

Exploration of project teaching reform of circuit theory

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Abstract: circuit theory is a professional basic course for electrical majors and plays an important role in the talent training program. This paper analyzes the current teaching situation of the course in Colleges and universities, studies how to implement the project-based teaching reform in the course teaching, redesigns and constructs the teaching implementation scheme of the course, and puts forward a new viewpoint on the course evaluation method, which provides a new idea for the teaching reform of related courses.

Key words: circuit theory; Project teaching; Teaching reform

1. introduction

In 2018, 79 countries (regions) participated in a sampling test of the international student assessment (pisa2018) for 15-year-old students. Chinese students ranked first in all three subjects (reading, mathematics and Science). The report on the international competitiveness index of China's education, released in December 2020, has carried out a comparative study on the international competitiveness of education in 38 countries. China's education competitiveness index is only in the 20th place. It can be seen that there are shortcomings in China's higher education. In order to make up for the deficiencies of education, the work of educational reform has been an important part of China's education in recent years. Project-based teaching is one of the directions of educational reform. It is a teaching mode that allows students to learn and teach by completing a complete project under the guidance of teachers. It does not adhere to the traditional discipline system, Instead, the knowledge content is transformed into several "teaching projects", so that students can become the "host" of the project, so that students can participate in the whole process of teaching through autonomous learning, and actively experience, comprehend and explore. Because of its strong project, practicality and practicality, project-based teaching has been widely used in the vocational education of cultivating skilled and applied talents. In recent years, project-based teaching has gradually spread out in the higher education of cultivating comprehensive and applied talents.

2. teaching status and difficulties

Circuit theory has always been a professional basic course for undergraduate automation majors. This course is highly theoretical, has many theorems and laws, and the teaching content is huge. The course focuses on cultivating students' ability of analysis and calculation, the ability of integrating theory with practice, and the initial formation of logical thinking, system modeling, scientific analysis and engineering approximation. Lay a solid foundation for subsequent relevant courses, design internships and future employment.

However, traditional teaching focuses on theoretical teaching. Although students have certain professional knowledge after learning the whole course, their hands-on ability and project practice ability are difficult to be exercised and improved in the conventional teaching link, and can not meet the needs of the industry and enterprises. On the other hand, the traditional "conclusive evaluation" method based on the final paper score in teaching is difficult to comprehensively, effectively and truly evaluate students' knowledge mastery and professional ability and accomplishment. This score only evaluation method makes students more willing to spend time and energy on "writing questions", ignoring the improvement of personal engineering practice ability and innovation ability. This makes many college students face huge employment pressure when they graduate, and even many fresh graduates are difficult to be competent even if they find the job they want. Therefore, teaching reform is imperative. In the face of industry demand and market challenges, how to implement the project-based education concept in the whole teaching process, pay attention to students, adjust teaching content, improve teaching methods, improve the evaluation mechanism, and ultimately improve students' autonomous learning ability and innovation practice ability is an urgent problem to be solved in the reform of higher education.

3. The implementation of project teaching reform

The project-based teaching reform of circuit theory needs to take the engineering background as the starting point. The teaching process should change from teachers' teaching to students' learning. The explanation of knowledge points should be carried out in the project driven mode, so that the integration of theory and practice increases, so as to further improve students' interest and autonomous learning ability, and better cultivate their ability to analyze and solve problems. Comprehensive ability of engineering quality and cooperation ability.

(1) Optimize the teaching content and reasonably select project topics

As the project-based teaching is a teaching process based on "teaching project", the project selection is the key to ensure the quality of project-based teaching of undergraduate professional theory courses. As for circuit theory, which is a professional basic course, the process of project selection is both important and difficult. Figure 1 shows the content architecture and project setting reference of circuit theory course. Generally speaking, the project topic selection needs the organic combination of two factors: on the one hand, it is to play the leading role of teachers. According to the course content and teaching needs, teachers should delimit the general scope for students to choose topics and give free play to their thoughts, and put forward specific requirements for the implementation of project teaching according to the purpose of course teaching; On the other hand, students should play the main role. Within the general scope defined by teachers, students can

choose their own topics according to their interests, needs, abilities, learning styles, existing knowledge and experience and other personality characteristics.

