Open classroom organization and implementation：A Case Study of "Introduction to Radio Frequency Identification and Internet of Things"

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Abstract. Introduction to Radio Frequency Identification and Internet of Things"is an elective course offered to all students in the school, so student's major are relatively complex; the course belongs to interdisciplinary fields, which results in a relatively large teaching content for this course. The traditional teaching mode cannot cover the knowledge points of the subject within 32 class hours, nor can it meet the learning needs of students from different majors. Therefore, it is necessary to change the existing teaching methods to meet the needs of course implementation. Open classroom is a course organization model in which teachers use methods such as collaborative exploration, cooperative learning, and heuristic teaching in the classroom. The classroom has high knowledge density, flexible teaching methods, and encourages knowledge exchange between students and between teachers and students. It is particularly suitable for the interdisciplinary technical characteristics and the course characteristics of elective courses. Teaching practice has proven that after adopting open classrooms in this course, students' learning enthusiasm and knowledge perspectives have greatly improved.

1 Introduction

In response to the new round of technological revolution and industrial transformation, and to support a series of national strategies such as service innovation and driving development, the Chinese government has proposed the goal of EEE (Emerging Engineering Education) and set construction standards for it. The EEE advocates taking moral education as the guide, responding to changes and shaping the future as the notion, and inheriting and innovating, crossing and integrating, coordinating and sharing as the main ways to cultivate future diversified and innovative outstanding engineering talents.[1] Compared with traditional educational goals, its biggest difference is that it emphasizes the importance of cultivating compound and innovative talents, and focuses on cultivating students' adaptability and collaboration abilities.Traditional on-feeding methods clearly cannot meet society's expectations for university education.

Under the traditional teaching mode, the organizational model of teacher led classroom is still followed, where the teacher either explains to the end and students fully accept it without thinking; Either the teacher asks questions throughout the entire process, leaving the students exhausted and circling around the teacher's questions; Or divide the course content into modules to for student discussions, ignoring the interconnectedness between subjects. Once students exceed the content of the modules, teachers always need to cleverly bring the focus back to the modules. These teaching methods may seem diverse, but the fact that the classroom is still led by the teacher has not changed. Therefore, the subjective initiative of students in learning has not been fully mobilized, and the subjectivity of students in teaching has not been fully reflected; The enthusiasm of students to actively improve their knowledge structure and cultivate innovative abilities based on their own needs has not been fully mobilized, which not only fails to meet the requirements of new engineering disciplines, but also inevitably leads to insufficient teaching effectiveness. When facing interdisciplinary teaching such as the RFID (adio Frequency Identification) and IoT (Internet of Things), especially in elective courses without restrictions on major, the drawbacks of traditional teaching are undoubtedly exposed. Therefore, new teaching models are needed to replace traditional teaching methods, and open classrooms are a better choice.

Open classroom is a classroom organizational form in which teachers use methods such as collaborative exploration, cooperative learning, and heuristic teaching to cultivate students' abilities to think independently, explore collaboratively, and analyze and solve problems from multiple perspectives. It is a model that focuses on cultivating students' innovative abilities. The students hold the cards in classroom, to learn and solve problems with teachers, it is better teaching modles in line with the subjectivity of students and the tutoring functions from teachers in the learning and ability development. This is

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also a teaching model that is more in line with the laws of learning and the requirements of EEE.

Introduction to RFID and IoT "is an elective course for the whole school. As an introductory course for other majors to understand and apply RFID technology. The majors of students are relatively complex, and the background knowledge of classmates in the class are also different. RFID and IoT, as emerging interdisciplinary application technologies mean that their system covers a wide range and their technology updates are fast. The characteristics of open teaching and the IoT, the course nature and the specificity of the teaching objects, are very compatible, it is the objective basis for open teaching in this course.

Taking the teaching situation of this course in the next academic year of 2022 as an example, students come from 17 majors, which can be divided into 9 major directions according to major categories. The students who choose courses generally cover various aspects of civil aviation transportation, which is also a typical field of IoT technology application and students have good learning needs. Different disciplines imply different Thinking mode and knowledge systems, and teachers need to meet the Knowledge demand and acceptance abilities of students in different majors when teaching. These differences often become obstacles to traditional teaching models, but they are advantages of open classroom teaching models.

Table 1. Statistics of Electors

semester	Major								
	EE	CS	ME	LA	ATS	MBA	Law	EPA	OTS
2021	11	14	10	8	4	3	3	3	4
2022	10	9	9	10	7	4	4	2	5
2023	8	7	9	11	8	7	4	3	3
2024	8	9	8	10	8	7	4	3	5

2 Plan of open classroom

Wu Chunlai believes that an open classroom should be a "five more classroom", which means "going to the students more, asking them more questions, showing them more, letting them think more, and having them discuss more"; Therefore, giving up classroom leadership does not mean a reduction in the requirements and responsibilities of teachers, but rather a higher demand for their knowledge scope and classroom preparation. [2] Open classroom not only requires a reorganization of teaching content and classroom structure, but also requires teachers to modify course resources and to adjust in teaching mentality, it means more knowledge reserves and a more open mindset.

