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Exploration on the Teaching Reform of Intelligent Vehicle Sensor Technology Based on OBE

Xingxing Shangguan, Tuochen Pan, Geng Chen and Jian Lin

Wenzhou Polytechnic, Wenzhou 325000, China

Abstract

In the critical period of China's automotive industry's transformation from large-scale to high quality development, vocational colleges shoulder the heavy responsibility of cultivating compound high-tech and high skilled talents for the automotive industry. Therefore, the teaching reform of the Intelligent Vehicle Sensor Technology course is of particular importance. Guided by the Outcomes-Based Education (OBE) teaching concept, this article takes into account the problems existing in the traditional teaching of the Intelligent Vehicle Sensor Technology course. Starting from multiple aspects such as curriculum objective formulation, teaching method improvement, and curriculum content reconstruction, it conducts reforms on the teaching of Intelligent Vehicle Sensor Technology. The aim is to enhance teaching quality, cultivate talents who can meet the needs of the industry, and promote the development of the intelligent vehicle industry.

Keywords

OBE, Vocational Education, Intelligent Vehicle Sensor Technology.

1. Introduction

Science and technology are the primary productive forces, and talent is the primary resource. China's automotive industry is at a crucial stage of transformation from being large-scale to becoming strong. Establishing a new model for cultivating automotive professionals is an important guarantee for achieving the strategic goal of becoming an "automotive powerhouse". Vocational colleges should unshirkably shoulder the heavy responsibility of talent output, and focus on cultivating compound high-tech and high skilled talents who are in short supply in the automotive industry[1]. Intelligent Vehicle Sensor Technology is a specialized course for students majoring in New Energy Vehicle Technology. Using new energy vehicles as a carrier, this course requires students to master the development status of intelligent connected vehicles, be able to install, adjust, detect, and diagnose automotive sensors, absorb the cutting edge technologies of advanced sensors in intelligent connected vehicles, and possess innovative awareness and capabilities. Characterized by new technologies, wide coverage, and strong innovation requirements, the course has complex content, numerous components, and intersecting knowledge points. It is a highly theoretical, practical, and comprehensive course[2]. In vocational colleges, when teaching such courses, issues like single - mode teaching, abstract course content, low student participation in practical operations, and passive learning among students are common. There is a certain contradiction between the complexity of the courses and the current single - track training mechanism. Moreover, in the context of engineering education accreditation, these courses will face challenges in various aspects, such as educational concepts, teaching methods, and educational relationships. Therefore, it is urgent to conduct theoretical innovation and practical exploration of the teaching system for the Intelligent Vehicle Sensor Technology course[3].

Outcomes-Based Education (OBE) is a structured educational model that organizes, implements, and evaluates teaching activities centered around expected learning outcomes. It

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also represents the development direction of the "new engineering" education reform in the context of the new era[4]. OBE advocates reverse design and forward implementation. It posits that students' learning outcomes should be regarded as the goal. Taking the final outcomes that students are expected to achieve upon graduation as the logical starting point, OBE emphasizes the reverse design of key aspects such as training programs and curriculum systems based on these outcomes. The OBE - based teaching model, through measures such as clarifying teaching objectives before class, refining teaching content and enriching teaching methods in class, transforms the Intelligent Vehicle Sensor Technology course from traditional knowledge - imparting to ability - cultivating. It changes the closed - door classroom into an open one, targets the classroom content, and professionalizes practical skills. This model can effectively integrate professional skills with industry development, strengthen students' adaptability to job - related skills, clarify students' future development goals, further cultivate students' innovative awareness and engineering practical abilities, increase students' employment options and opportunities, and meet the requirements of new engineering construction in the new era.

2. Problems Existing in the Traditional Teaching of Intelligent Vehicle Sensor Technology

2.1. The curriculum objectives do not take students as the main body

The curriculum objectives of the "Intelligent Vehicle Sensor Technology" course are formulated by teachers in combination with the objective requirements of professional development and the study of textbook content. The original determination of curriculum objectives took teachers as the main body, emphasizing the learning of various knowledge points. It overlooked the original intention of vocational colleges to improve the quality of cultivating technical and skilled talents. Additionally, it failed to attach importance to students' needs for a higher level of vocational orientation, resulting in the knowledge objectives and ability objectives being insufficiently specific and clear, and lacking in pertinence[5].

