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Research on the Application of Virtual Simulation Technology in the Teaching of Programmable Application Technology

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Abstract: Application of Programmable Control Technology is a highly practical course that requires students to have certain hands-on abilities and practical experience. However, due to limited experimental equipment and insufficient experimental venues, traditional teaching methods often fail to meet the learning needs of students. The emergence of virtual simulation technology provides new ideas for solving this problem.

Keywords: Virtual Simulation Technology; Programmable Control Technology; Teaching Model.

1. Introduction

Programmable Logic Controller (PLC) is a digital operation electronic system specially designed for application in industrial environments. Due to its high reliability, strong flexibility, and convenient use, it has become a core controller widely used in the intelligent manufacturing industry. Therefore, there is a huge demand for PLC application technicians in the intelligent manufacturing industry [1, 2]. However, at present, there is a lack of teaching and training methods for PLC. Traditional PLC teaching heavily relies on teaching and training equipment, with expensive investment and limited time and space, making it difficult to integrate into teaching practice in real time, resulting in students being unable to delve deeper into PLC control. Therefore, based on the teaching of PLC practical training equipment, introducing virtual simulation technology, effectively combining physical information in the manufacturing process with virtual information in digital products, and integrating diverse teaching resources, is an important way to solve the shortage of PLC teaching resources and insufficient practical training for students [3].

2. The Advantages of Virtual Simulation Technology in Teaching

Virtual simulation technology is a key technology for the integration and interconnection of virtual and real information. It can use digital and visual technology to create simulation models for physical entities such as controllers, production lines, and robots in a virtual environment, achieving faithful mapping of physical entities. At the same time, by simulating and optimizing behavior in virtual space, the full lifecycle of physical entities can be truly reflected, and behavior prediction and evaluation of real physical scenes can be carried out through a large number of data samples [4, 5]. Therefore, by applying virtual simulation technology to the teaching and training of PLC systems, students can learn relevant knowledge through simulation modeling of virtual models with limited resources, and can synchronize the virtual training process with corresponding physical entities. At present, the advantages of simulation technology in teaching are reflected in:

1) Improve teaching content. Reconstructing the course content based on the existing teaching foundation, designing teaching simulation resources based on the actual project development process of enterprises, and integrating them into teaching cases can greatly improve the lag between existing teaching content and enterprise production, allowing students to be exposed to actual cases of enterprises, and keeping up with the pace of industry development in teaching content.

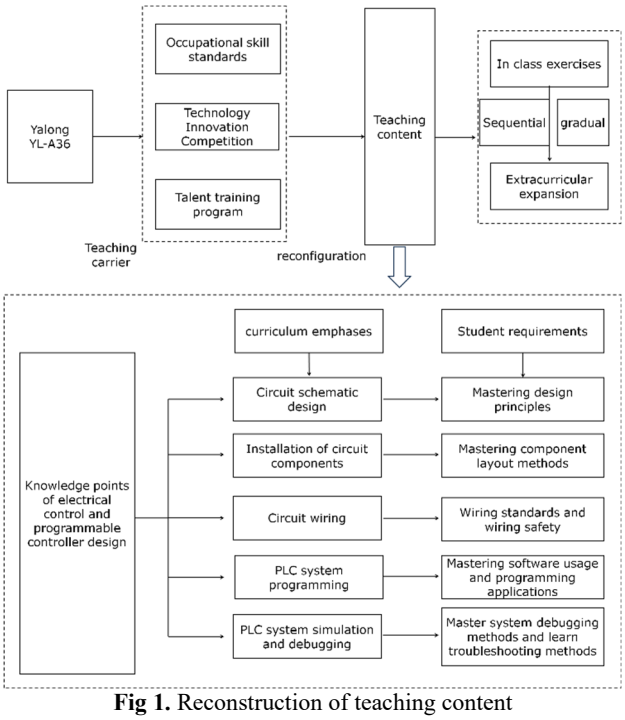

Fig 1. Reconstruction of teaching content

2) Reduce trial and error costs. Vocational college students need to have comprehensive knowledge and skills, strong problem-solving abilities, and good communication and cooperation skills in order to establish themselves in today's society. Faced with this new demand, vocational college students need to continuously "learn practice discuss practice" in order to improve their comprehensive abilities. The introduction of virtual simulation technology can reduce the trial and error costs for students in device practice, giving them more opportunities to discuss, practice, and innovate.

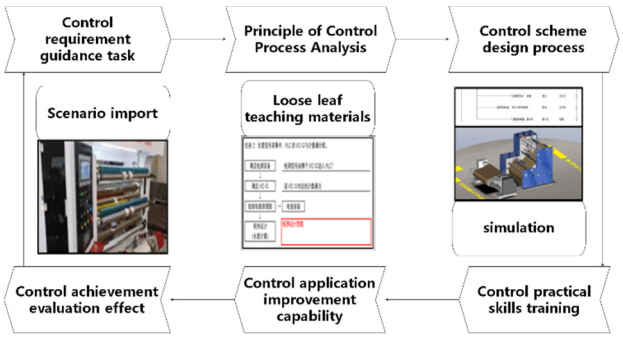

Fig 2. Teaching Process

3) Innovative teaching methods. Based on actual enterprise development projects, virtual simulation technology is introduced to enable students to trace the development process of scientific research projects. Through flipped classroom and extracurricular expansion forms, students are required to deeply study the control process and methods of PLC systems, and put forward their own opinions, thereby improving their learning enthusiasm and exploring their innovative ideas.

