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Exploration and Practice of Teaching Mode for College Sensor and Detection Technology Course

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Abstract: Sensor and Detection Technology is a core course for majors such as electrical engineering, automation, measurement, and control in colleges and universities. It features a strong theoretical nature, practicality, and applicability, and its teaching mode determines the effectiveness of talent training. With the continuous changes of the industry and the deepening of curriculum reform, the traditional teaching mode can no longer meet the needs of industrial development and students' growth. Based on this, this paper explores the suitable teaching modes for the college course of Sensor and Detection Technology, so as to provide a theoretical reference for curriculum teaching reform.

Keywords: Sensor and Detection Technology; Curriculum reform; Teaching mode; Automation

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1. Introduction

With the rapid development of emerging technologies such as intelligent manufacturing and Industry 4.0, sensors and detection technologies act as the core link connecting the physical world and the digital world, playing an irreplaceable role in many fields including industrial production, intelligent manufacturing, aerospace, biomedicine, and so on. The market has an increasingly urgent demand for professional talents in sensor-related fields with a solid theoretical foundation, strong engineering practical ability, and innovative literacy [1]. As a basic course for majors of electrical engineering, automation, measurement and control technology, and instrumentation in colleges and universities, Sensor and Detection Technology undertakes the important mission of imparting professional knowledge, cultivating practical ability, and stimulating innovative thinking. The selection of its teaching mode is directly related to the quality of professional talent training. Therefore, optimizing and innovating the teaching mode can effectively improve the teaching quality of the course and cultivate high-quality engineering talents meeting industrial demands.

2. Significance of optimizing the teaching mode of college Sensor and Detection Technology course

2.1. Improving curriculum teaching quality and enhancing targeted talent training

The course of Sensor and Detection Technology integrates theoretical nature, practicality, and applicability. Its teaching quality is directly related to students' mastery of professional knowledge, cultivation of practical ability, and improvement of innovative literacy. As a key starting point for systematically improving curriculum teaching quality, the optimization of teaching mode can make the teaching process more interesting, interactive, and practical by innovating teaching methods, building practical platforms, and enriching teaching forms, stimulate students' learning interest and initiative, and increase students' learning participation, thereby effectively improving classroom teaching quality [2]. At the same time, colleges and universities can build a trinity teaching objective system based on curriculum characteristics and talent training needs, clarify the specific objectives and requirements of each teaching link, and keep teaching activities centered on the improvement of students' comprehensive literacy. It ensures that teaching content, teaching methods, and teaching evaluation are accurately aligned with teaching objectives, avoids blindness and randomness in the teaching process, fundamentally enhances the pertinence and effectiveness of teaching, and promotes the steady improvement of curriculum teaching quality.

2.2. Adapting to industrial development needs and improving comprehensive literacy

With the rapid development of emerging technologies such as intelligent manufacturing, Industry 4.0, and the Internet of Things, sensors and detection technologies, as the core bridge linking the physical world and the digital world, are increasingly widely applied in many fields including industrial production, aerospace, biomedicine, and intelligent equipment, resulting in rapid iteration and updating of relevant technologies [3]. By actively optimizing the teaching mode, colleges and universities can keep up with the overall trend of industrial technological development, integrate cutting-edge industrial achievements such as new sensor technologies and intelligent detection technologies into daily teaching, and continuously update and improve the overall knowledge system of the course. In this way, students can master the latest professional knowledge and practical skills of the industry, effectively avoid disconnection between learned knowledge and industrial practical application, and steadily improve their adaptability to professional knowledge and future posts.

In addition, the industry has a high demand for sensor professionals. Practitioners are required to proficiently apply professional knowledge to solve various technical problems in engineering practice, debug detection equipment, and complete detection system design [4]. Innovative teaching modes can promote in-depth integration of theoretical knowledge and engineering practice, guide students to actively participate in practical exploration, and comprehensively improve their hands-on operation ability, problem-solving ability, and engineering design ability, so as to quickly adapt to job requirements.

