ISSN: 2688-8653

Application Practice of Training Students to Solve Complex Engineering Problems under the Background of "1+X" Certificate

Shilei Wang

Wenzhou Polytechnic, Wenzhou 325035, China

Abstract

”1+ X” certificate focuses on the post and the competence to complete the task, responds quickly to new technologies, new processes and new norms, and improves the students' adaptability to the job. Based on the “1+X” certificate standard content of "Intelligent Distribution Integration and Operation and maintenance", this paper takes the application course "fieldbus Technology", which is closely related to this standard, as the practice carrier, and the design and implementation of the course are closely integrated with the standard to improve students' engineering practice ability, the effect is good.

Keywords

Fieldbus; “1+X” Standard; Intelligent Distribution Integration.

1. Introduction

Intelligent power distribution is to make full use of mobile Internet, artificial intelligence and other modern information technology and advanced communication technology to realize the Internet of everything and human-computer interaction in all aspects of the traditional distribution system. State awareness, efficient information processing, convenient and flexible distribution Internet of things system. Intelligent power distribution provides safe, efficient and intelligent energy transmission for the "new infrastructure". The innovation and development of the industry will certainly require a large number of intelligent power distribution compound engineering and technical personnel.

"Intelligent Distribution Integration and Operation and maintenance" 1+X Standard aims at the skill needs of intelligent distribution employees in different types of units in the intelligent distribution ecological chain, such as design institutes, power enterprises, power construction companies, integrators (general contractors), enclosure enterprises, municipal units, large and medium-sized factories, etc., extract knowledge and skill points from job groups, work areas, and work tasks. "Electrical CAD", "Edge Computing Technology", "Power supply and Distribution Technology" and "Field bus Technology" are the main supporting courses of this standard. Among them, "fieldbus technology" is a characteristic course of electrical specialty, which is a learning-and-doing integrated and task-driven course.

The course relies on the WinCS control system of ABB, through project-leading and task-driven, the intelligent technology engineering center based on ABB is equipped with engineering case analysis to carry out project-based teaching. The course introduces the main device layer communication buses in the market, among which Modbus protocol and Profibus-DP bus are the key contents of this course. Through task-leading and enlightening project teaching activities, students can understand the basic principles of various fieldbus, master the basic operation of electrical products with Modbus protocol / Profibus-DP bus, mainly cultivate students' application ability of fieldbus, and improve the professional quality and innovative consciousness of electrical students. After mastering the basic concept and principle of fieldbus control technology and the use method of WinCS system combined with intelligent electrical equipment, we will initially have the ability to design and plan fieldbus control system. It

ISSN: 2688-8653

enables students to integrate the system and function of intelligent electrical products based on fieldbus.

2. Design of Complex Engineering Problems

2.1. Core of Complex Engineering Problems

The so-called complex engineering problems, according to the Washington Agreement, have seven elements. The first point defines its essence, that is, "it can only be solved through analysis by using in-depth engineering principles." Points 2 to 7 are the description of its apparent nature, including "requirements involve a wide range of technical, engineering and other factors, and may conflict with each other", "with high comprehensiveness, including multiple interrelated sub-problems" and so on.

2.2. Course Design of Fieldbus Technology

2.2.1. Taking Engineering Cases as the Starting Point to Carry out Engineering Project Teaching

Taking the engineering case as the starting point for teaching, the biggest feature is that it can effectively overcome the contradiction between theory and practice, and the key to its smooth implementation is to take the real case as the carrier and design a teaching practice project that conforms to the actual situation of the students. at the same time, professional ethics and quality should be integrated into the project. At present, the college training room has a variety of typical ABB intelligent electrical products (all industrial grade products), has developed the project as the carrier of curriculum standards, teaching plan and the overall teaching design of the course. Classroom teaching takes the core content of the engineering project as the main line, runs through the main knowledge points and skill points in each specific application-oriented practical project, and analyzes each link of the project-based teaching. through doing middle school and case-based education and learning to improve students' design ability and innovation ability. All the knowledge points are included in a specific project, using multiple projects to guide students to learn. Emphasize the application of technology to enable students to master the knowledge points of this course quickly and efficiently.

