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Construction and Effect Evaluation of the Project-based Teaching Model for the Internet of Things Major in Colleges and Universities

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Abstract: With the rapid development of Internet of Things (IoT) technology, the social demand for IoT professionals is constantly increasing. The project-based teaching model has become an important path for the teaching reform of the IoT major by enhancing students' practical ability, teamwork ability, and innovation awareness. This article analyzes the existing problems in the IoT major in colleges and universities, explores the construction method of the project-based teaching model, and evaluates its effects in improving students' comprehensive quality, enhancing their employment competitiveness, and promoting teaching reform. The research shows that the application of the project-based teaching model in the IoT major in colleges and universities has significant positive impacts.

Keywords: Internet of Things major; Project-based teaching model; Teaching effect evaluation

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1. Introduction

IoT technology is widely used in fields such as smart homes, intelligent transportation, and smart cities, driving the growth of demand for related talents. The IoT major in colleges and universities plays a crucial role in cultivating technical talents, and its teaching quality directly affects the development of the industry. However, currently, there are some problems in the curriculum settings and teaching methods of the IoT major, which affect the effectiveness of talent cultivation. Therefore, it has become an important issue to be solved urgently to adopt the project-based teaching model for reform and improve teaching quality.

2. The necessity of project-based teaching

2.1. Meeting the actual needs of the industry

With the rapid development of IoT technology, the IoT industry has become an important pillar of the national economy. As a key base for cultivating talents, the teaching quality of the IoT major in colleges and universities

is directly related to industry development and talent supply [1]. The current traditional teaching model mainly focuses on theory, and the experimental and practical activities that students participate in often cannot reflect the actual working environment of modern enterprises. This gap makes it necessary for students to re-integrate their knowledge after entering the enterprise. The project-based teaching model allows students to participate in real IoT projects, enabling them to better understand technology applications and actual needs and laying a foundation for their future careers.

2.2. Stimulating learning interest and motivation

The traditional teaching model often emphasizes the imparting of theoretical knowledge and ignores students' interest in learning and motivation. The project-based teaching model, by introducing actual enterprise projects, can let students feel the value of the knowledge they have learned in actual work, thus enhancing their learning interest and enthusiasm [2]. In projects, students can not only acquire knowledge but also cultivate their abilities of autonomous learning and problem-solving, stimulating their passion for learning and facilitating their better adaptation to the future working environment.

3. Problems in the Internet of Things major in colleges and universities

3.1. Differences in students' adaptability

The IoT major in China started relatively late, and the IoT major courses in many colleges and universities are still in the exploration stage. Since the IoT involves multiple disciplinary fields, such as computer science, communication, and electronic technology, there are significant differences in students' knowledge backgrounds and abilities [3]. Some students can quickly adapt to the project-based teaching, understand and apply interdisciplinary knowledge for project development, while others find it difficult to cope with the technical depth and interdisciplinary integration, lacking the necessary basic knowledge and practical operation experience [4].

3.2. Insufficient teaching staff

At present, there are certain shortages in the teaching staff of the IoT major in many colleges and universities. Since the IoT discipline involves multiple fields and the major in many colleges and universities has evolved from old majors such as electronic information, communication, and computer, these colleges and universities often lack teachers with rich industry-practice experience. Many teachers have a solid theoretical foundation but lack practical application experience and project-practice guidance ability in the IoT field. In the project-based teaching model, teachers not only need to master theoretical knowledge but also should have rich industry experience and the ability to solve practical problems [5, 6].

4. Construction of the project-based teaching model

In response to the problems existing in the IoT major in colleges and universities, the project-based teaching model provides an effective solution. The project-based teaching model emphasizes student-centered learning. By participating in real IoT projects, it closely combines theoretical knowledge with practical operations, cultivating students' practical operation ability, teamwork spirit, and innovation awareness [7]. The following are the construction methods of the project-based teaching model.