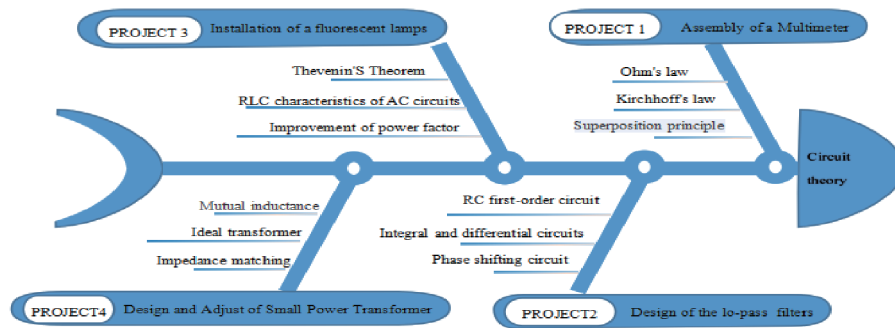


Fig. 1 fishbone diagram of content structure and project setting of circuit theory course

In order to successfully complete the project, each project can be broken down into several sub projects in a progressive manner. After determining the tasks of each project, teachers should redesign and adjust the teaching content and order according to the requirements of the syllabus. Different methods such as heuristic, discussion, inquiry, and case-based teaching should be used in theory teaching, so as to make sure that the teaching units are all around the promotion of the project. At the same time, it is also necessary to highlight the professionalism and applicability of the knowledge points, and organically combine the course teaching with the actual engineering projects, Cultivate students' engineering concept. As a main line, project tasks run through the whole teaching unit, which can make students feel the orderliness and coherence of knowledge, and can actively study and independently construct knowledge. From the collection of information, the design and implementation of the scheme, to the final project report, the whole teaching process is carried out in the way of autonomy, exploration and cooperation, so that students' learning ability, practical operation ability and team cooperation ability have been well exercised and improved. Table 1 shows the implementation of organizational design in the course of teaching.

Table 1 organizational design of project teaching implementation

Teaching stage	Teacher activities	Student activities and submissions	Thinking development process
Phase 1 - conception	Project deployment, put forward functional requirements	Consult the data, complete the demand analysis, and submit the project plan	Stimulate interest and explore goals
Phase 2 - Design	Explanation and guidance, scheme review	Formulate plans, demonstrate plans, and submit project implementation plans	Search matching knowledge base and build knowledge system independently
Phase 3 - Implementation	Explanation and guidance, project acceptance	Simulate and test the circuit, build the physical circuit, and submit the project circuit diagram	Theory guides practice and practice validates theory
Phase 4 - Operations	Project evaluation, review report	Project summary and improvement, submit project report	Review project characteristics and summarize experience and lessons

(2) Increase the proportion of practice and introduce simulation

The success or failure of the project-based teaching reform of the course largely depends on the implementation of the practice link. Most of the traditional circuit experiments are verification experiments, which are far from meeting the requirements of project-based teaching in terms of experimental hours and content. Therefore, the reform of project-based teaching needs to adjust the proportion of theoretical / practical hours and increase the class hours of practice. Secondly, the content setting of the practice link needs to be adjusted. The practice teaching should be strengthened according to the progressive thinking of the basic level, the application level and the innovation level. At the basic level, the verification of the basic theory of the circuit is mainly used to enable students to master the use of common instruments for circuit measurement and have an intuitive impression of the classroom theory teaching; At the application level, students are required to use the circuit knowledge they have learned to explain circuit phenomena, and to draw inferences from one instance to verify relevant knowledge points. The purpose is to inspire ideas and give play to their subjective initiative; At the innovation level, students are required to conduct demand analysis according to the requirements of the project, expand the required knowledge with various resources, and carry out comprehensive independent innovation experiment design.

For application-oriented and innovative experiments, simulation software (such as Multisim or matlab) can also be used to add simulation and testing links to the project to visually display the abstract theoretical knowledge in the form of graphics, which can not only help students intuitively and profoundly understand the basic theoretical knowledge, but also enable students to master the circuit simulation analysis method. At the same time, the use of simulation software to test and analyze the circuit can avoid the potential power risk caused by students' design errors, improve the safety factor, and reduce unnecessary component losses, which is more economical.