3. Current Research Status at Home and Abroad1) Reconstructing Teaching Content

Virtual simulation experiments first emerged abroad, with the United States being the first representative country to conduct research on virtual simulation laboratories and propose concepts. Virtual simulation experiments were initially applied in the military, using DARPA (Advanced Defense Research Institute) virtual technology to develop virtual simulation battlefields, allowing soldiers to experience the battlefield environment and create the best training atmosphere [6, 7]. Levin D et al. created a virtual laboratory based on the principles of developmental biology course, where students can access experimental scenarios online and act as graduate level researchers conducting developmental biology experiments. However, there are some shortcomings in the implementation process of this study, such as fixed scenarios and limited scalability, which are not conducive to students making independent choices and obtaining meaningful learning. Some foreign universities have also conducted research on virtual simulation experiments. The British Open University has used the "Second Life" of the Internet in teaching to achieve timely interaction between teachers and students in distance teaching. When using, teachers and students participate in teaching activities at the same time. Kocijanic pointed out that integrating virtual and reality can greatly demonstrate the teaching advantages of virtual reality. The VREL Chemistry Virtual Laboratory, jointly developed by East Carolina University and North Carolina University in the United States, helps learners complete experiments in the field of chemistry; The VRICHEL simulation system designed and developed by some universities in Pava, Italy, is mainly used for online remote education in chemical production. TAN Shou biao et al. used virtual technology to implement a university physics experiment simulation system [8, 9].

With the development of virtual simulation technology, the research on virtual simulation experiments in subject education and teaching in China is becoming more and more in-depth, mainly focusing on the research of subject teaching effects, course teaching models and teaching concepts, as well as teaching systems. Based on the virtual simulation experiment center, Dai Chuanjin and others have constructed a "two horizontal and two vertical" curriculum system for mechanical and electrical majors, integrating simulation experiment teaching with practice, gradually advancing training objectives, and transforming scientific research achievements into teaching content. Liu Fang and others elaborated on the construction ideas, plans, and teaching characteristics of the virtual simulation experiment teaching mode in microbiology, and constructed a virtual simulation experiment teaching system from two aspects: basic microbiology and applied microbiology [10, 11]. Wu Yongle and others have constructed a practical teaching system based on information technology and virtual simulation technology. Wang Xiaodi pointed out that a virtual real experimental teaching system should be formed in the process of experimental teaching [12]. Liu Bin and others enhanced the purposefulness of student experimental learning by allowing learners to use virtual simulation experimental platforms for university physics experiments, organizational teaching, and computer network continuation. The effectiveness of experimental teaching has been improved, and the enthusiasm and initiative of learners have been enhanced, promoting the cultivation of their practical and innovative abilities, Furthermore, strengthening students' theoretical knowledge and operational skills can help them maintain their mastery of sexual problems and enhance their ability to solve transfer related problems [13]. Sun Yanna and others believe that virtual simulation experiments can help students conduct experiments and assist teachers in teaching. However, they have failed to organically combine physical experiments with online virtual experiments, classroom teaching with online teaching, and actual assessment with online assessment. Wang Shaolan analyzed the current application status of virtual simulation experimental platforms in experimental teaching in various levels and types of higher education institutions, and proposed improvement measures to address the shortcomings of virtual simulation experiments in experimental teaching [14, 15].

In summary, both domestic and foreign scholars have conducted research on virtual simulation experiments, and the development in foreign countries is ahead of that in China. Although there have been studies on the use of virtual experimental software in PLC experimental teaching in China, most of them focus on theoretical research, and in the development of virtual experimental software, two-dimensional virtual simulation is mainly used, with weak three-dimensional sense and a lack of certain situational sense; There are few experiments in which students actually operate and participate in, and the design and development of virtual experiments lack certain educational theoretical guidance. In addition, there is relatively little research on the application of combining virtual simulation experiments with PLC course experimental teaching. Therefore, it is necessary to explore the application research of virtual simulation technology in the teaching of programmable control application technology.

4. Research Contents

1) Reconstructing teaching content

The course uses the Yalong YL-A36 programmable controller system application practical training and assessment device as the teaching carrier, connects with the professional skill level standards of programmable controllers, adapts to the requirements of vocational skill competitions

and technological innovation competitions, benchmarks talent training plans, integrates professional course certificates, and restructures the teaching content into five projects: PLC system control overview. The teaching content is divided into five interrelated teaching tasks according to the design process of "overall plan, segmented modules, and overall station debugging", and integrates ideological and political elements such as craftsmanship and labor spirit. Based on the school enterprise dual classroom, the focus is on cultivating students' technical skills and professional qualities to engage in the design, simulation, and installation of intelligent production lines, and providing reference for later engineering majors.

