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The Application of Learning-doing-thinking in Sensor Teaching

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Abstract: Sensors are a course that combines theory and practice. This course covers a wide range of knowledge, has a wide range of content, and is updated and developed quickly. It has strong theoretical and practical applications. Traditional teaching methods are difficult to achieve teaching objectives. This article proposes a teaching model that integrates learning, practice, and thinking based on the positioning of talent cultivation goals in higher vocational education, in order to address the problems in traditional teaching of sensor courses and improve students' initiative in learning and practical abilities. Teaching practice has shown that the integrated teaching model of learning, doing, and thinking not only achieves positive interaction between teachers, students, and students, but also improves students' problem-solving and innovative application abilities, as well as the teaching level of teachers.

1. Introduction

The sensor course is a compulsory course for IoT related majors in vocational colleges, and its importance is self-evident. The course mainly involves the basic principles, characteristics, applications, and system design of sensors. Sensors, as a key component of modern measurement and control systems, have been widely used in various fields such as industry, transportation, healthcare, environmental protection, and military. This course aims to cultivate students' mastery of the basic theory and application technology of sensors, laying a solid foundation for their research, development, and application in related fields. Strong practicality is the biggest characteristic of this course[1], and how to improve practical ability is an important issue to consider in course teaching design. This article explores and reflects on this based on teaching practice.

2. Problems in the current teaching mode

(1) There is a disconnect between theory and practice. The primary issue lies in the disconnect between theoretical teaching and practical operation. Many textbooks and courses focus too much on imparting theoretical knowledge, while neglecting practical aspects. Students may have a deep understanding of the working principle of sensors, but they may feel confused in practical applications because there are often differences between theory and the real environment. (2) Device update lag. The updating speed of teaching equipment cannot keep up with the development

of technology. Sensor technology is constantly changing, but many school laboratory equipment cannot be updated in a timely manner, resulting in students being exposed to outdated technology, which undoubtedly limits their learning and innovation abilities. (3) Lack of interdisciplinary integration. The third challenge is that sensor teaching is often isolated from other related disciplines, and the application of sensors involves multiple fields such as physics, electronics, and computer science. However, traditional teaching models often separate these knowledge, making it difficult for students to fully understand and master the comprehensive application of sensors. (4) Insufficient case studies. In addition, the lack of case studies in sensor teaching is also an important issue. Through specific cases, students can better understand the practical applications and potential problems of sensors, but in current teaching, such practical cases are often overlooked. (5) The assessment mode is single. The traditional assessment and evaluation method is mainly based on exam papers, supplemented by appropriate amount of homework practice after class. Under this assessment and evaluation method, most students prioritize theory over practice, and their understanding of sensors is basically limited to relatively empty theoretical knowledge, which does not meet the training goals of applied talents[2][3][4][5]. (6) The learning situation is difficult to grasp. In the traditional teaching mode, the teacher mainly explains the theoretical knowledge of sensor working principles and measurement circuits, and most of the teaching is in a cooperative class. There is little positive interaction and communication between teachers and students, and students sit passively in the seats of the large classroom, resulting in low participation in classroom teaching. At the same time, lacking feedback on teaching effectiveness, teachers often do not know how much students have understood, and a single teaching process leads to a decrease in students' learning enthusiasm and initiative, resulting in poor learning outcomes[6].

3. Integrating learning, doing, and thinking, exploring the path of integrating knowledge and practical actions

In the context of the knowledge economy, learning-doing-thinking has become an important way for us to acquire knowledge, enhance abilities, and realize value. This article proposes an integrated teaching model of learning, doing, and thinking, which emphasizes not only mastering knowledge in the learning process, but also transforming it into practical actions, continuously improving and enhancing oneself through reflection and summary.

3.1 Learning

Learning is the foundation for acquiring knowledge. In this era of information explosion, we need to constantly learn new knowledge and skills to adapt to the constantly changing social environment. Learning is not only to acquire knowledge, but also to cultivate students' thinking ability and innovative spirit. Therefore, we should keep students curious and curious, constantly broaden their knowledge fields, and lay a solid foundation for their future development.

Learning is a verb that involves two subjects: the teacher and the student. Regarding the verb of learning, teachers need to solve the problem of what to teach and how to teach, and students need to know what to learn and how to learn.

3.1.1 Teacher’s teaching

Before students learn sensors, teachers must be fully prepared and have a clear understanding of the learning situation, teaching content, and teaching objectives. Meanwhile, we purchase a batch of Arduino sensor learning kits online[7]. This kit includes a variety of sensors with a wide range of cases, including photoresistors, flame sensors, vibration sensors, infrared sensors, smoke sensors,

etc. In addition, the kit also comes with a bread board, which is a solderless circuit connection method that is very convenient to use. During the teaching process, the teacher uses Arduino motherboard, breadboard, and some sensor modules to conduct experiments with actual circuit connections, and provides a detailed explanation of relevant knowledge, including the characteristics of sensors and the working principle of circuits. If necessary, the teacher can demonstrate or play relevant case videos in person, allowing students to have an intuitive understanding of the knowledge learned. During the sensor teaching process at our school, we divided the teaching cases into the following three levels, with increasing difficulty and interest, as shown in Table 1.