4.1. Curriculum design

The curriculum design of the project-based teaching model should focus on strengthening the close combination of theory and practice, aiming to improve students' operational ability and innovation awareness. The curriculum design of the IoT major needs to be planned based on the actual application of technology to ensure that students can master theory and solve practical problems while completing project tasks. For example, basic courses such as Introduction to the Internet of Things, Sensor Technology, and Wireless Communication Technology should lay a solid technical foundation for students [8]. At the same time, the curriculum arrangement should avoid content repetition or omission to ensure the coherence of knowledge points. When designing the curriculum, the curriculum content should be adjusted in real-time according to the development trend of IoT technology and industry needs to ensure that students can master current and future technologies. The practical link is an important part of the curriculum design. The curriculum should include practical case studies and project-practice links. The experience students gain from practice can help them better understand theory. In addition to basic courses, interdisciplinary integration should also be part of the curriculum design. For example, in fields such as embedded system development and big-data analysis, the curriculum can combine the technologies of computer science and communication engineering to help students comprehensively master the interdisciplinary knowledge system. The curriculum design should also pay special attention to cultivating students' innovation awareness and independent thinking ability. It is not only necessary to let students learn how to use technical tools but also to help them understand the principles behind the technology and learn how to put innovative ideas into practice [9]. Through curriculum setting and adjustment, students can not only master the core knowledge of IoT technology but also enhance their ability to solve practical problems.

4.2. Project implementation

The project implementation link directly determines the improvement of students' practical ability. As shown in **Figure 1,** "Framework Diagram of Project Implementation Process," during the implementation process, teachers need to design IoT projects with strong challenges and close to industry needs. The project themes should be combined with application scenarios such as smart homes, intelligent transportation, and smart healthcare, with practical operation and application value. These projects should not only include the technical implementation process but also simulate actual work problems to help students quickly respond and find solutions when facing real-world problems [10]. For example, in a smart-home project, students need to design a sensor network to achieve intelligent control of the home environment, carry out actual wiring and testing, and simulate a complete IoT application. This project-driven learning method allows students to understand theory through hands-on operations, cultivating their practical ability and innovation spirit. During the project implementation process, the role of teachers changes from knowledge transmitters to guides and problem-solvers. Teachers should provide guidance when necessary to help students overcome technical difficulties and ensure the smooth completion of projects. The cooperation among students is also crucial. Teachers should cultivate students' team awareness, communication ability, and comprehensive problem-solving ability through teamwork. To this end, teachers should provide continuous feedback according to the progress of the project, pay attention to students' teamwork and technical implementation, and adjust teaching strategies promptly. During the project implementation process, students' self-learning ability and innovation ability are fully exerted. They can not only learn advanced technologies but also improve their ability to solve complex problems through the actual challenges in the project [11].

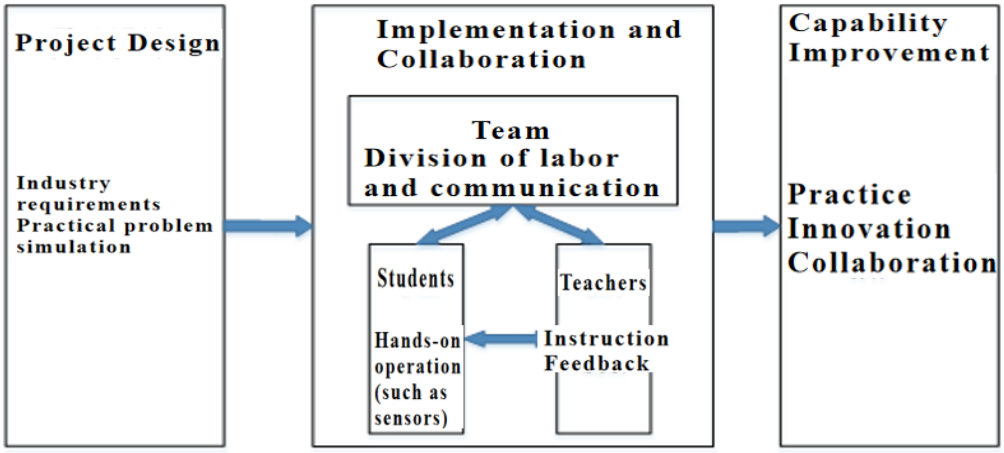

Figure 1. Framework diagram of project implementation process.