2) Building simulation resources

System simulation includes circuit simulation and equipment simulation. Based on CADE-SIMU software, construct circuit simulation to solve students' PLC basic simulation and practical training problems; Based on NX 3D modeling software and using Yalong YL-36A as a simulation object, a simulation teaching model is constructed. By displaying and simulating in a virtual environment, problems such as planning, interference, and PLC logic control in product design are solved. On the basis of existing teaching resources, teaching simulation resources are used to form teams, design equipment models, record virtual real joint debugging videos, and facilitate student queries and exercises.

3) Innovative teaching mode

Based on the design and application process of the enterprise production line control system, the Yalong YL-A36 programmable controller system application training and assessment device is used to deeply analyze the control system. Three typical workstations are selected as the analysis objects to analyze the working principle, control principle, and installation principle of the PLC control system. Before class, tasks are released through the Learning Platform. During class, practical work tasks such as scheme design, line overlap, and program writing are combined to form a design process of "Control Requirements Guide Tasks Control Principle Analysis Process Control Case Design Plan"; According to the application process of "Control Practice Skills Training - Control Application Capability Improvement - Control Achievement Evaluation", students are organized to use simulation resources, practical training equipment physical operations, and other methods to carry out skill exercises through demonstration operations and effect demonstrations. After class, continuously strengthen professional skills through practical exercises. By innovating the teaching mode before, during, and after class, students can not only master the classroom teaching content, but also make good use of simulation resources and practical training resources to comprehensively improve their abilities.

4) Optimize lesson plan design

Based on the teaching process, optimize the teaching content, design teaching plans that are suitable for teaching, and grasp the basic situation of students' knowledge, abilities, and qualities through self testing of test questions before class. In class, we follow the learning patterns of students and comprehensively evaluate their knowledge, abilities, and qualities through methods such as classroom attendance, group interaction, task implementation, and achievement display. After class, we connect task learning with professional quality, carry out comprehensive improvement and cultivation of knowledge, abilities, and qualities, and assist in the cultivation of craftsmen throughout the process.

5) Integrated teaching design for integrating ideological and political education into the curriculum organically

Based on the characteristics of the profession, systematic design should be carried out from the top level, and the spirit of "curriculum ideology and politics" should be implemented in the talent training program. From the design of talent training programs to the formulation of curriculum standards, and finally to the implementation of each lesson and teaching link, integrated teaching design is carried out to integrate ideological and political education into the process of students learning knowledge and skills, achieving a subtle value leading effect. Through deep learning and detailed understanding of 's thought of socialism with Chinese characteristics for a new era, efforts are made to improve political literacy, and efforts are made to achieve true learning, true trust and true application, so as to enhance the professional course teachers' awareness of "curriculum ideological and political" from the perspective of ideology. In the process of teaching implementation, teachers are the best role models. Teachers with a broad mind towards the motherland can cultivate students' patriotic spirit of serving the people; By climbing to new heights in skill operation, teachers can cultivate students' innovative spirit of daring to be the first; Teachers pursuing truth and rigorous academic pursuits are more likely to cultivate students' dedication to fame and fortune, as well as their dedication to research

5. Implementation Methods

1) Establish a simulation system development team based on enterprise projects

Based on the completed project design objectives, a virtual simulation research and development team will be established to collaborate in groups and coordinate the learning and training of specific tasks for each module. Starting from imitation learning, actively organize brainstorming, explore innovative thinking, and enhance the ability of students to combine theory with practice.

2) Establishing traceable learning resources based on online course platforms

In order to improve the quality of student learning activities and ensure that students at different levels have the opportunity for self-directed learning, relevant content is uploaded to the online course platform in modules, and a learning progress limit threshold is set. Based on the virtual simulation training platform, online and offline interactive teaching is used to stimulate students' enthusiasm for learning both inside and outside of class, provide expansion and innovation guidance for top students, and provide retrospective learning opportunities for underperforming students.

3) Build a project achievement conversion team

Relying on existing virtual simulation project platforms and completed project results, transforming them into papers, patents, competitions, and other content can not only obtain certain project results, but also enhance the comprehensive abilities of team members. After hard work, they can obtain other results besides knowledge and skills, thereby greatly mobilizing the enthusiasm of students.

6. Conclusion

The trend of mass data in power system provides a basis for load characteristic analysis and prediction model establishment, but the classical load forecasting method

cannot afford such a huge time and computing resource consumption. The problem of over fitting in large sample set will affect the prediction accuracy. In this paper, a power load forecasting model is built by using the BP neural network model, making full use of the powerful data processing function of Clementine and preventing the over fitting function. The experimental results show that the BP neural network model has good predictability and robustness, and has a certain practical application value.

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