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Research on the Reform of Practical Teaching of Internet of Things Engineering in the Context of New Engineering

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Abstract: The emergence of new engineering disciplines has resulted in the growing trend of cross-discipline, and the enhancement of students' technical application ability has become the main teaching objective of engineering disciplines. For this reason, the Internet of Things (IoT) engineering program should be actively reformed, providing students with sufficient opportunities to improve their practical skills. This paper identifies the challenges within practical teaching of IoT engineering, delves into effective strategies for practical IoT teaching within the context of emerging engineering disciplines, and presents practical teaching experiences from the School of Information Engineering at Hainan University of Science and Technology as a case study. The aim is to offer guidance and insights to educators in this field.

Keywords: New engineering background; Internet of Things engineering major; Practice teaching

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1. Introduction

New engineering is a new direction of educational and teaching reform of engineering majors in colleges and universities, aiming to promote the intersectionality of theoretical knowledge and practical skills so that students can become talents with comprehensive qualities. In the face of the new educational situation, the Internet of Things (IoT) engineering specialty needs to actively carry out educational reform, improve the importance of practical teaching, and develop a systematic and practical teaching mode, in order to promote the simultaneous improvement of students' theoretical knowledge level and practical ability [1].

2. Problems in the practical teaching of the IoT engineering specialty

The IoT engineering major specializes in network communication engineering, intelligent engineering, and computer engineering, focusing on the cultivation of highly skilled personnel with excellent theoretical knowledge and practical skills. Practical lessons are an important part of the IoT Engineering major. Proper practical lessons can enhance the students' ability to apply theoretical knowledge to solve problems in real

life. There are several challenges in the theoretical and practical teaching of IoT engineering in colleges and universities, so effective countermeasures need to be taken. Firstly, theoretical teaching is emphasized while practical teaching is ignored. Some schools prioritize the teaching of theory over practical lessons. Consequently, students have fewer opportunities to develop their practical skills. The passive learning of the learning materials also hampers active thinking and the development of innovation skills [2]. The second problem is that the practical lessons are often detached from the actual practices in the industry. As a result, many graduates cannot adapt to the needs of society. Thirdly, the teaching plan for practical lessons is yet to be perfected. Many colleges offering IoT majors lack a multidisciplinary approach and fail to integrate industry application environments into their curricula. This deficiency adversely impacts the growth and development of students [3].

2. Strategies for teaching IoT engineering

2.1. Enhancing the quality of the educators

To enhance the quality of practical teaching in IoT engineering and improve talent cultivation, universities should send teachers to work in enterprises to enrich their experience in project management. Experts from enterprises should be invited to teach in universities, especially practical lessons to enhance the overall quality of practical teaching [4]. Moreover, colleges and universities need to accurately grasp the actual needs of the market and the development of the industry. The practical teaching system should encompass internships, experiments, a final-year project, vacation social practice, comprehensive practical training, comprehensive course design, project training, and lectures by corporate executives. By offering students a plethora of practical opportunities, the overall quality of practical teaching can be enhanced [4]. By taking these measures, students can be provided with ample opportunities to enhance their ability to apply their theoretical knowledge [5].

2.2. Adjusting the teaching content according to the social demands

The IoT engineering courses in many universities are outdated. The Internet of Things (IoT) engineering course primarily caters to the IoT industry, so the course should be application-oriented. However, with the advancement of science and technology, traditional IoT engineering curriculum no longer meets the demands of the field [6]. Therefore, colleges and universities must adapt and enhance teaching content in response to societal needs. This involves reducing the emphasis on theoretical courses in the curriculum and increasing the inclusion of highly practical subjects such as intelligent terminals, image digital processing, and mobile application development. Furthermore, reducing theoretical emphasis during teaching and incorporating more engineering project-based cases allows students to grasp theoretical knowledge while learning. This approach enables students to apply theoretical knowledge effectively in solving practical problems.

2.3. Cultivating diversified application-oriented talents

Colleges and universities should emphasize cultivating diversified application-oriented talents. This can be achieved by ensuring high-quality instruction in basic theory, enhancing students' comprehensive practical skills, and refining teaching evaluation methods. As the Internet of Things engineering field is part of the rapidly evolving computer education discipline, it is crucial to guide students in mastering fundamental knowledge thoroughly. Moreover, increasing the emphasis on practical skills in teaching assessments can enhance students' focus on practical teaching [7]. Secondly, colleges and universities should enhance practical teaching through various methods such as organizing competitions, facilitating course design, hands-on practice, classroom demonstrations, summer training, and final-year projects. These avenues provide students with ample practical

opportunities and continually enhance their comprehensive practical abilities. Thirdly, during practical teaching, students should be assigned tasks such as writing and public speaking to foster teamwork skills, thereby creating favorable conditions for their growth and development.

