Research on the Practical Teaching Content of the Internet of Things Engineering under the Background of New Engineering

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Abstract. With the transformation and upgrading of China's industrial structure, the Ministry of Education has proposed the construction of new engineering disciplines. This article explores the practical teaching content of the Internet of Things engineering program under the background of new engineering. The model not only focuses on cultivating students' general education, professional foundation, and professional core knowledge, but also emphasizes the cultivation of students' engineering practical abilities. The article proposes a structure for interdisciplinary integration practice content in the construction of practical teaching content, and constructs a practical teaching content that conforms to the characteristics of the Internet of Things engineering program. Taking the practical teaching content of the Internet of Things engineering program at Shandong Xiehe University as an example, based on optimizing multi-disciplinary practical resources, a four-level practical teaching project has been established, which not only improves the quality of teaching, but also promotes industry development.

Keywords: New Engineering, Internet of Things Engineering, Practical Teaching, Interdisciplinary Introduction

1 Introduction

Since its proposal in 2016, the concept of "New Engineering" has formed the "Fudan Consensus" and "Tianjin Action" through in-depth discussions by universities, and in 2017, the Ministry of Education's office issued a notice on recommending new engineering research and practice projects (Ministry of Education Office of High Education Letter [2017] No.33.), determining the "New Engineering" plan[1]. The purpose of this plan is to actively respond to the new round of scientific and technological revolution and industrial transformation, accelerate the training of engineering technical talents in emerging areas, upgrade traditional engineering majors, actively layout the training of strategic future-oriented field talents, explore and establish new concepts, standards, models, methods, technologies, and cultures for "New Engineering" construction[2]. In 2023, the Ministry of Education stated in the "Adjustment and Optimization Reform Plan for General Education Discipline Specialty Setting" that we should deepen the

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construction of "New Engineering", focus on "new engineering majors, new requirements for engineering majors, and new interdisciplinary integration", promote the interdisciplinary integration of existing engineering majors and other disciplines, extend applied science to engineering, form emerging interdisciplinary majors, and cultivate new fields of engineering[3].

The origin of the Internet of Things (IoT) can be traced back to 1999, when American scientist Kevin Ashton proposed this concept to solve the problem of matching physical objects and information, and improve asset utilization[4]. Since then, IoT technology has continued to develop and innovate, and its application fields have gradually expanded, from initial industrial automation, smart homes, smart cities, to medical care, transportation, logistics, environmental protection, and other fields[5]. In terms of its development history, IoT technology has gone through multiple stages. In 2010, the Ministry of Education issued a document that explicitly stated that IoT technology should be classified as a national strategic emerging industry, and since then, many universities have applied and opened IoT engineering majors nationwide[6]. In 2023, the Ministry of Education announced in the "Notice on the Publication of the 2022 Annual General College Discipline Registration and Approval Results" that 7 new IoT engineering majors were added at 7 institutions nationwide, bringing the total number of IoT engineering majors to 560.

2 Internet of Things Engineering Knowledge System

2.1 Architecture of Internet of Things Engineering Knowledge

The construction of the Internet of Things engineering program has received widespread attention and promotion, and gradually formed a relatively complete teaching system and curriculum setting[7-8].

Internet of Things engineering is a interdisciplinary subject. In terms of curriculum setting, the Internet of Things engineering program involves multiple subject areas, including computer, electronics, communication, automation, etc., requiring students to master the basic theory, technology, and application of Internet of Things technology, and to possess professional skills in embedded system development, sensor technology, Internet of Things platform development and operation and maintenance. In terms of practical teaching, universities gradually increase the proportion of practical teaching, and improve students' practical ability and innovative spirit through experiments, course design, graduation design, etc. At the same time, many universities also cooperate with enterprises and research institutions to carry out practical teaching, providing students with more practical opportunities and employment channels.

The architecture of the Internet of Things engineering knowledge system is generally divided into four modules from bottom to top: general education module, professional basic module, professional core module, and application (cross) field module. The general education module mainly includes mathematical knowledge such as high mathematics and physics; programming knowledge such as C and C++; professional basic modules mainly include knowledge about hardware such as circuit and electronic technology, single-chip microcontroller principles, and database systems; professional core

modules mainly include perception and transmission knowledge such as sensors and detection technology; application (cross) field modules mainly include different knowledge areas according to different college characteristics and professional construction settings.

2.2 Knowledge Structure of Internet of Things Engineering under the Background of New Engineering

From the perspective of the knowledge structure of Internet of Things engineering, the Internet of Things is a network that realizes the connection between objects and the network through information terminal devices such as radio frequency identification (RFID) and infrared sensors, and information exchange and resource sharing according to certain protocols, in order to achieve intelligent identification, positioning, tracking, monitoring and management[9]. From the perspective of professional structure, Internet of Things engineering is a multi-disciplinary and integrated major[10]. Based on the background of new engineering, in addition to the knowledge architecture of basic general education, professional foundation, professional core and application (cross) field modules, it is necessary to optimize the cross-disciplinary redundant knowledge from four levels of perception, transmission, processing and application, and construct a theoretical and technical system for new engineering Internet of Things engineering. Secondly, it is necessary to design graduation requirements for students majoring in new engineering Internet of Things engineering from four aspects of quality, knowledge, ability, and value, and pay attention to practical teaching links to broaden students' subject perspective and professional orientation, and enhance their comprehensive engineering practice ability.

