Reform and Research on Practice Teaching of Internet of Things Engineering

JieQiong Han
School of Information Science and Technology
Zhongkai University of Agriculture and Engineering
Guangzhou, China

ZhiHuang Liu*
School of Applied Mathematics
Guangdong University of Technology
Guangzhou, China

Abstract—**In 2010, the Ministry of Education officially approved the qualification of 27 higher education institutions in terms of Internet of Things. In 2013, Zhongkai University of Agriculture and Engineering added Internet of Things Engineering and accepted students from all over the country. In the first two years, the University copied and explored major and curriculum construction, and after years of hard work, it has actively combined with its software and hardware resources as well as the actual ability and level of students in the teaching reform and practice of relevant professional courses and accumulated relevant experience and lessons. The University is willing to share experience and communicate with all peer universities.**

Keywords—curriculum system; knowledge structure; talent training; teaching reform

I. INTRODUCTION

As specified in the 2011 government work report, it is necessary to accelerate the cultivation and development of strategic emerging industries, including the active development of the new generation information technology industry, construction of the high-performance broadband information network, acceleration of the three-network integration process, and the pilot application of the Internet of Things, and it is necessary to comprehensively strengthen the work of talents, that is, emphasis should be laid on high-level and high-skilled talents, and the pace should be accelerated to cultivate a large number of innovative scientific and technological talents and urgently needed talents.

In order to speed up talent training for Chinese emerging industries, the Ministry of Education published the recording or approving results on the major setup of higher education institutions in 2010 (Jiao Gao [2011] No.4) to approve the setup of majors related to "Internet of Things" in 27 higher education institutions, which began to officially recruit students

in 2011. By 2019, students after the college entrance examination can fill the intention for Internet of Things Engineering of 460 higher education institutions.

II. STATUS OF INTERNET OF THINGS ENGINEERING

As a provincial un iversity, Zhongkai University of Agriculture and Engineering has advantages in agriculture and engineering and insists on coordinated development of agriculture, engineering, science, economics, management, literature, art, and law. The University located in Guangzhou, a famous historic and cultural city, has two campuses in Haizhu and Baiyun, 17 secondary colleges and 55 majors. The College of Information Science and Technology first set up the technical direction of Internet of Things in 2011, and after two years of exploration and learning, it added Internet of Things Engineering in 2013 and recruited 79 students in 2 professional classes from all over the country. The College of Information Science and Technology began to classify students into categories of electronic information and computer in 2014 for recruitment and include Internet of Things Engineering in the category of electronic information. In 2017, the College included Internet of Things Engineering into the category of computer, but in 2019, it recruited students again by major, and there are 592 students at present. According to the identification of major orientation in the fourth semester, Internet of Things Engineering is favored, and there are basically four classes for each grade.

III. CURRICULUM SYSTEM

With distinctive characteristics of comprehensiveness, inter-discipline and applicability, Internet of Things Engineering attaches importance to theory, practice, discipline basis, inter-discipline, and innovative and entrepreneurial capabilities.

Based on computer, Internet of Things Engineering is an inter-discipline of computer, communication, electronics, and automation, which is applied to various industries and fields. The high education institutions with different professional backgrounds and discipline characteristics are of significant differences in the curriculum system so that students have different knowledge systems.

Internet of Things Engineering courses are classified into four course platforms, namely general course platform, basic

course platform, professional course platform, and practice teaching platform. Core professional courses include C Language Programming, Circuit and Electronic Technology, Computer Network, SCM Theory and Application, Internet of Things Technology and Application, FRID Theory and Application, Wireless Sensor Network Theory, Sensor Theory And Application, Embedded System Theory and Application, Cloud Computing Technology, Internet of Things Mobile Application Development, Internet of Things Control Foundation, and Big Data Technology.

IV. REVISION OF TALENT TRAINING PLAN

The University revises the talent training program with a view to further deepening education reform, implementing innovation and entrepreneurship education, optimizing the talent training process, building a characteristic, innovative and diversified applied talent training model and cultivate high-quality applied talents with innovative spirit and entrepreneurial awareness in the new situation.

The talent training program is the standard document on the learning contents for talent training in higher education institutions, so the scientific and rational talent training program is the premise of talent training and plays an important role in teaching management, and the improved level and quality of the talent training program decide the success of talent training. The talent training program is revised based on interviews with enterprises and reference to the National Standard on the Teaching Quality of Higher Education Institutions, and Knowledge System and Curriculum Planning of Internet of Things Engineering of Higher Education Institutions. The revision is employment-oriented and guided by the advanced applied talent training principle, which follows the talent training idea of solid foundation, broadened caliber, reinforced quality, strengthened ability, and prominent characteristics and emphasizes practice ability and comprehensive quality.

