platform. Science and Technology Wind, 2021(22): 1–2.