Investigation of Sensor Technology Teaching Based on CDIO and SC

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Abstract: "Sensor Technology" is an important basic professional course for majors of electronic information, including basic theory and technology of multiple subjects. The principles, techniques and knowledge involve in this course are complex and theoretical. It is more likely to be boring and tedious during teaching process, resulting in lacking of concentration and being difficult in this course for the students. CDIO engineering education mode is applied to teaching of the course of "Sensor Technology" in this paper, focusing on the cultivation of students' basic engineering knowledge, teamwork and ability of engineering system. The attempt and exploring are implemented in teaching contents, teaching methods and assessment methods. In the process of teaching based on CDIO, student-centered ideas are followed. Flipped classroom, teamwork and other methods are adopted to improve students' ability of independent learning, searching information, analyzing problem and solving problem, so as to improve teaching quality and students' professional ability and accomplishment.

Introduction

One of the cores of education certification for engineering is "ability orientation". The ability refers to analysis and solving problem with subject knowledge. Engineering education certification is of great significance to applied technology universities, which can promote international recognition of engineering education and enhance competitiveness.

The urgent task of Chinese high engineering education is to train engineers in line with international standards as soon as possible. However, there are still some problems in the practice of Chinese engineering education, such as playing more attention to theory than practice, attaching importance to knowledge learning and ignoring the cultivation of innovation[1].

In order to improve the engineering ability of students in sensor technology, this paper discusses the teaching reform of "Sensor Technology" course from aspects of teaching content, teaching methods and assessment methods.

Features and Existing Problems of the Course

The course of "Sensor Technology" is various and involves with a wide range of knowledge. Each part of the content is independent, poor systematic and poor continuity. And it's also a course that emphasizes practice. In the process of traditional theory teaching, the structure, working principle, main characteristics, measuring circuit and application of sensors are usually used to introduce various types of sensors [2].

The total class hour of sensor technology is 32, and there are no relevant experimental or practical courses at present. "Sensor Technology" is an application-oriented subject, but without corresponding experiment. So it is difficult to improve the capabilities of students' comprehensive knowledge application and engineering innovation.

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Curriculum Reform Based on CDIO and SC

In order to cultivate students' abilities from multiple perspectives the reform of “Sensor Technology” course is done from four aspects in this paper: learning objectives, teaching content, teaching methods and assessment methods.

Explicit Learning Goals

Sensor technology, computer technology and information technology have become three pillars supporting the whole modern information industry. As a teacher of “Sensor Technology”, an unusual wide field of vision must be presented to the student when they first come into the contact with the course. What’s more, vivid application examples and specific video should be used to stimulate their interest in knowledge seeking and exploring.

Therefore, the introduction of the course is particularly important. Video displaying is used instead of simply listing the development of history in traditional teaching, which not only integrates a large amount of practical engineering information, but also stimulates the interest of students.

Reformation of Teaching Content

Adjustment of Theoretical Teaching Content

In order to form the concept of engineering design and enhance the concept of engineering design, the key theoretical knowledge should be explained, and the concept of engineering practice should also be highlighted. What’s more, engineering design problems encountered often in the work should be introduced, so that students can accept the concept of engineering in the learning process and learn to solve the problem from practical operation[3]. So the following theoretical knowledge is introduced.

Table 1 Theoretical Teaching Content

Directory	The main content
Introduction	Basic concept of sensor, static and dynamic characteristics of sensor.
Inductive Sensor	The working principle, structure, conversion circuit and measuring circuit of sensor.
Capacitive Sensor	
Strain Sensor	
Magnetic Sensor	
Thermoelectric Sensor	

Reform of Practical Teaching

The knowledge of course is rearranged based on the competence training syllabus of CDIO, and project teaching is taken as the guidance, so that students have more opportunities to get in touch with actual projects and apply sensor technology to the actual projects. This reform makes up for the lack of practical teaching in the previous teaching process. Combining theory with practice, so ability of student to analyze and solve problem is cultivated. So that students can understand the application of sensor more intuitively and master the sensor technology better.

As this course has only 32 class hours， so two verification experiments and a comprehensive project are introduced[4]. The content of the practical teaching is from easy to difficult, from single to comprehensive, which can cultivate and improve the ability of students gradually. During this process, students can not only master the basic knowledge of the course, but also build good engineering practice. The content and operation of the comprehensive project is more complicated. Therefore, the students can work together in small team with 4 to 5 members. And students can flexibly apply the theoretical knowledge into the actual project through practical practice, so as to improve their professional quality. Specific experiments and comprehensive projects are shown in Table 2 and Table 3.

Table 2 the Verification Experiment

The verification Experiment	Sensor
Capacitive Sensor Experiment	Capacitive Sensor
Hall Sensor Experiment	Magnetic Sensor

Table 3 the Comprehensive Project

Comprehensive Project	Sensor
Electronic Thermometer	Thermocouple Sensor

Reformation of Teaching Method

Increase of Classroom Dynamics and Students' Personal Ability Through Flipped Class

Traditional teaching-based method is reformed, and the student-centered (SC) is introduced. "Sensor Technology" involves lots of knowledge of analog electronic technology, circuit analysis and principles of MCU which have been learned before. It's likely that the students have poor foundation and forgot much about the pre-course. Since the typical application circuit is very important in practice, flipped class is introduced to teach typical application circuit[5].

In the class, students preview the class by MOOC, video, courseware, textbook, etc[6]. to understand relevant knowledge and discuss with others in class. So the initiative of students is improved, and the interests of students in unknown knowledge are cultivated, too. Different students are invited to analyze and explain the application circuits of the differential transformer sensor after introduction of inductive sensor measurement circuits. So the learning autonomy is mobilized and students' personal ability is enhanced.

Improving Teamwork Ability through Group Discussion

In class, case studies and design, method analysis are organized and debated in group. in this process, students can improve their understanding and mastery of practical knowledge. What's more, the thinking ability and independent analysis ability of students are also improved[7].

For example, in the exercise after class, students are allowed to complete the design of the sensor measurement circuits. In the design process, a variety of design schemes appear. In the course of the exercise explanation, different groups introduce their respective design schemes, and each group can cross-evaluate and rate the design of different teams. This way, the classroom atmosphere is quite active, which greatly improves students' practical analysis and design as well as their sense of teamwork.

Assessment of the Course

In the traditional teaching process, the evaluation of students' learning is mainly realized through the course examination. There are some defects such as single evaluation goal, one-sided evaluation content and simplification of evaluation method. It is difficult to reflect the comprehensive quality improvement of students during the course learning.

However, in the reformed course, assessing the performance of learning process and comprehensive application skills is needed for the final assessment. The comprehensive application ability assessment mainly includes the assessment of project, experiment, homework and quizzes, which is more flexible. Not only are the results of the learning assessed, but the entire learning process and the state of learning. Students are guided to learn knowledge at each stage and actively participate in skill practice. The proportion of the assessment results in this part of the total assessment is 40%, the specific content of which is shown in Table 4.

Table 4 Content of Assessment

Content of assessment	Percentage
Practical project	20%
Homework	5%
Quiz	5%
Experiment	10%

Summary

The teaching model that separates practice from theory is formed based on CDIO and SC teaching engineering. During the teaching process, the engineering project is taken as main line of teaching, and the students are taken as the main body of the class. Furthermore, the simply imparting knowledge is replaced by cultivation of abilities, so that the students can learn the course from passively to actively. The students can not only acquire new knowledge, but also improve the enthusiasm greatly through the establishment, analysis and observation of the practical project. At the same time, the engineering literacy of students to find problems, solve problems and teamwork are also cultivated.

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