The talent training program should be revised in full accordance with the education policy of the Communist Party of China and in the principle of moral education. It is necessary to refresh the education idea and reform the applied talent training model as well as innovation and entrepreneurship education. Based on the top-level design of the whole process of talent training teaching, the research level and quality should be improved comprehensively through research and reform to promote the overall quality of teachers and students. It is necessary to carefully design the talent training program and establish a diversified high-quality applied talent training curriculum system based on professional education as well as strengthened and integrated innovation and entrepreneurship education. Starting from the revision of the talent training program, the collaborative education channels should be expanded to integrate industry and education and diversify talent training through multiple channels.

The program is revised in the following aspects:

(1) The professional curriculum system reduces class hours of theoretical courses and increases class hours of practice in combination with the actual teaching;

(2) The revision with active response to "mass entrepreneurship and innovation" develops the second classroom for students and actively guides students to participate in relevant discipline competitions to train their innovative consciousness, innovative ability and practical ability;

(3) Combined with the actual situation of the University and students, the revision actively explores the university-enterprise cooperation mode suitable for the development of the major and introduces a two-way double-effect evaluation mechanism to truly invite enterprise experts and help students connect with society.

Internet of Things Engineering graduates will have a solid foundation of natural sciences, humanities and social sciences and comprehensive ability of foreign language. They will systematically master the basic theoretical knowledge, including Internet of Things technology, basic principles and applications of computer software and hardware, circuit theory, embedded technology, and sensor detection technology, as well as the basic methods of system analysis and design in Internet of Things applications to develop their basic ability to research, design and develop sensor networks, design and develop intelligent information processing system and embedded system.

V. PRACTICE TEACHING REFORM

In 2013-2014, due to the lack of relevant experience, the curriculum and talent development program of Internet of Things Engineering learned from other universities and had some problems in the implementation of the talent training program. After years of exploration and summarization, combined with the situation of employment of Internet of Things Engineering graduates, the idea and experience have been gradually formed and summarized that are suitable for the major development. Combined with software and hardware resources as well as the knowledge and ability level of Internet of Things Engineering students, the University scientifically and rationally has developed a talent training program suitable for its development to implement and respond to the national strategy of innovation-driven development, meet the development trend of mass entrepreneurship and innovation and integrate double creative talent education into the whole talent training process with a view to comprehensively improving the innovative thinking and spirit as well as the entrepreneurial awareness and potential of students.

Practice teaching includes experiment, cognitive practice, curriculum design, graduation practice, graduation design, and extracurricular practice to train the theoretical and practical ability, innovative and entrepreneurial awareness, and technical ability of students.

A. Curriculum Experiment

At present, the teaching of Internet of Things Engineering includes theoretical teaching and experimental teaching. The reform of experimental teaching increases the class hours and proportion of experiment and teachers are required to actively reform the teaching content and mode. The experimental contents are required to increase the proportion of design-based

comprehensive experiments and reduce the proportion of verification-based experiments to increase the practice opportunities and ability of students. As a result, the experiments are increased from 8 class hours to 16 class hours, and at present the class hours and proportion of practice are basically more than 30%. The experimental class hours for practical courses such as mobile terminal development of Internet of Things and web programming have reached 50%.

B. Curriculum Design Reform

The professional courses of Internet of Things are designed in the following principle: after relevant theoretical courses are completed, two-week curriculum design is added in addition to the practical ability training completed in the experimental course. Based on the courses learned, 2-week comprehensive curriculum design is completed to transform relevant theoretical knowledge learned into practice to strengthen the practice process, train the innovative consciousness and idea of students, improve their entrepreneurial ability, and further strengthen their practical ability. At the same time, teachers are required to strictly control the quality, attention is paid to process evaluation, and presentation and defense are added to evaluate the participation of students in curriculum design and their project completion so that more rational and impartial scores can be given in accordance with student attendance.

C. Graduation Practice Reform

Internet of Things Engineering students start their graduation practice in the eighth semester and determine their topic of graduation design. The companies or enterprises for the practice of Internet of Things Engineering students must be related to the major, and the students are required to practice at the same enterprise for more than 7 weeks. Graduation design should be started in the eighth semester, and the work content and task of each time node should be determined around the whole process of graduation design (thesis), including collection and selection of topics, assignment of tasks, submission of thesis proposal, design stage, thesis stage, first draft of thesis, revision and supplement of thesis, check, submission, defense, printing and filing of thesis.

The selection of topic is the premise of good graduation design (thesis). In principle, one student selects one topic for graduation design, which should be closely related to Internet of Things Engineering. Students should actively research and application of key technologies of Internet of Things. The topic should reflect the goal of the major, combine production, scientific research and experiment, have certain application value and prospects. The topic with appropriate difficulty should encourage students to actively innovate.