The construction of an open classroom is mainly carried out from four aspects: teaching philosophy, teaching content, teaching methods, and evaluation indicators whitch supports the foundation of the openness of the course. The open teaching philosophy aims to transform teaching ideas, with students as the main body, focusing on the dialectical relationship between teaching and learning, fully mobilizing students' subjective initiative, and improving teaching efficiency. The openness of teaching content refers to the fact that the course content should not be limited to textbook knowledge, nor should it be limited to existing technologies, it should also include the development trends of IoT technology and potential breakthrough application directions as teaching content, so that the course has high timeliness and practicality. The transformation of teaching philosophy, content, and methods inevitably requires the openness of assessment methods; the open assessment method avoids the unfairness caused by a one-size-fits-all exam to students with different knowledge backgrounds, and also facilitates inspiring students to use IoT knowledge to conduct in-depth research on the application of their professional direction, strengthen what they have learned by using.

2.1 Open teaching philosophy in the context of Emerging Engineering

Open classroom first requires an open teaching philosophy. Psychology shows that a happy and relaxed mood is beneficial for students to maintain their subjectivity and creativity, achieve the unity of conscious and unconscious, and thus unleash enormous learning potential. Therefore, the essence of open teaching is to construct a teaching model that respects students' individuality as the main feature and aims to cultivate students' subjectivity and creativity. [3] In this mode, teachers and students are harmonious and equal, growing together in teaching and creating a pleasant and relaxed teaching environment. The teaching methods and Learning-Evaluation methods should also break away from the traditional cramming teaching mode and establish a new mode with equal participation and open conclusions between teachers and students.

Encourage students to draft their own questions and design their own plans to become the main body of the classroom. As classroom managers, teachers act as "consultants" and "reviewers" for students to design plans, transforming passive learning into active learning and absorbing teaching into exploratory research.

2.2 Open teaching content

The Internet of Things, as an interdisciplinary technology, includes AI, big data, and intelligent sensors in terms of technology, covering logistics and warehousing, unmanned factories, and smart homes in terms of industry. It is impossible to cover all the content in a 32 hour course. By organizing course content to fan out from point to area through specific application cases, students can have a comprehensive understanding of the course content even under the premise of limited prerequisite courses. The course adopts a thematic organizational form in content design, decomposing the course content into 9 topics and using case studies to establish an engineering technology map of IoT applications, including 7 technical topics and 2 design cases, including IoT concepts, RFID technology architecture and middleware technology, intelligent sensor technology, WSN network and protocol, etc. Covering the three-layer structure that constitutes the Internet of Things, students can also gain a comprehensive understanding of IoT applications through these case studies. Especially in the case of civil aviation applications, it is conducive to inspiring students to consider the application scenarios and implementation paths of the IoT in their own fields based on professional requirements.

The course content revolves around the civil aviation industry. The whole class voluntarily formed more than ten research groups, covering topics such as airport management, aviation materials, aircraft maintenance, cargo transportation, personnel management, etc., with the goal of designing an information construction plan based on the IoT.

By designing thematic course content in a concise manner, the curriculum system is made more compact. It can not only introduce the full picture of the Internet of Things to students, but also cater to the acceptance and needs of students from different majors, cultivating students to think about the prospects and solutions of Internet of Things applications with an open mind.

2.3 Open teaching methods

Diversified teaching content requires corresponding teaching methods to achieve, and open teaching methods are the inevitable result of the openness of teaching content and the direct embodiment of the concept of open teaching. The core of open teaching is to create a pleasant, equal, and positive classroom teaching environment for students' physical and mental well-being. Therefore, it is particularly crucial to change the traditional classroom organization form centered on teaching and establish a relaxed and flexible classroom atmosphere. In the teaching of the course "Introduction to RFID and IoT Technology", the main improved teaching methods used are: teacher-student dialogue teaching, group discussion teaching, and case design teaching.

2.3.1 Dialogue teaching between teachers and students

Different from Student-centered teaching mode including the teachers' one-way teaching and flipped classroom, Dialogue classroom is the teaching form that emphasizes equal participation and two-way communication between teachers and students. The teacher-student dialogue teaching is led by the teacher to ensure the progress of the course, while also taking into account the learning difficulty of students with different knowledge foundations. In teaching, teachers create topics according to the requirements of the curriculum, guide students to participate in discussions, and gradually demonstrate knowledge from low to high levels by teacher-student communication. In communication, it is important to guide students to actively expose their thinking processes, which can not only deepen their understanding of knowledge from the source, but also inspire each other. Taking the "Internet of Things structure" as an example, the following can be designed: ① Let students try to explain the simple hierarchical structure of the Internet; ② Guide students to understand and discuss the functions of these hierarchical structures; ③ Discuss the main functions of the IoT based on practical applications; ④ Guide students to compare the functions of the Internet and the IoT, and inspire them to discuss what kind of hierarchical structure is needed to support functions of Internet and IoT;⑤ What are the differences in functional requirements between the IoT and the Internet, and the resulting structural differences ⑥ Discuss which disciplines and technologies are needed to support or implement each layer of the IoT. In a conversational classroom atmosphere, students discuss problems in a relaxed manner - both expressing their own opinions and evaluating others' viewpoints. They are not afraid of making mistakes and can enjoy the pleasure of showcasing themselves, greatly improving their initiative and sense of achievement in learning.