3 Practical Teaching Content of Internet of Things Engineering

3.1 Principles of Setting Up

Principles for talent cultivation: The establishment of practical teaching content should take into account overall and systematic considerations to comply with talent cultivation laws. The principle of organic integration: True "interdisciplinary integration" should not simply involve the superimposition of multiple courses. Instead, courses should be integrated, integrated, and innovated, based on research in application fields such as the medical industry and intelligent transportation, to achieve organic integration of multi-disciplinary knowledge and engineering applications. Principle of teaching laws: Follow the basic principle of "easy to difficult, consolidation and promotion, comprehensive mastery", and set up four levels of practical teaching content, including "basic experimental projects, comprehensive practical training projects, innovative practical projects, and post practical projects". Principle of professional characteristics: Multi-level practical projects involve experiments and comprehensive course designs in courses related to the Internet of Things and multiple disciplines, innovative training,

and related subject competitions, ensuring the integration of Internet of Things technology and multi-disciplinary applications, forming a "interdisciplinary IoT" characteristic.

3.2 Content Arrangement

Based on the principles of talent cultivation, organic integration, teaching laws, and professional characteristics, restructuring the four-level practical teaching content and incorporating subject competitions and enterprise participation is conducive to the cultivation of students' four-dimensional ability. Each practical project in each level is based on a specific field application, embedding domain-specific elements into Internet of Things course experiments, or integrating multiple scientific courses with Internet of Things courses for comprehensive course design, or integrating innovative training and related competitions for application system development, truly achieving interdisciplinary integration rather than simply superimposing courses, avoiding the phenomenon of "two skins" between other disciplines and Internet of Things engineering teaching.

4 Practical Application

Taking the Internet of Things engineering program at Shandong Xiehe University as an example.

4.1 Talent Cultivation

The Internet of Things engineering program at Shandong Xiehe University is based in Jinan, rooted in Qilu, and faces the whole country. It focuses on new engineering, aims at fields related to IoT data acquisition and perception data collection, data processing, and system operation and maintenance. It cultivates high-quality application-oriented talents with IoT-related theories, technologies, and information literacy, as well as the ability to integrate hardware and software systems and perform intelligent analysis of sensor data. They can work in the field of smart city construction, engaging in IoT planning and design, system architecture design, deployment, maintenance, sensor network application, and intelligent hardware development.

4.2 Practical Teaching System

The school-enterprise-academy tripartite cooperation has innovated an advanced practical teaching system. In the first two years, students mainly receive training in IoT professional skills and cross-disciplinary practical training, cultivating their awareness of IoT engineering and industry information literacy, and mastering the basic application of IoT technology in smart city construction. In the third year, students participate in comprehensive practical training projects created in cooperation with enterprises, cultivating their system development and data analysis abilities. In the fourth year,

students go for on-the-job internships in IoT enterprises and engage in innovative practice, cultivating their innovation ability.

4.3 Integration of Medical and Engineering Practical Teaching Projects

Based on the principles of talent cultivation and professional characteristics, a four-level practical teaching content is constructed, which includes "Basic Experimental Projects, Comprehensive Training Projects, Innovative Practical Projects, and Post Practical Projects". (see Fig. 1)

Basic Experimental Projects	Comprehensive Training Projects	Innovative Practical Projects	Post Practical Projects
Experimental courses within the major	Comprehensive professional course design	Medical and Engineering Integration Comprehensive Practice	Enterprise Practical Experience
Medical Courses and Laboratory Experiments	Medical and Engineering Integration Course Design	Innovation and Practice	Graduation Internship
Enterprise Perception Survey	Enterprise Experience	Professional Internship	Graduation Thesis
Academic Competition	Academic Competition	Academic Competition	Entrepreneurial Practice

Fig. 1. Four-level Practical Content

4.4 Promotion Value

Through research and application of practical teaching content for the Internet of Things engineering program in the context of new engineering, this can serve as a reference for the construction of a medical and engineering integration practical teaching model for related engineering majors in undergraduate institutions, providing new ideas for project-based practical teaching. It promotes the transformation from single-discipline to multi-discipline, multi-field integration and cross-domain joint training, shifting from "individual effort" to "collective efforts". This integrates high-quality educational resources across disciplines, deepens interdisciplinary integration, further enhances the level of education, and continuously promotes innovative development of engineering and medical education. It also promotes the optimization and upgrading of medical industry and service industries, and contributes to the construction of a healthy China.

5 Conclusions

Practical teaching content is very important for major construction because practice is the application and verification of theoretical knowledge, and an important link in cultivating students' practical operating abilities and innovative spirit. For the Internet of Things engineering program in the context of new engineering, research on practical

teaching content can discover the gap between basic theoretical knowledge and practical cross-application fields, providing feedback and guidance for major construction and reform, and promoting the sustained development of the major.

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