

Reform and Exploration of Sensor Course Teaching based on OBE Concept and Proteus Simulation

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Abstract: Under the background of promoting the construction of new engineering, this paper aims at the problems existing in the traditional teaching mode of "Sensor Principle and Application" course for the Internet of Things major, based on the OBE concept and Proteus simulation platform, combined with the teaching practice, and carried out reform and exploration on the training objectives, theoretical and practical teaching, teaching methods and achievement evaluation system of this course. The result-oriented, student-centered and mixed online and offline teaching practice shows that the teaching effect of the course has been significantly improved, and the students' engineering practice ability has been enhanced.

Keywords: Sensor Principle and Application; OBE; Proteus; Online and Offline.

1. Introduction

"Sensor Principle and Application" is a basic compulsory course for Internet of Things majors, and sensor data acquisition technology is also the basis of the entire Internet of Things technology architecture. The course covers a wide range of subjects, including circuit, electronic technology, microcontroller technology and detection technology, which is highly theoretical and practical, and difficult to teach. The traditional teaching mode has some problems, such as unreasonable training goal, separation of theory and practice, old teaching method and single evaluation method. Outcome Based Education (OBE) is a results-oriented educational philosophy [1], which is centered on: First of all, the expected learning outcomes of students are clearly defined, and then based on these outcomes, the output is used to reverse the input, the course design is reversely planned, the teaching objectives are established, and the corresponding teaching activities are organized to ensure that the curriculum objectives are closely matched and highly consistent with the educational outcomes. Proteus software can create a virtual sensor experiment environment and build simulation circuits of various sensors, which can be used to assist teaching, so as to improve teaching effect and result output. The teaching reform of "Sensor Principle and Application" course based on OBE concept and Proteus simulation is conducive to improving the teaching quality and students' learning effect, and the talents cultivated are also more in line with the actual needs of enterprises.

2. Issues in the Teaching of the Course 'Principles and Applications of Sensors'

2.1. Unreasonable Training Objectives

Although the curriculum has set training goals, it does not take into account the actual needs of IoT enterprises, resulting in a disconnect between graduation requirements and the actual needs of enterprises. In the teaching process, teachers rarely take graduation requirements as the basis, and fail to design the course objectives that can support the graduation requirements, resulting in the lack of pertinence in the teaching process. In this case, it is often difficult for students

to achieve the expected learning outcomes, and it is difficult to train students to meet the actual needs of enterprises.

2.2. Separation of Theoretical and Practical Teaching

In terms of teaching methods, the traditional teaching method is the separation of theory and practice lessons [2], that is, the first theoretical lesson is followed by the last practical lesson. This method cannot allow students to establish perceptual cognition of sensors in the first time. Most practical classes focus on verification, with little room for free play [3]. Students can only operate in a specific time and place, and this teaching mode which separates theory and practice is not suitable for the strong practical characteristics of sensor courses. In addition, the over-instilling of theoretical knowledge in the classroom often leads to students' fear of difficulties in the learning process, and it is difficult to stimulate students' interest in learning.

2.3. Outdated Teaching Methods

The traditional teaching mode is teacher-centered. Teachers teach knowledge on the platform, and students listen, memorize and complete the tasks assigned by teachers under the platform. However, this teacher-led, passively accepted teaching method is often difficult to produce ideal learning results. Classroom teaching focuses too much on the explanation of theoretical knowledge, and there are relatively few practical application cases related to the Internet of Things, resulting in students not knowing how to apply what they have learned to enterprise IoT projects after the course.

2.4. Monolithic Course Evaluation Methods

The traditional course evaluation method mainly relies on a test paper at the end of the term to test the learning effect of students, attaches too much importance to the test results of theoretical knowledge, and neglects the practical ability of students. For practical sensor courses, this assessment method can not fully reflect the true level of students.

3. Optimizing Teaching Methods Based on the Concept of OBE

3.1. Optimizing Course Objectives

Before formulating training goals, we must first investigate the actual needs of IoT related enterprises for talents, and then formulate reasonable graduation requirements according to the positioning of the school. Based on graduation requirements, design the course objectives that can support graduation requirements. Aim at the course goal, formulate reasonable ways to achieve the goal, and ensure that the course goal and the needs of the enterprise fit. Considering the nature and characteristics of the course and the needs of enterprises, we should pay attention to the cultivation of students' knowledge application ability and engineering practice ability when formulating the course objectives. Based on the concept of OBE, the learning results are reflected in the form of training objectives. On the basis of clarifying enterprise needs and training objectives, the course objectives of sensors are refined into the following aspects [4-5]:

Familiar with the basic knowledge of common sensor operation mechanism, measurement circuit design, error correction and detection system performance evaluation;

Able to independently complete the testing system planning and circuit design, improve the practical operation ability, thus shaping the comprehensive career competitiveness of students;

Apply knowledge into teaching, strengthen students' self-learning ability, and cultivate excellent teamwork and in-depth research qualities.