VI.   UNIVERSITY-ENTERPRISE COOPERATION

Base on the advantages and effective resources of the University and enterprises, industry and education are actively integrated for collaborate education, and enterprise mentors are hired to participate in the curriculum construction and major construction of Internet of Things Engineering. On the other hand, the University is responsible for the education of students, so the enterprises involved in the curriculum design process are

strictly controlled to resolutely prevent formalized perfunctory cooperation, teachers are required to participate in curriculum design, and the shift system ensures available teachers at each class to effectively supervise and manage the entire process and take the opportunity to learn professional technologies.

Enterprises provide the hardware platform resources required for practical training, while the University provides the venues for the teaching activities. Enterprise engineers impart the contents of practical training, while teachers provide effective professional guidance to the students. The task or project arranged in practical training is checked and accepted on site, and each student or each group of students need to make immediate presentation and defense so that all students can participate in the learning process and thus continuously improve their professional knowledge and practical ability, accumulate project development experience and strengthen their competitiveness.
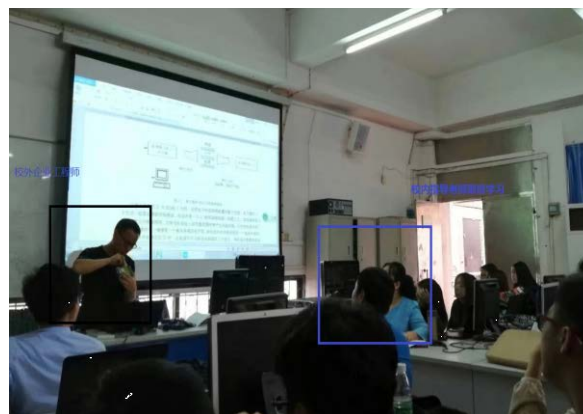

Fig. 1.   Enterprise engineers impart practical knowledge

VII. CONCLUSION

After years of exploration and practice, Internet of Things Engineering closely combines with applied talent training, actively reforms teaching contents and methods, deeply integrates modern information technology and education, optimizes the practice teaching system, increases the class hours and proportion of practice, and actively carries out social practice, extracurricular scientific and technological innovation as well as entrepreneurship education and exploration to train the innovative and entrepreneurial quality and ability of students and integrate innovation and entrepreneurship education into the whole process of talent training with a view to improving their practical ability, innovative spirit and awareness, entrepreneurial ability, and problem-solving ability.

After years of hard work, the University has greatly improved the talent training quality of Internet of Things Engineering, with the initial employment rate up to 98%. Internet of Things Engineering was evaluated as a provincial engineer major, excellent major and university-level characteristic major respectively in 2015, 2018 and 2019. Since 2013, the major has obtained 14 research projects, 10 teaching research and reform projects from the Department of Higher Education of Ministry of Education and Guangdong Province, and more than 7 university-level teaching research and reform

projects, with more than 12 provincial and university-level quality resource sharing courses opened and 3 textbooks developed and published. In addition, it has obtained 2 university-level teaching achievement awards and more than 50 national intellectual property rights. Students have participated in various discipline competitions, and more than 100 awards have been granted to more than 200 students (there are 592 Internet of Things Engineering students). At the same time, they have won the first prize of the Guangdong Robot Competition and two special prizes of China Education Robot Final, breaking the monopoly of 211 and 985 universities. In addition, they have applied for more than 50 national and provincial innovative and entrepreneurial projects of university students. Through the preparation for discipline competitions and practice of innovative projects, students have greatly improved their practical ability.

REFERENCES

[1] Teaching Guidance Committee for Computer Science and Technology of Higher Education Institutions of the Ministry of Education. Practice Teaching System and Norms for Internet of Things Engineering in Higher Education Institutions [M]. Beijing: China Machine Press. 2012: 61-64.

[2] Cai Chang'an. Construction of Practice Teaching System of Internet of Things Engineering Based on CDIO [J]. Education Exploration, 2015(6).

[3] Ge Wenjie, Zhao Chunjiang. Research and Application Status and Development Measures of Agricultural Internet of Things [J]. Transactions of the Chinese Society for Agricultural Machinery, 2014(7): 222-230.

[4] Che Wei. Research on the Status Quo of Internet of Things Industry [J]. Electronic Technology & Software Engineering, 2015(19): 38.

[5] Yao Hong, Liang Qingzhong, Zeng Deze et al. Integration and innovation of Experimental Teaching Contents in Network Engineering (Internet of Things) [J]. Journal of China University of Geosciences (Social Sciences Edition), 2014 (supplement 1): 46-48.