2.3. Highlighting the essential attributes of curriculum education and enhancing core competitiveness

The theoretical knowledge of Sensor and Detection Technology is closely connected with practical application. Theoretical knowledge is the foundation of practical application, while practical application is the extension and sublimation of theoretical knowledge. The reform of teaching mode can break the separation of theory and practice in traditional teaching, run practical teaching through the whole teaching

process, and enable students to understand and apply theoretical knowledge in practice, realizing the coordinated improvement of theoretical knowledge and practical ability, and giving full play to the practical and application advantages of the course [5]. At the same time, it can effectively promote the in-depth development of curriculum teaching reform, form a distinctive teaching mode, enhance the recognition and influence of the course, make it a characteristic and advantageous course for engineering majors in colleges and universities, provide strong support for professional connotation construction, and further strengthen the talent training advantages and core competitiveness of colleges and universities.

3. Existing problems in the teaching of college Sensor and Detection Technology course

3.1. Single teaching mode lacking innovation

At present, the teaching methods of Sensor and Detection Technology in colleges and universities are single and fixed, lacking innovation and interactivity, and difficult to stimulate students' learning interest and initiative. On the one hand, some colleges and universities still adopt the traditional teaching mode of teacher lecturing and students listening. Teachers occupy the dominant position in the whole classroom, and mostly instill theoretical knowledge through PPT and blackboard writing, while students are in a passive state of listening and receiving knowledge all the time. In this case, students lack space and opportunities for independent thinking and exploration, resulting in insufficient thorough understanding of curriculum knowledge points and difficulty in applying what they have learned into practice [6]. On the other hand, the course of Sensor and Detection Technology is both theoretical and practical, which requires diversified and innovative teaching methods combined with its own characteristics. However, many colleges and universities still adopt rigid single teaching methods, and fail to actively implement new teaching modes such as project-based teaching, case-based teaching, and flipped classroom. It is difficult to combine abstract theoretical knowledge with practical application scenarios, and impossible to mobilize and stimulate students' learning enthusiasm and exploration interest.

3.2. Unreasonable teaching content with insufficient adaptability

In the field of sensors and detection technology, technology iterates rapidly, and industrial application scenarios continue to expand [7]. However, the current teaching content of the course in most colleges and universities mainly focuses on traditional sensor principles and detection methods, emphasizing the structure, principle, and application of traditional sensors such as resistive, capacitive, and inductive sensors. It involves little content of emerging sensors developed in recent years such as optical fiber sensors, MEMS sensors, and intelligent sensors, and fails to integrate the latest research achievements and industrial application cases of sensor technology in a timely manner [8]. It is difficult for students to understand the cutting-edge trend of industrial technology and master relevant knowledge and application skills of new sensors, leading to a disconnection between learned knowledge and actual industrial needs. Most importantly, some colleges and universities fail to absorb the latest industrial standards and engineering specifications in a timely manner and still follow traditional ones, making students' learned knowledge inconsistent with practical industrial specifications and difficult to adapt to job requirements quickly.

3.3. Inadequate construction of practical teaching system and weak ability training

Practical teaching is a key bridge connecting theoretical knowledge and engineering practice, and also an important carrier for cultivating students' engineering practical ability, innovative thinking, and job adaptability in the course of Sensor and Detection Technology. At present, some colleges and universities have certain deviations in the orientation of practical teaching for this course. They simply regard practical teaching as a supporting auxiliary link of theoretical teaching, without establishing an independent and perfect practical teaching objective system or clarifying the core role of practical teaching in talent training [9]. Therefore, it cannot effectively help students improve their practical operation ability and innovative literacy. In addition, the current practical teaching content is still dominated by traditional basic operations, focusing on simple debugging of traditional sensors and verification of basic detection methods, lacking comprehensive and innovative practical content such as new sensor applications, detection system design, and engineering problem solving.

4. Teaching modes of college Sensor and Detection Technology course

4.1. Implementing case-based teaching mode to consolidate students' knowledge and skills

Case-based teaching mode relies on the core knowledge points of the curriculum to construct a correlated and systematic teaching case system. With the gradual guidance and in-depth analysis of typical cases, it naturally connects theoretical knowledge with practical application. It can not only help students deepen their understanding and mastery of curriculum knowledge, but also gradually cultivate their logical analysis ability and the ability to flexibly apply professional knowledge to solve practical problems.

Firstly, teachers should carefully select appropriate teaching cases combined with daily teaching progress and core curriculum knowledge points, ensure a high fitting degree between cases and theoretical knowledge to support the explanation of knowledge points, and further deepen students' understanding. At the same time, guide students to quickly integrate into the classroom learning atmosphere, fully mobilize their learning interest and desire for independent exploration, and make them clearly grasp the core teaching objectives and key knowledge of the course.