2.2.2. Building Online Courses based on Knowledge Points

Construct the course resource database of fieldbus Technology. The resource library includes curriculum-level resources and material-level resources. The construction of curriculum-level teaching resources includes curriculum information resources, learning packages and curriculum development resources. Material-level teaching resources are the material supply pool of course teaching resources. Classification according to media type includes text, picture, video, animation, virtual simulation and so on.

Add a wealth of practical projects and supplemented by enterprise cases to practice, the use of classes and online and offline student places to make the plan operational. Make use of various platforms to communicate with students in time to facilitate the improvement of teaching plan, teaching content and so on. For example, students in pre-class preparation, related knowledge learning, it is necessary for students to learn to use material-level resources or online courses. In the classroom to find information, analyze problems, etc., but also use the resource library. Various resources online and offline can also be used for review and practice after class.

2.2.3. Revise the Textbook of Intelligent Electrical Appliances

Considering the actual situation of higher vocational students, the traditional theoretical textbooks are less attractive to students. In the context of information-based teaching, it is necessary to build rich teaching resources to assist teaching. Without good material resources, traditional teaching materials alone can not really meet the needs of teaching. Through the in-

ISSN: 2688-8653

depth cooperation between schools and enterprises, this project will continue to obtain fresh engineering practice cases. As core resources, these cases will be put into the supporting resources of teaching materials. Learners can scan mobile phones, resource websites and other ways to learn the resources corresponding to a certain knowledge point, so that they can organically combine traditional paper resources with digital resources to help students learn before, during and after class. The integration of engineering cases and resource database teaching materials is convenient to carry out practical teaching of engineering cases. The teaching materials will match the teaching resource database of the course, so that learners and teachers can make use of the rich teaching resources to assist in teaching and learning.

3. The Course is Integrated into the Content of “1+X” Standard

3.1. Hardware Condition Construction

Teachers actively participate in and build a supporting training room. The architecture of intelligent power distribution integration and operation and maintenance platform includes three levels: perception layer, network layer and platform layer. The core of the whole Internet of things system is the platform layer. The application layer (cloud: cloud computing, artificial intelligence) is the user interface of the Internet of things system, which is located at the top of the architecture, and provides users with rich specific services through the analysis and processing of the data. The application layer receives the information from the platform layer, processes and makes decisions on the information, and then unidirectionally sends the information through the platform layer and the network layer to control the device terminal of the perception layer. The application layer can access the data in the form of Web browser, or APP, official account, Mini Program and so on.

The perception layer is the lowest of the four layers of the Internet of things system, which is the foundation of the whole training room. The main function is responsible for information collection and signal processing. Through perceptual recognition technology, things and things are connected through the network. The network layer accesses and transmits the information from the perception layer through the existing Internet, mobile communication network and other basic network facilities. In the Internet of things system, the network layer connects the perception layer and the platform layer, which serves as a link between the preceding and the following. In this scheme, the hardware of each device edge control system is the network layer, and the Ethernet communication is used between the devices. The platform layer is in the environment of server cluster or data center, in order to integrate the vast amount of information resources in the network into an interconnected large network through computing power, to solve the problems of data storage, retrieval, use, mining and security privacy protection. The platform layer is located above the perception layer and the network layer, and below the application layer, which is the core of the Internet of things.

3.2. The Alignment Standard is Integrated into the Curriculum Project

The course of "fieldbus Technology" designs several typical practical projects, arranges teaching with skill points as the main line, explains necessary knowledge points, assigns tasks in class, and has difficult and easy levels of tasks. Students are encouraged to do more training tasks to improve their ability to analyze and solve problems. In order to enable students to not only meet the needs of their jobs after graduation, but also further improve their career development, it is not only necessary to train students to be skilled in hands-on operation, but also to guide students to use corresponding theoretical knowledge. cultivate the intellectual skills of "analyzing and solving practical engineering problems". The project name and key contents of the course are shown in Table 1.