2.3.2 Group-discussion teaching

Group-discussion teaching is a classroom teaching method mainly based on students' free communication. Teachers can group students according to their major, or allow students to freely combine. Students can engage in collaborative learning based on the topics, knowledge points, or chapters set by the teacher according to the course schedule. [6] In discussions, different perspectives can be presented on the same issue, and others' viewpoints can also be borrowed to compensate for one's own knowledge deficiencies. This is particularly suitable for cross disciplinary school elective courses. This teaching method cannot be used alone for the entire lesson, and can usually be used as a teaching tool for knowledge summarization, otherwise there may be problems such as classroom disorder and lack of focus on topics. This model can be adopted in summarizing the industrial IoT. Students from different major can combine their knowledge of industrial IoT with the characteristics of their respective major to plan the solutions of industrial IoT suitable for different manufacturing industries. In group discussions, group members can freely express

themselves and break through their own knowledge limitations, absorbing new perspectives of the other major.

2.3.3 The Case Teaching Method

As a course that focuses on industrial practice, using case design to cultivate students' hands-on ability and innovative thinking is an inevitable choice. Case teaching is presented as part of the course assignment, and there are two modes: one is the teacher's design of a reproducible case based on the course content, mainly including two: "AGV System Design" and "RFID based Aviation Material Management System Design"; One is exploratory case design by students combined with their own majors and Students can freely form teams to complete case designs. The reproducible cases set by teachers will provide more standardized design goals and ideas, and students will design schemes and module divisions based on the design goals and teachers also encourage students to make innovative modifications to the schemes. Taking the case of "AGV System Design" as an example, students have shown high enthusiasm and broad thinking. Some studentsdesign automatic sorting carts based on the characteristics of express sorting, while others can design automatic aircraft tractors based on airport application environments and also provide reasonable improvement plans according to the constraints in details. Exploratory case design is rich and colorful, and students propose various IoT application solutions based on their majors.

2.4 Open Exam Plan

As a course in higher education, the final assessment is an inevitable step. As the baton of teaching and learning, open teaching also requires an open-minded assessment method.

The course asks essay for exams, and the questions, requirements, and evaluation criteria of exams are all open. The exam content can be a summary of course learning or an in-depth study and discussion of specialized technologies in the IoT. It is also encouraged to combine the characteristics of RFID and IoT technology to to design application solutions in one's familiar field and encourage project practice. Students who have received innovation and entrepreneurship funding from the school on the application of IoT technology during the teaching period can use the project proposal as the final essay to evaluate their course grades based on project level and personal contributions.

3 Effect of open classroom

Open classroom has increased the attractiveness of the course. As shown in Table 1, after adopting open classroom, more and more non-information majors have taken this course, and the distribution of students is more balanced. According to the follow-up survey results, as shown in Table 2, since the adoption of open classrooms in 2021, an increasing number of students have shifted their teaching methods from a relatively simple paper to practical program design and competition participation. It aligns well with the original intention of curriculum reform and meets the requirements of the EEE set by the Chinese government.

Table 2. Statistics of class-ending model

class-ending model	2021	2022	2023	2024
Paper	61%	44%	30%	17%
Scheme Designs	19%	22%	30%	34%
Project Proposal	10%	20%	21%	22%
Application Design	10%	13%	19%	27%

However, there are also certain issues in implementation. Students may encounter certain difficulties when collecting information, mainly due to knowledge barriers caused by patent protection; For example, the latest RFID technology usually only sells licenses to larger and more powerful enterprises, and restricts the dissemination of its technical standards in the public domain, making it difficult for students to obtain. On the other hand, the era of self media and the abuse of knowledge generation technology have led to incorrect knowledge information drowning out correct knowledge information, especially in popular, rapidly developing, and highly specialized fields. The Internet of Things and RFID are the hardest hit areas for this proliferation of junk information. Therefore, students may obtain incorrect information in self-directed learning, which can be misleading and affect the teaching progress in the classroom. Teachers need to have sufficient course preparation and work with students to conduct professional analysis and identify authenticity.

4 Conclusion

This article takes "Introduction to RFID and IoT" as an example to introduce the implementation plan of using open classrooms for elective courses in the EEE background.By establishing an equal and mutually supportive teacher-student relationships, open classrooms create a pleasant, inclusive, and harmonious teaching environment that respects students' subjectivity. It plays a significant role in cultivating students' practical abilities and innovative spirit, which is precisely the goal of the EEE. How to control the degree of openness is a tricky problem. Giving up the initiative to students without any restrictions can sometimes lead to issues that are too divergent, slow course progress, and students being misled by misinformation. Teachers need to provide more active guidance, that is, to prepare course materials more thoroughly and join students' learning earlier.

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