Secondly, teachers systematically explain relevant theoretical knowledge combined with the core problems in cases, establish internal correlation between cases and theories, help students understand the application scenarios and value of theoretical knowledge, and realize the resonance of theoretical knowledge and case content. Finally, teachers can guide students to analyze cases in depth in the form of group discussions, deepen their understanding and mastery of theoretical knowledge, and cultivate their logical analysis ability, critical thinking, and communication and collaboration ability.

For example, in course teaching, teachers can introduce a specific case of sensor system detection, let students focus on the core problems of the case, carry out independent exploration in groups, and preliminarily judge possible causes such as unreasonable sensor selection, improper setting of detection circuit parameters, and inappropriate signal processing methods combined with learned theoretical knowledge. Then, teachers guide students to analyze the causes one by one, analyze the correlation between sensor selection and detection accuracy based on sensor working principles, and formulate targeted optimization schemes, so as to strengthen students' knowledge and skills.

4.2. Promoting online-offline blended teaching mode to meet talent training requirements in the new era

Under the modern education system, online learning platforms have gradually become the mainstream trend in the teaching of professional courses in colleges and universities. Therefore, teachers should realize complementary advantages of online and offline teaching based on the main characteristics of Sensor and Detection Technology Course combined with students' learning characteristics and the development needs of the times, promote the innovation and upgrading of teaching modes, and meet the training requirements of engineering talents in the new era [10].

In the online part, teachers release teaching courseware, knowledge explanation videos, homework, and expanded learning materials relying on online learning platforms, guide students to arrange learning time independently, and complete a preview to master basic theoretical knowledge. Meanwhile, teachers timely answer students' learning questions through online Q&A and discussion area communication to improve students' autonomous learning ability.

In the offline part, teachers focus on key and difficult points of online learning, deepen students' understanding and mastery of knowledge through classroom explanation, group discussion, and interactive teaching, and guide students to carry out interactive exploration to improve their logical thinking ability and communication and collaboration ability.

4.3. Utilizing digital technology to create practical teaching scenarios

Digital technology is the main carrier for colleges and universities to deepen teaching reform and realize intelligent teaching, and also a new teaching mode conforming to the development trend of information technology and engineering education reform in the new era. Therefore, teachers should integrate digital means such as virtual simulation, virtual reality, and intelligent interaction into the whole teaching process based on the advantages of digital technology, realize the innovation and upgrading of teaching modes, and meet the demand for engineering talent training in the new era [11].

First, teachers should use digital technology to build practical teaching scenarios close to engineering reality combined with practical teaching objectives and core knowledge points of the course. The scenario design should pay attention to authenticity, simulation, and interactivity, accurately simulate engineering practice scenarios such as sensor detection, detection system design, and equipment debugging, and enable students to obtain the same experience as real practice in the simulation scenario [12].

Second, teachers shall set practical scenario tasks with clear requirements, guide students to carry out independent practical exploration, and improve their practical operation ability and problem-solving ability by operating simulation equipment, designing detection schemes, and solving practical problems.

Third, build a virtual simulation platform to simulate the working principle, detection process, and equipment debugging of sensors, allowing students to conduct practical operations in a virtual environment. It helps students intuitively understand the structure, working principle, and composition logic of detection systems, and deepen their understanding and mastery of theoretical knowledge. Meanwhile, students can adjust practical parameters and operate simulation equipment according to practical needs to enhance the autonomy and effectiveness of practical exploration.

For instance, in the learning of inductive sensors, teachers can adopt digital modeling technology to build a three-dimensional digital model of inductive sensors, intuitively present the composition and assembly relationship of core structures such as inductive coils and armatures, and help students quickly

understand the structural characteristics and working mechanism of inductive sensors. At the same time, virtual simulation technology can be used to create the operation scenario of inductive sensors, allowing students to adjust parameters and operate equipment independently under different working conditions for real-time interaction with the simulation scenario, so as to realize in-depth integration of theoretical knowledge and practical ability.

5. Conclusion

In short, the construction of emerging engineering education has put forward brand-new requirements for teaching reform and talent training in colleges and universities. Adopting approaches such as case-based teaching mode, online-offline blended teaching mode, and virtual scenario creation mode can effectively consolidate students' professional foundation and improve their engineering practical ability and innovative application capacity.

Disclosure statement

The author declares no conflict of interest.

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