4.3. Teaching evaluation

In the project-based teaching model, teaching evaluation should not only examine students' mastery of theoretical knowledge but also comprehensively evaluate their practical ability, innovation ability, and teamwork ability. The evaluation should run through the entire learning process, from the initial stage of project implementation to the final result presentation, and each link should be evaluated in a timely and effective manner. Specifically, teachers can evaluate students' performances in technical mastery, project management, teamwork, etc. through methods such as evaluating the mid-term progress of projects, students' project reports, and result presentations. For example, in a smart-home project, students need to show the system architecture and code implementation they designed, and teachers can evaluate students' technical depth and problem-solving ability through actual demonstrations [12]. Different from traditional examinations, project evaluation pays more attention to students' comprehensive abilities. Therefore, the evaluation methods should be diversified, and a comprehensive assessment should be carried out by combining students' performances, teamwork situations, and innovation achievements. In addition, during the evaluation process, teachers should also pay attention to process-based evaluation, that is, pay attention to students' performances throughout the project implementation, and provide timely feedback and guidance instead of relying solely on the final results for evaluation. Such process-based evaluation can help students discover their shortcomings and promote their improvement and progress in practice. Moreover, the evaluation is not limited to the one-sided evaluation by teachers. Students' self-evaluation and peer-evaluation should also be important components. Self-evaluation prompts students to reflect on their learning process, and peer-evaluation can enhance communication and cooperation among students, helping them understand their advantages and disadvantages from different perspectives [13]. Through a comprehensive evaluation system, teachers can comprehensively understand students' ability levels and provide valuable feedback for the next step of teaching improvement.

5. Effect evaluation of the project-based teaching model

5.1. Improving students' comprehensive quality

The project-based teaching model effectively improves students' comprehensive quality by allowing students to participate in real IoT projects and closely combining theoretical knowledge with practical operations. During

the project-practice process, students need to use the knowledge they have learned to solve practical problems, which not only exercises their hands-on ability and practical skills but also cultivates their innovative thinking and problem-solving ability. Project practice also requires teamwork and communication among students, which helps to improve students' teamwork spirit and communication ability [14]. By participating in project practice, students can have a deeper understanding of the application scenarios and implementation methods of IoT technology, strengthening their understanding and mastery of IoT technology.

5.2. Enhancing employment competitiveness

With the widespread application of IoT technology and the rapid development of the industry, the demand for IoT professionals is increasing. The project-based teaching model enables students to better adapt to market demands and industry development by cultivating their practical operation ability and innovation awareness. By participating in real IoT projects, students can accumulate certain project experience and work experience, improving their employment competitiveness. In addition, the project-based teaching model can also promote the cultivation of students' autonomous learning and lifelong learning abilities, laying a solid foundation for their future career development. In the job market, IoT professionals with practical experience and innovation abilities are more favored by enterprises. Therefore, the application of the project-based teaching model helps to improve students' employment rate and employment quality.

5.3. Promoting teaching reform and innovation

The application and promotion of the project-based teaching model not only improve students' comprehensive quality and employment competitiveness but also promote the teaching reform and innovation of the IoT major in colleges and universities. Through project practice, teachers can have a deeper understanding of students' learning needs and interests, thereby optimizing the curriculum content and teaching methods. At the same time, project practice can also promote communication and cooperation among teachers, driving the update and improvement of teaching content [15]. In addition, the project-based teaching model can stimulate students' innovative thinking and creativity, providing a continuous source of motivation for the innovation and application of IoT technology. During the project-practice process, students can discover, analyze, and solve problems, thus cultivating their innovation awareness and practical ability. The application of this teaching model helps to promote the teaching reform and innovation of the IoT major in colleges and universities and improve the quality of talent cultivation.

6. Conclusion

The application of the project-based teaching model in the IoT major in colleges and universities provides new ideas for the reform of the traditional teaching model. By participating in actual projects, students can better master IoT technology, improve their operational ability, innovation awareness, and enhance teamwork and communication abilities, thereby enhancing their employment competitiveness. However, during the implementation process, problems such as insufficient teaching resources and unreasonable curriculum settings still need to be solved. In the future, colleges and universities should continue to explore and optimize the project-based teaching model to make greater contributions to the cultivation of high-quality IoT talents.

Disclosure statement

The authors declare no conflict of interest.

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