Table 1: Case Level and Name

Case number	Case Name	Case level
1	Light controls lamp	base
2	Vibration alarm	
3	Horizontal detector	
4	Fire extinguishing fan	
5	Human body induction fan	advance
6	Infrared remote controls LED	
7	Steering gear sector sway	
8	Reverse radar	
9	Touch fan	senior
10	Temperature controlls fan	
11	Rocker controls servo	
12	Water level detection	

3.1.2 Student's learning

Students learning sensor knowledge includes three major parts: first, basic knowledge learning. This includes understanding the basic principles and classifications of sensors, and being familiar with the common application areas of sensors. The second is theoretical learning. This includes learning the relevant theoretical knowledge of sensors, such as the principle of electromagnetic induction and the working principle of photoresistors. By consulting relevant textbooks, papers, and academic materials, one can gain a deeper understanding of sensors. The third is practical learning. We can ask students to conduct sensor experiments, build sensor circuits by hand, edit relevant program codes, observe and record experimental results.

3.2 Doing

Doing is the key to transforming knowledge into practical actions. Knowledge can only truly realize its value when put into practice. Teachers should encourage students to apply the knowledge they have learned to practical work, and test the authenticity and effectiveness of the knowledge through practice. At the same time, teachers and students also need to constantly explore and innovate in practice, discover new problems and solutions, and promote the continuous improvement of knowledge and skills. Doing is also a verb, which includes two processes: the teacher watching and the student doing.

3.2.1 Teacher's view

During the process of student hands-on experiments, teachers play an important guiding role. Teachers should pay attention to observing the practical situation of each student and patiently guide them if they find any experimental problems. If students are found to be distracted or playing with their phones during the learning process, teachers should remind them in a timely manner and take preventive measures.

3.2.2 Student’s doing

Students build circuits by hand based on the tasks and relevant circuit diagrams posted by the teacher, learning and working on them. If they encounter difficulties during the process, they should seek advice from the teacher or other classmates in a timely and effective manner to solve any problems.

3.3 Thinking

Thinking is a reflection and summary of the process of learning and practice. Reflection can help us identify problems and shortcomings, summarize experiences and lessons, and provide useful references for future learning and practice. Both teachers and students should always remain vigilant and introspective, constantly reflect on their learning and practical processes, identify their blind spots and weaknesses, and make timely adjustments and improvements.

3.3.1 Teacher's thinking

Zengzi once said, "I reflect on myself three times a day." This is about the importance of reflecting on oneself. As a teacher, one should reflect on their teaching mode, teaching process, and teaching effectiveness, thinking about how to improve classroom teaching effectiveness to a new level, and thinking about how to make learning easy and enjoyable for students.

3.3.2 Student’s Thinking

After completing each lesson, students should reflect and summarize. The working principle of sensors needs to be further deepened. Students should review and reflect on the errors that occurred during the experiment to prevent recurrence in the future. To understand, one must think more. Thinking can promote understanding, and understanding can deepen memory. Only by using their brains and independent thinking can students effectively digest the knowledge they have learned, turn it into knowledge they truly master, and transform it into inner abilities, becoming a source of innovation.

4. The teaching effect of integrating learning, doing and thinking

The sensor course, which involves restructuring the teaching system, integrating teaching objectives, and innovating teaching modes, was conducted through practical teaching in three classes of Electronic Information Engineering Technology in the 2022 class of our school, with a total of 60 students. Teaching practice has proven that the teaching objectives based on learning situation analysis and the innovative teaching model of integrating learning, doing, and thinking have been widely welcomed and recognized by students, allowing each student to gain a sense of achievement, enhance their sense of mission, and enhance their sense of responsibility while mastering knowledge and skills. Compared with traditional teaching methods, students' learning interests and abilities have significantly improved. At the same time, there has been significant

progress in the teaching ability of teachers. As the saying goes, teaching and learning are mutually beneficial.

5. Conclusions

The sensor course, as an important course in the field of electronic information technology, is of great significance in cultivating students' professional literacy and practical abilities. With the continuous development of technology, sensor technology is also constantly being updated. In the future, sensor courses will continue to focus on the development of new technologies and applications, and continuously update course content. The challenges of sensor teaching require us to reform from various aspects such as educational models, teaching resources, and teaching methods.

The teaching model of integrating learning, doing, and thinking proposed in this article is a new way of learning, which emphasizes not only mastering knowledge in the learning process, but also transforming it into practical actions, continuously improving and enhancing oneself through reflection and summary. In future learning and work, both teachers and students should always adhere to the concept of learning, doing, and thinking, constantly explore and practice. Only in this way can we cultivate sensor technology talents that meet the needs of future technological development and promote technological progress.

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