ISSN: 2688-8653

Table 1. "Fieldbus Technology" course project

Project name	Key content
1.Item 1 Basic knowledge of fieldbus	1.Concept carding and preliminary knowledge of training equipment
2.Item 2 Software basic understanding	2.The practical basis of WinCS software
3.Item 3 Modbus fieldbus	3.Understanding of protocol and correct understanding of function code
4.Item 4 EM instrument communication	4.Practical operation of power instrument communication
5.Item 5 ACS510 inverter communication	5.Frequency converter operation
6.Item 6 M102 communication between motor control and protection unit	6.Practical operation of motor protector
7.Item 7 Profibus-DP communication for PSE soft startup	7.Practical operation of soft starter
8.Item 8 Profibus-DP communication of UMC motor controller	8.Practical operation of motor controller
9.Item 9 Overall training of intelligent electrical appliances based on WinCS	9.Overall training

In the 1+X standard "Intelligent Distribution Integration and Operation and maintenance", the skill level is divided into three levels: primary, intermediate and advanced. The three levels are advanced step by step, the high level covers the low-level vocational skill requirements, and the higher vocational college students generally correspond to the intermediate requirements, that is, they can design the secondary diagram of the system according to the demand and the primary diagram, complete the project design drawings according to the intelligent power distribution standards and specifications, sort out the intelligent distribution component communication I/O address table, design the system network architecture diagram and complete the intelligent distribution system communication network. Can complete intelligent distribution software communication program and man-machine interface development, can understand circuit breaker protection parameter setting and electrical and mechanical performance testing (LIS protection), can complete the development of intelligent power distribution remote operation and maintenance system.

As shown in Table 2, the typical engineering task of "Joint Adjustment of Intelligent Distribution system" is fully integrated into the course "fieldbus Technology", and its corresponding vocational skills are disassembled into several course projects. Taking "Project 5 ACS510 Inverter Communication" as an example, students can operate industrial-grade equipment in the training room. Through this application project, students are more familiar with WinCS control system, learn to create new variables in two ways, complete hardware configuration, static picture design and other configuration operations, master monitoring operations such as monitoring picture viewing and system diagnosis screen viewing, master the basic methods of FBD programming, and develop practical application programs, which can remotely control frequency converter based on Modbus protocol.

In the process of practical teaching of ACS510 frequency converter, complex knowledge points are integrated into typical engineering problems. Figure 1 shows the FBD program started by the frequency converter. if students can really understand this part of the program, they must use principle analysis and be familiar with the use of relevant FBD blocks. Why do you need to add a "black spot" in front of the "ACS510-W1 W01" pin? What are the functions of function block 31 and function block 32 respectively? Why do you use a "hollow" circle here? How to realize "forced single coil"? Wait, it looks like a short program, but you have to understand these knowledge points if you want to understand it.

ISSN: 2688-8653

Table 2. The Corresponding Relationship Between the Requirements of the Standard Section and the Curriculum Project

Work task	Vocational skills	Corresponding curriculum project
Joint adjustment of intelligent distribution system	1.1 Can complete the database construction of intelligent distribution system according to the list of system data variables.	Item 4 ~ Item 9
	1.2 It can write communication programs according to the program development rules of intelligent distribution system, and realize data acquisition and remote control of multi-function instruments.	Item 4
	1.3 According to the program development rules of intelligent distribution system, the communication program can be written to realize the data acquisition and remote control of intelligent molded case circuit breaker.	Item 9
	1.4 According to the program development rules of intelligent distribution system, the communication program can be written to realize the data acquisition and remote control of frame circuit breaker.	Item 9
	1.5 It can write communication programs according to the program development rules of intelligent distribution system, and realize data acquisition and remote control of frequency converter.	Item 5
	1.6 According to the man-machine interface regulations of intelligent distribution system, it can develop the man-machine interface of intelligent distribution system.	Item 4 ~ Item 9