2.2. The teaching methods are relatively outdated

At present, the curriculum of Intelligent Vehicle Sensor Technology is set to 38 class hours, with 24 class hours allocated for theoretical teaching and 14 class hours for practical teaching. In traditional teaching of Intelligent Vehicle Sensor Technology, the main teaching methods are courseware demonstrations and teacher lectures. Most teachers rely too heavily on courseware during the teaching process, lacking communication and interaction with students. As a result, students are in a passive learning state, and their enthusiasm and initiative in learning are limited. Moreover, within the limited class hours, it is quite difficult for students at different levels to fully master the structures and principles of various sensors, such as speed sensors, temperature sensors, ultrasonic radars, millimeter-wave radars, lidars, vision sensors, and pressure sensors. Pure theoretical teaching by teachers is also not conducive to stimulating students' interest in learning, leading to poor teaching results. Practical teaching can deepen students' understanding of theories. However, the Arduino kits used in practical training require students to have a comprehensive understanding of knowledge such as single-chip microcomputers and C language, as they need to conduct integrated debugging of hardware construction and software programming. This situation has made some students feel daunted by the difficulties, thus failing to achieve the expected goals.

2.3. The teaching content cannot meet the actual social needs

The development of modern intelligent vehicles relies on the advancement of automotive sensor technology. Intelligent vehicles need to accurately perceive the surrounding environment, including information about vehicles, pedestrians, traffic signs, and road conditions. This requires sensors to collect data in real time, providing a basis for the vehicle's

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decision making system. However, the sensors mainly introduced in the traditional "Intelligent Vehicle Sensor Technology" course are relatively basic, with an emphasis on theory and neglect of practical teaching. Moreover, the practical teaching only stays at the cognitive level and lacks open-ended experiments. Students cannot fully understand and digest the knowledge, and their practical operation skills are weak. They lack a perceptual understanding and are somewhat disconnected from cutting-edge technologies. The excessive theoretical introduction also deviates from the requirements of the automotive industry for technical and skilled talents in vehicle detection and maintenance.

3. Reform Measures for "Intelligent Vehicle Sensor Technology" Based on the OBE Concept

OBE adheres to the concept of "student-centeredness". It focuses on the achievements that students can attain and the abilities they can acquire upon the completion of their studies. All educational activities should be carried out with the aim of achieving the expected learning objectives[6].

3.1. Formulation of Curriculum Objectives

Based on the OBE concept that emphasizes educational outputs, and in combination with the talent cultivation objectives of the automotive major in our school and the demands of the new energy vehicle industry, a reverse design of curriculum objectives is carried out. The goal of vocational colleges is determined to cultivate compound talents with a sense of social responsibility, professionalism, innovative thinking, and a sense of standardization, who are capable of engaging in tasks such as performance testing and detection, quality inspection, and technical maintenance services for new energy vehicles. The knowledge objectives and ability objectives in the curriculum objectives are determined by the talent cultivation objectives.

3.1.1. Knowledge Objectives

Intelligent Vehicle Sensor Technology is an elective professional course for the New Energy Vehicle Technology major. It is necessary to cultivate students' abilities to analyze the structural design concepts and working principles of various automotive sensors, to compare their advantages and disadvantages, to collaborate in teams and efficiently complete work tasks, and to truly master automotive sensor technology, and ultimately aiming to turn them into high-quality applied talents. Through the study of this course, students should achieve the following knowledge objectives:

(1) Understand the development and classification of intelligent vehicle sensor technology;

(2) Grasp the structures, operating principles, and applications of various automotive sensors;

(3) Master the locations of sensors in major automotive systems and the phenomena that occur when sensor malfunctions happen, and acquire the theoretical foundation for fault analysis, detection, and maintenance.

3.1.2. Ability Objectives

The "Intelligent Vehicle Sensor Technology" course is highly practical. In addition to enabling students to master basic theoretical knowledge, they should also possess certain hands-on practical abilities as well as the capabilities to analyze and solve problems. Therefore, during the teaching process, teachers should center around students, take engineering practice tasks as the main line, and combine theoretical knowledge with job-related ability requirements to achieve integrated theory-and-practice teaching. Through the study of this course, students should achieve the following ability objectives:

(1) Be able to proficiently use the tools, instruments, and equipment for automotive sensor fault detection;

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(2) Be able to independently analyze the basic structures and working principles of various automotive sensors, identify the causes of sensor faults, and carry out repairs on them;

(3) Be capable of conducting team communication and cooperation, and completing engineering practice projects related to automotive sensors.