3.2. Assisting Teaching with Proteus Simulation Software

Proteus is an EDA tool software published by LabCenter Electronics in the United Kingdom, which can simulate microcontroller and peripheral devices in a virtual experimental environment, and also includes a variety of common sensors. While teaching theoretical knowledge, teachers can guide students to build simulation circuits of various sensors in a virtual experimental environment, so that students can intuitively understand the internal structure and working principle of the sensor, such as how the temperature sensor converts the ambient temperature into electrical signals, and how the photosensitive sensor senses the light intensity and outputs the corresponding electrical signals. This way of integrating theory and practice can not only allow students to establish perceptual cognition of sensors in the first time, but also stimulate students' interest in learning. In addition, students can also install software on their own computers, and with a virtual lab, students can do sensor experiments even in their spare time. In addition, Proteus can also be developed in conjunction with other software, which has a lot of free play space, so that students can learn how to program control sensors, so as to understand more about sensor control and application technology, and better produce learning results.

3.3. Blended Online and Offline Teaching Model

By adopting the learning-centered online and offline mixed teaching mode, teachers can guide students to actively participate in the learning process, which can effectively

improve the learning effect. The blended teaching mode requires teachers to build curriculum resources on the basis of curriculum objective construction and online learning platform. First, teachers need to apply for the courses they teach on the platform, then create the corresponding course chapters, and publish the teaching resources in the corresponding chapters. The uploaded teaching resources will include PPT, reference documents, preview videos, case tutorials, etc., and you can also publish quizzes. The mixed teaching mode is mainly divided into three stages: before class, during class and after class.

Before class, teachers release learning resources, such as learning videos, on advanced information-based teaching platforms, and require students to get task points in the learning process by watching videos. In addition, teachers can issue pre-class quizzes. Teachers can get the data statistics in the background, so that they can know the learning situation of students in advance.

In the course, teachers can use the attendance system of the platform to check students' attendance. The course teaching mainly adopts project teaching method and case analysis teaching method. Specific engineering cases are published on the platform, and teachers guide students to analyze the application of sensors in practical engineering to stimulate learning interest. The students are divided into groups, each group chooses its own project topic, the students learn the sensor principle independently, and the teacher is responsible for providing guidance and support. Deepen the understanding of knowledge points through project practice, discuss in the group, jointly solve problems in project implementation, and cultivate cooperation ability. Finally, the students show the project results and exchange their learning experience. Teachers comment and guide, students reflect on the learning process, summarize the acquired knowledge and experience, and teachers collect feedback for optimizing teaching.

After class, homework is published on the learning platform to help students consolidate the knowledge points they have learned, and students are required to complete and upload it to the platform within a specified time, which is convenient for correction and summary, and timely understand the achievement of students' course goals. In addition, expansion tasks are arranged on the platform, and some latest research trends are released, so that students can understand the frontier of the discipline and encourage students to explore new applications of sensors independently.

3.4. Improving Evaluation Methods

The traditional assessment mode of sensor principle and application course is composed of regular scores and final exams. Among them, regular grades account for 40%, and final exams account for 60%. However, this assessment method has drawbacks, it overemphasizes the test results of theoretical knowledge, and it is difficult to fully reflect students' ability of classroom participation, hands-on practice and engineering application. In order to overcome this shortcoming, this course designs a multi-dimensional and more scientific evaluation method based on the concept of OBE. Assessment methods include process assessment and final examination, of which the final examination accounts for 30%, process assessment accounts for 70%. The results of the process assessment are comprehensively evaluated by classroom interaction, project practice, simulation exercises, homework and stage tests. This multi-dimensional evaluation

method can better stimulate students' learning enthusiasm, comprehensively understand students' learning situation, and provide more accurate reference for the subsequent teaching

improvement. Specific evaluation methods are shown in Table 1:

Table 1. Assessment method

Compositi-on	Process assessment							Final grade
form	Homework	Participa-te	Simulation exercise	Course video	Attenda-nce	Normal test	Group task	Final exam
Proportion	10%	10%	10%	10%	10%	10%	10%	30%

4. Conclusion

The sensor principle and application course teaching reform is guided by the OBE concept, through the output backward input, and on the basis of fully understanding the actual needs of enterprises, a reasonable course goal has been formulated to better meet the needs of enterprises for talents. The course adopts Proteus simulation assisted teaching, which combines theory and practice to stimulate students' learning interest. Experimental links are not limited by location and time, and this open and free experimental environment (whether online or offline) can fully stimulate students' creativity. The combination of online and offline mixed teaching mode achieves the high efficiency of teacher-student interaction and enhances students' learning initiative. In order to ensure the effectiveness of the teaching reform, this paper uses the multi-dimensional evaluation system to accurately grasp the learning state of students and timely adjust the teaching strategy. Through the implementation of these measures, the reform has achieved good results, effectively improved the quality of teaching, to meet the needs of enterprises for talents.

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