

Thinking about teaching international talents in sensor principle and application course

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Abstract. In order to improve the level of internationalized Mechanical-electronic talents in our school, this paper takes the internationalized experimental class of measurement and control technology used by our department as the main body, and adopts the mixed teaching method of domestic and international students in the same class to explore a new teaching way. It integrates international teaching with localized teaching to realize the reform of Mechanical-electronic majors through the course "Sensor Principle and Application". This investigation serves as a practical prototype for the cultivation of internationalized talents in our university, as well as an example for the exploration of teaching mode of internationalized Mechanical-electronic talents in our department.

Keywords: Mixed teaching method; Mechanical-electronic talent; Internationalization; International accreditation system.

1. Introduction

Sensor principles and applications course is an important foundation course in measurement and control technology, which is the source of information for modern industrial production [1]. It involves the working principle of various sensors, conversion circuits and various applications. It is an essential knowledge for students to design and select measurement and control systems [1]. We should strengthen international exchange and cooperation, requires universities to "cultivate international talents with international vision and capable of improving international competition" according to "The National Medium and Long-Term Education Reform and Development Plan (2010-2020) " [2] [3]. Shanghai University clearly put forward the goal of becoming a comprehensive research university with international reputation, domestic first-class and distinctive characteristics. Therefore, we take the course "Sensor Principle and Application" as the pioneer, adopting the mixed teaching method of domestic and international students in the same class, exploring the teaching way of integrating the nationalized teaching with the local reality, and reforming the education system of the department of electromechanics to cultivate for the spirit of patriotism and national self-esteem, rich professional knowledge, and practical ability of foreign language.

2. Current status of course teaching

At present, due to the short semester in our school, many courses still use the Chinese "duck-fill" teaching method. The teacher does not have time for the students to ask questions and many teaching styles are still "teachers speak and students listen". This teaching mode is not compatible with their country's open teaching style, and the language problem makes foreign students easily lose their motivation to learn in the classroom [4].

2.1 Teaching methods and content are out of date

Intelligent sensing technology, wireless sensor technology, internet of Things technology has undergone rapid changes with the development of technology [5], but many of our sensor teaching materials or content are still the traditional sensor design principles, design methods and transmission methods, and do not keep up with the development of the technology. Therefore, how can the teaching content and methods of this course be improved in the future, considering the

differences in learning ability, learning level and language application of domestic and foreign students, stimulating students' learning enthusiasm and innovation ability, ensuring students keep up with the times to better understand the application of sensor principles and real-life scenarios, and better mastering the knowledge of this course to use it. It is an urgent issue that needs to be solved.

2.2 A gap between experiments and practical applications

Sensor theory is important to understand and master, the current "Sensor Principles and Applications" laboratory course is only 3 hours, which is far too short for a practical course. And the current course in the experimental content set is still relatively old. Students do not take advantage of the hard-won experimental time well, and do not familiarize themselves with the experiments in advance. Meanwhile, it is very serious to report the sameness of the experiment, resulting in students becoming mechanized operator, away from the training of students in experimental hands-on ability and innovation. Thus, there is an embarrassment when students have excellent experimental scores, but they are unable to complete the experiment due to a little change in the measuring object. Furthermore, due to the current epidemic, many foreign students cannot come to school to carry out the actual hands-on experiments, limiting their hands-on opportunities.

2.3 Insufficient innovation and entrepreneurship

From the source of our students, many families are only children, they are spoiled at home, and their parents do many things, which leads to their poor initiative of innovation and entrepreneurship, and the many innovation and entrepreneurship projects of the school seem to have a "forced" nature for them. For international students who come from abroad, most of them do not have the idea of innovation and entrepreneurship because their families are well-off, and many of them think it is useless to do so. Meanwhile, many teachers are of high academic level, but are still far from adequate for practical application or realistic problem-solving ability, which also leads to the inability of teachers to stimulate new sparks in their students during teaching and guiding them in developing innovations.

3. The reform method based on the teaching of international talents

3.1 Curriculum development for modularized teaching methods

By sorting out the original course content and teaching plan, we based on our school's characteristic "three semesters", the course has 30 hours of modular teaching design in the form of projects. Teaching lectures will no longer be in accordance with the teaching sequence of chapters, but the order of sensors involved in the project-based experiments to teach a variety of modular sensors. The following is the course training objectives:

- 1) To grasp the features of sensors, dynamic characteristics and master the basic principles of the work of a variety of sensors, performance, characteristics, and applications.
- 2) to be able to master the response of dynamic testing and the conditions of non-distortion and analyze and calculate the key aspects of the measurement system.
- 3) be able to apply professional knowledge of measurement and control technology to comprehend the frontiers of discipline development and the application of sensors in various fields.
- 4) Be able to use the acquired knowledge of sensors to propose solutions for units or systems in the measurement of typical mechanical quantities.

All sensors are divided into eight sensor principal modules according to their characteristics: resistive sensors, inductive sensors, capacitive sensors, piezoelectric sensors, magnetolectric sensors, Hall sensors, photoelectric sensors, and digital sensors. At the same time for each module according to the main line of the project need to collect data to establish the topic task, for each topic task will be assigned the corresponding class time and the regular grade, midterm grade, final grade assessment criteria.