3.2. Improvement of Teaching Methods

Teaching methods are the key and starting point of curriculum reform. Based on the OBE concept, the traditional teaching methods centered on "instruction" should be changed. Modern teaching resources should be rationally utilized, adhering to the student-centered teaching principle. Methods such as project-inspired teaching, case-guided teaching, and group - discussion teaching should be adopted. These methods can fully arouse students' learning enthusiasm and initiative, enabling students to develop the ability to analyze and solve problems as well as innovative thinking. Guide students to design and complete experimental projects corresponding to engineering practice in their spare time to enhance their autonomous learning ability. Meanwhile, on the basis of continuing to combine theory with practice, actively explore the online-offline blended teaching model. Make full use of information - based teaching platforms such as Xuexitong, Yuketang, and Tencent Meeting to manage the three teaching stages: pre-class, in-class, and after-class, as shown in Fig.1.

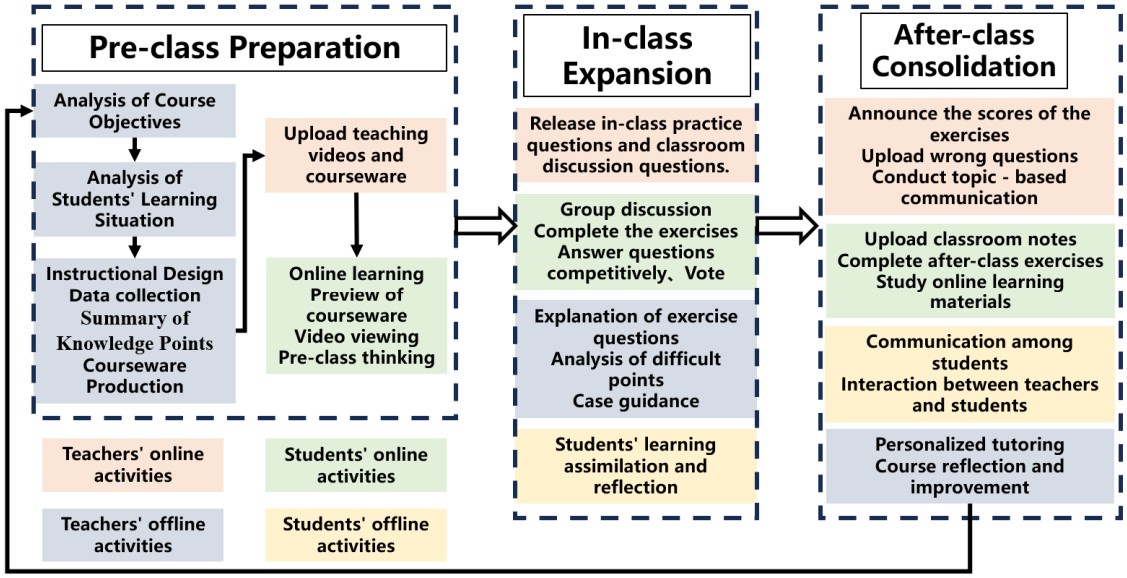

Figure 1. Improvement of teaching methods

Submit teaching resources such as courseware and teaching videos to the information-based teaching platform in advance, and notify students to preview, so as to promote their online learning. In offline teaching, carry out reforms in teaching models like flipped classrooms and discussion-based classrooms, adhering to the principle of "teachers as the guides and students as the main body". During the teaching process, for teaching contents that are difficult to understand intuitively and experience in real vehicles, such as intelligent vehicle assisted driving functions, environmental perception systems, and typical autonomous driving scenarios, use videos and discussions for supplementary teaching to stimulate students' learning interest and improve the teaching effectiveness. In the after-class phase, urge students to complete the review assignments on the teaching platform in a timely manner and preview the content of the next class.

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3.3. Reconstruction of course content

Based on the OBE concept, reconstruct the teaching content of intelligent vehicle sensor technology.

3.3.1. Reconstruct the teaching content with employment as the orientation

The course of intelligent vehicle sensor technology should not only focus on learning the content in textbooks. Instead, teaching content should be selected in a targeted manner based on industry development trends and the knowledge and skills required for students' future professional positions.