2.4. Promoting school-enterprise cooperation

School-enterprise cooperation is an effective way to cultivate high-quality talents. colleges and universities should select enterprises with robust comprehensive capabilities that can accommodate a significant number of student internships for collaboration. They should also consider hiring personnel from these enterprises to teach at schools. Additionally, organizing students to regularly participate in practical activities within these enterprises enables students to gain insights into industry developments and master practical skills [8]. Secondly, colleges and universities should work with enterprises to develop a perfect talent training program. This involves determining the skills that the students are required to master during the internship program and requiring the students to complete a final-year project according to the product development project management system of the enterprise. Thirdly, colleges and universities should collaborate with enterprises to establish practical training bases for IoT engineering majors. The students will get to participate in various projects in the bases, thereby improving their comprehensive qualities [9]. Fourth, colleges and universities should actively promote collaboration between industry, academia, and research. This involves facilitating partnerships where IoT engineering students work with enterprises to develop and design products. Through this collaboration, students enhance their problem-solving skills by applying their knowledge and contributing to the expansion and improvement of enterprise design concepts.

2.5. Other strategies

Colleges and universities need to optimize and adjust the curriculum system of IoT engineering by increasing the variety of content in the syllabus. Besides, they should encourage students to participate in high-level competitions such as ACM, IoT design, and robotics competitions to improve their skills. Additionally, colleges and universities should regularly facilitate the involvement of exceptional student representatives in enterprise scientific research projects. By establishing a comprehensive practical training platform that bridges on-campus and off-campus activities, the innovation skills of students can be strengthened [10].

3. Case study

Based on the needs of the construction of the Hainan Free Trade Port and with the goal of cultivating highly skilled talents, the IoT engineering program of this university attaches great importance to practical teaching and actively implements practical teaching reform. Data transmission is the core of practical teaching. In practical teaching, teachers focus on data transmission as the core component. They guide students in processing data on embedded platforms and PC platforms, involving them in the development of intelligent mobile applications and industrial intelligent applications. Students also delve deeper into embedded applications, wireless networks, and IoT communication, with a focus on Bluetooth modules, Wi-Fi communication, TCP transmission programming, and serial programming. Through hands-on projects in intelligent mobile applications, wireless networks, and IoT communication, students gain an in-depth understanding of IoT-related technologies. Additionally, projects related to smart gateway data processing are incorporated to further enhance students' practical abilities. This approach enables students to grasp the advantages of IoT-related technologies and application programs accurately [11]. In the process of teaching microcontroller integration innovation, teachers focus on improving students' hardware design and development capabilities. Students are encouraged

to participate in printed circuit board design competitions, develop diverse circuit boards independently, and apply them in sensor component integration [12,13]. Thirdly the teachers apply a cloud platform in teaching IoT engineering during the thesis and internship phases. By learning web front-end development, SSH framework, web service, and data visualization, students can master the methods of collecting, aggregating, calculating, and analyzing data. They then integrate this data into the cloud platform to construct a comprehensive IoT infrastructure. This approach enhances students' practical abilities in data analysis, IoT application, and project management [14]. Fourthly, competitions play a crucial role in IoT engineering programs to ignite student enthusiasm for practical learning and foster their innovation skills. Through these competitions, students become proficient in key technologies like data acquisition, visualization, and intelligent hardware design while honing their teamwork abilities. In recent years, our School of Information Engineering (Hainan University of Science and Technology) has organized various interdisciplinary competitions for IoT Engineering students. Leveraging local characteristics, students have developed projects such as the Intelligent Shanlan Rice Traceability System and ICU Intelligent Nursing Service System. This hands-on approach allows students to continuously refine their projects, resulting in valuable teaching and learning experiences [15]. Fifthly, we prioritize reforming the teaching system within our Internet of Things engineering program. We continuously refine and enhance our teaching system by establishing a 1 + 2 professional practice structure. This entails focusing on data transmission as the core practice in the foundational teaching system (1), while expanding into microcontroller integration and innovation towards the Internet of Things cloud platform (2). Through this approach, we aim to continuously adjust and improve our practical training methods to achieve the most effective outcomes.

4. Conclusion

Under the background of new engineering, cultivating excellent application-oriented talents is the core teaching goal of each specialty. To adapt to emerging trends, the IoT engineering field must emphasize practical teaching, conduct industrial research, actively pursue teaching reforms, and accurately address industrial needs. Through measures such as school-enterprise cooperation, adjusting teaching content, and diversified talent cultivation, students' practical abilities can be enhanced. This facilitates a deep connection between the industrial and educational sectors, ultimately producing high-level technical talents that meet industry requirements.

Disclosure statement

The authors declare no conflict of interest.

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