We divided the Chinese and foreign students into groups during the implementation, with at least one Chinese student in each group, so that they could communicate with Chinese enterprises subsequently. At the end of the tasks, students are asked to assess their classmates and write down the reasons for their scores, in order to encourage them to participate and to think about the tasks. With the development of the modular teaching method, the scoring of project task can improve the students' practical skills from the perspective of practical use or development, as well as provide advice and guidance.

3.2 Project-based experimental extension

Because "Sensor Principles and Applications" and "Microcomputer Principles and Applications" are offered in the same semester, the course reform took advantage of this opportunity to combine the "Sensor Principles and Applications" with "Microcomputer Principles and Applications" for project practice reform, increasing the project practice hours. In the experimental settings, the eight modules mentioned earlier will be the project's main line design new experiments to keep up with current information, so that students can understand the basic working principles of advanced technology, novel products. The purpose of the experiment is not simply to build a circuit, record data, and then write an experimental report, each project does not have a unified result, nor a unified report. The final report will be assessed not only by the simple experimental results, but also by whether the main experimental process is correct and whether they have their own unique ideas. In this way, students can find fun in the experiment, recognize their own value in the experiment, and really understand that the knowledge they learn is often used in real life. At the same time, in the project-based experimental extension, all the modular sensors involved in the lecture process of "Sensor Principles and Applications" will be connected to everything through NB-IOT technology, and then the open IoT application development through Ali Cloud. This substantially simplified the situation that Chinese and foreign students could not work together at the same time during the epidemic, and they could transmit data and control these modular sensors remotely from home.

3.3 Teaching evaluation based on international accreditation system

With the development of globalization, many domestic engineering and technology talents have gone abroad, and for the purpose of seamlessly connecting domestic cultivated talents and foreign employment [6]. In 2016, China became a member of the Washington Agreement on Mutual Recognition of International Undergraduate Engineering Degrees, which is conducive to promoting the cultivation of engineers in China, and is critical to China's engineering and technology field ability to compete in the global market [7]. In 2021, the Department of Measurement and Control Technology and Instrumentation has passed the professional certification of engineering education. The teaching evaluation of the international experimental class will be based on the professional certification of engineering education in measurement and control technology and instrumentation, and will be in line with the needs of international talents, and the spiral of "learning-practice-evaluation" will be used to make comprehensive evaluation of students.

1) Evaluation of engineering knowledge

The evaluation of this part is to examine if students have mastered the fundamental knowledge, basic structure, working principle and measurement circuit of sensors, as well as whether they can master and skillfully use the measurement methods of vibration, displacement, force and other common mechanical quantities in mechanical systems, so as to observe whether students have really grasped the engineering application of sensor principles and applications in this course.

2) Evaluation of problem analysis ability

Through the project-based experimental extension, we will examine whether students can use the basic principles of mathematics, electronics, and engineering mechanics to accurately analyze the key factors of vibration measurement, displacement measurement and force measurement in mechanical and electronic engineering applications, and establish mathematical models for information description, spectrum analysis and static and dynamic measurements in test systems.

3) Evaluation of solutions

Through modularized teaching and project-based experimental extension, with common problems in daily life as the guide, students team up to solve the problem solution design, using the basic theory, performance, and characteristics of the sensors that students learn. Meanwhile, teacher also observe whether students can skillfully and practically meet the system function and performance requirements of mechanical quantity sensing detection and information signal analysis, processing, and other functional units. Students can target the analysis and calculation of key designs.

4) Evaluation of the ability of internationalization vision

Through the students' preliminary study and practice, the exchange and communication between domestic and international students will become more and more frequent, and their problem analysis and solution will not be limited to the situation encountered in the country, but rather a kind of integration of domestic and foreign knowledge, thus broadening the international vision of domestic and foreign students. The purpose of evaluating their problem and solution is to check if they have a strong international awareness, an open and broad vision, and a strong research and exploration of cross-cultural traces, as well as see if they can analyze with international awareness and thinking.

4. Summary

We have made some attempts to teach international talents during sensor principles and applications based on the international experimental class of measurement and control technology and instrumentation. But the course has only been tested by one class of students, it is not a good indication of its long-term effectiveness. The students were enthusiastic about the adjustment. In the classroom, there is the exchange of ideas between domestic and foreign students, and some new ideas emerge from the collision of domestic and international ideas. The comprehensive evaluation system can not only let students know the extent of their engineering knowledge, but also their ability to analyze problems, solve them, and communicate and collaborate internationally. On the one hand, this change of teaching method allows our majors to communicate and exchange with their foreign peers without leaving home, and cultivates their international vision; on the other hand, it allows international students visiting China for exchange to gain good course knowledge and the ability to think about problems from multiple perspectives in the measurement, control and instrumentation majors studied at Shanghai University. As a result, it is a good exploration and practice for the cultivation of international talents in our department, and the orderly implementation of the all-round promotion of international talents cultivation program in the future.

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