In the course, the focus will be on explaining the structure, working principles, and cutting-edge technologies of speed sensors, temperature sensors, ultrasonic radars, millimeter-wave radars, lidars, vision sensors, and pressure sensors involved in new-energy vehicles and intelligent vehicles. This content will be uploaded to the Xuexitong Learning platform in the form of PPTs and micro-courses for students to watch repeatedly and learn independently. The offline theory-practice integrated teaching content includes the use of automotive sensor detection and repair tools, as well as knowledge and skills regarding the application fields, installation positions, fault phenomena, detection, and repair of the above-mentioned various sensors in new-energy vehicles. The improved teaching content pays more attention to the cultivation of students' professional and vocational skills.

3.3.2. Reconstruct the teaching content driven by projects

The rapid development of the intelligent vehicle industry has created a huge demand for relevant professional talents. Enterprises need a large number of compound talents who not only master the intelligent vehicle sensor technology but also possess interdisciplinary knowledge and practical abilities. However, the traditional teaching models and content can hardly meet this demand. Graduates often face problems such as a single knowledge structure and insufficient practical abilities when dealing with real - world projects. To meet the needs of the automotive industry's development and talent cultivation, the teaching content of intelligent vehicle sensor technology should be reconstructed based on the OBE concept and driven by projects to improve students' comprehensive qualities and practical abilities.

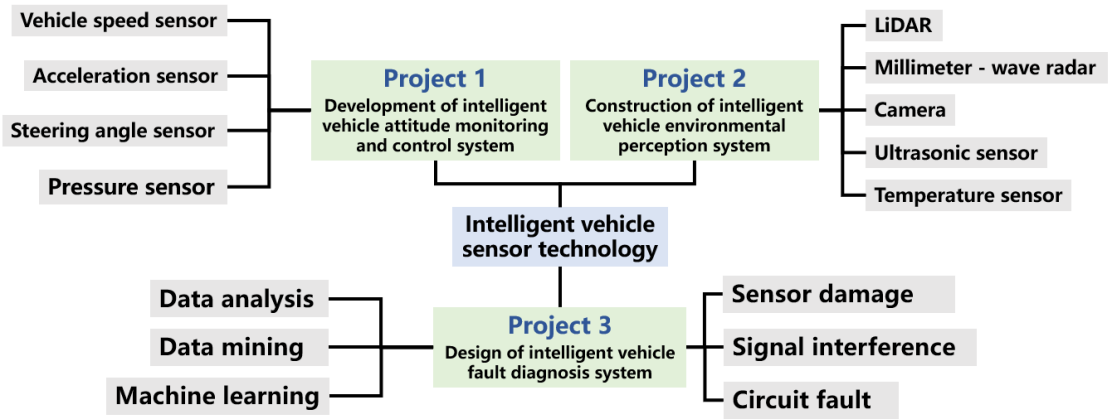

Figure 2. Teaching content of intelligent vehicle sensor technology

The teaching content reconstructed with project-based drive is shown in Fig. 2. Three relevant projects, namely the development of an intelligent vehicle attitude monitoring and control system, the construction of an intelligent vehicle environmental perception system, and the design of an intelligent vehicle fault diagnosis system, are designed to reconstruct the teaching content. This approach guides students to learn and apply the working principles of speed sensors, acceleration sensors, steering angle sensors, pressure sensors, lidars, millimeter-wave

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radars, cameras, ultrasonic radars, and temperature sensors. Meanwhile, faults such as sensor damage, signal interference, and line faults are designed, and the basic methods and techniques of fault diagnosis are explained, including model - based fault diagnosis, data-based fault diagnosis, and rule-based fault diagnosis. In addition, data analysis and processing techniques are taught, such as the application of data mining and machine learning algorithms in fault diagnosis.

3.3.3. Integration of knowledge structure

Integrate traditional intelligent vehicle sensor knowledge with emerging technologies such as computer science, big data, artificial intelligence, and environmental perception to form an interdisciplinary curriculum system.

4. Conclusion

Implementing teaching reform of the Intelligent Vehicle Sensor Technology course based on the OBE concept serves as an effective approach to meeting the current demands of the automotive industry's transformation and resolving the issues in traditional teaching. By redefining course objectives, improving teaching methods, and restructuring course content, integrating theoretical knowledge with practical skills, and emphasizing the cultivation of students' comprehensive abilities, it is expected to enhance students' professional qualities and employability. This not only lays a solid foundation for students' future career development but also provides the intelligent vehicle industry with more high - quality interdisciplinary talents, facilitating the Chinese automotive industry's advancement towards intelligence and high - end development. In the future, continuous attention should be paid to the implementation effects of the teaching reform, and the teaching system should be constantly optimized and improved to adapt to the rapid development needs of the industry.

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