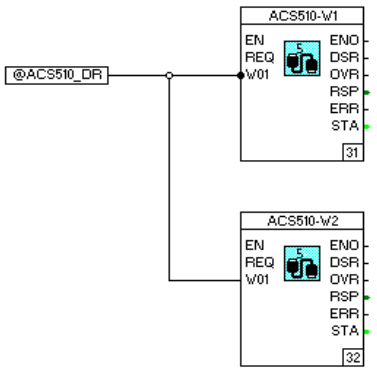

Figure 1. Inverter starts FBD program

ISSN: 2688-8653

4. Curriculum Assessment Method

The traditional assessment includes peacetime score, training score, paper score and so on. The engineering practice model "under the background of 1+X Certificate" pays more attention to the evaluation process of course teaching, not only to the cultivation of students' engineering application ability, but also to their professional consciousness and team spirit. In the course teaching, there should be students' feedback, that is, pay attention to listening to all kinds of information (including suggestions, etc.). Therefore, it is necessary to guide the student group to evaluate the cooperative learning process and learning effect. The process assessment is used to comprehensively evaluate the students' learning process and learning results in the course, which is based on the students' development and pays attention to both the learning results and the learning process. The multi-dimensionality of the evaluation content should improve the bad learning atmosphere in which students usually relax at the end of the period, promote the cultivation of students' good learning attitude and learning style, and pay attention to the dual development of students' intellectual and non-intellectual factors. to promote the achievement of the teaching goal of "cultivating not only a certain knowledge reserve, but also strong practical ability and good quality".

The course highlights the process and module evaluation, combined with classroom questioning, practice testing, after-class homework, module assessment and other means to strengthen the assessment of practical teaching links, and pay attention to the usual points. At the same time, the curriculum emphasizes the comprehensive evaluation after the end of the course, mainly focuses on the changes of students' ideas, and pays attention to the assessment of students' comprehensive vocational ability and level. In addition, the course strengthens the examination of each practical training project, and pays attention to collecting points in peacetime.

5. Conclusion

Whether the cultivation of students' ability to solve engineering problems is good or not reflects the pertinence, adaptability and flexibility of the "1+X" certificate, which is conducive to the self-understanding and career planning of students' personal professional skills, and is conducive to the selection and employment of employers. The teaching reform of engineering application course is carried out based on "1+X certificate", which corresponds to the development trend of science and technology, docking market demand, docking professional post requirements, and reflecting the real needs of professional posts. In the practice of curriculum reform such as "fieldbus Technology", the relationship between teachers and enterprises becomes closer and closer, the cooperation between schools and enterprises is carried out solidly and effectively, and the kinetic energy ability of students is significantly improved. Most of the evaluation of graduates by enterprises are good practical ability, strong post adaptability and so on, and the training quality has been tested.

Acknowledgments

Project support: This article is the research result of the "Thirteen Five" Provincial Industry-University Cooperation Collaborative Education Project (No. 180) "Reform Practice of Teaching Content of" Fieldbus Technology "Course Based on Engineering Practice Cases.

References

[1] Wu Changcheng, Fei Fei, Yao Entao, Zhu Yongkai, Dong Wende: Curriculum Reform of Sensor Theory to Cultivate Students' Ability of Solving Complex Engineering Problems for Engineering Education Professional Certification,China Modern Educational Equipment,(2021)No.21,p.70-72.

ISSN: 2688-8653

[2] LIU Xiaoyan, ZUO Feng, ZHANG Jue, LIU Xiaojie: Reform and Practice of Automation Experimental Teaching of Complex Engineering Problems under the Background of New Engineering, Research and Exploration in Laboratory, Vol. 39 (2020)No.9,p188-191.

[3] Wu Changcheng, Fei Fei, Yang Dehua, Zhu Yongkai: Curriculum Reform of Embedded Measurement and Control System for Course Objectives and Complex Engineering Problems, China Modern Educational Equipment, (2020)No.3,p.65-67.

[4] JIANG Xiang-ju, LIU Er -lin: Teaching Innovation and Practice in Detection Technology Curriculum Catering for“Solving Complex Engineering Problems”, Journal of Weifang Engineering Vocational College, Vol. 32 (2019)No.4,p32-36.

[5] Shilei Wang: Research on the Construction of Enterprise case Resources in the course of principle and Application of Intelligent Electrical Appliances,International Core Journal of Engineering, Vol.5 (2019) No.7, p.173-177.

[6] Shilei Wang: Design and Application of "Fieldbus Technology" Engineering Practice Case under the Concept of OBE Education, Scientific Journal of Economics and Management Research, Vol.2 (2020) No. 5, p.147-152.

[7] Shilei Wang, Lingjiao Dong, Bimiao Wu: Intelligent electrical appliances and applications(Xidian University Press,China 2019), p.148.

[8] Information on https://vslc.ncb.edu.cn/csr-home.