(3) Enhance the teaching staff and strengthen school enterprise cooperation

The core work of project-based teaching is to choose comprehensive experimental project cases that can run through the course content.

This requires teachers to have solid theoretical foundation, strong practical ability and rich practical experience. However, many young teachers in the teaching line lack experience in enterprise project development, It is difficult to design excellent teaching project cases. In order to solve this dilemma, the school can issue relevant policies to promote teachers' practice in enterprises, strengthen the relevant technical training of professional teachers, or strengthen the school enterprise cooperation, and hire enterprise technical backbones to join the course group, so as to make up for the shortcomings of the low level of practice of school teachers.

4.Evaluation scheme of project teaching

Usually, the project-based teaching assessment uses the “assessment score method” to evaluate, and the data comes from the statistics of teachers and related auxiliary software, but this quantitative evaluation method is difficult to get an objective assessment conclusion for the assessment content of “team cooperation ability”, “communication ability”, etc. Therefore, it is suggested to increase the use of “questionnaire method”, which is filled in by students independently. This evaluation result comes from students' subjective judgment, and then combined with “assessment score method” to assess the effect of project-based teaching. Of course, the evaluation objects of the two evaluation methods are the teaching effect of project-based teaching, the focus of the investigation is different, and due to the different starting point and subjective consciousness of the evaluation subject, the evaluation results are different. Although the evaluation of the former is usually qualitative judgment and lack of objectivity, considering that the purpose of the project-based education concept is student-centered, the data statistics of the two can investigate the teaching effect from different angles and help teachers analyze, judge and reflect on teaching, so the evaluation from both sides is very important and cannot be discarded.

(1) Evaluation scheme of “questionnaire method”

At the end of the course, the teacher should design a questionnaire according to the teaching objectives of the course. The questionnaire should be arranged according to the detailed indicators of different teaching objectives. It can be carried out on a network platform (such as questionnaire star) to facilitate data statistics after the questionnaire is collected. Each question is usually evaluated at six levels (a= excellent, b= good, c= medium, d= pass, e= fail). For each course objective, students are required to grade evaluation according to their own learning situation this semester, and then the teacher makes statistics and data analysis. See Table 2 for the contents of the questionnaire.

Table 2 assessment contents of project teaching questionnaire

content of examination	Assessment rules
Personal professional ability	Consult the components manual and the instrument manual
	Data were obtained using electronic resources such as online retrieval
	In the circuit design and debugging, the problems are found and clearly stated
	Use the knowledge reserve to analyze and solve the problems
	Test results analysis and troubleshooting
	Good at summing up the experience and lessons learned
	Find the possible improvements in the solution
Learning ability attitude	Have a confident, positive attitude and determination to achieve goals
	Correct face of setbacks, have the courage to solve difficulties
	Capability of time management
Team collaboration ability	Have the team spirit, can seriously complete the tasks in the team
	Play an active role in the team and give help and support to the team partners
	The league members pay attention to communication and listening, and effectively resolve conflicts

(2) Evaluation method of “assessment score method”

The assessment score analysis method is that teachers assess and score each link of the project-based teaching process. The assessment basis is mainly based on the evaluation of discipline safety, practical ability and submitted material reports. See Table 3 for the specific algorithm.

Table 3 project assessment score table

Discipline and security	After class on time, comply with the laboratory regulations and operating procedures, and operate safely	10
Project practical operation	Submit the project plan according to the existing resources and time schedule	10
	Be able to design a reasonable circuit diagram and submit the project implementation plan	20
	Can use the simulation software for test and analysis, and submit the circuit diagram	10
	Can accurately build the physical circuit	20
	Test results analysis, troubleshooting capability	10
Materials and reports	The project report has clear thinking, smooth text, complete experimental data and correct charts	10
	Can carefully summarize the harvest and experience, to provide ideas and methods for the improvement of the project	10

Although project-based teaching is the focus of teaching reform, it is only one of many teaching links of the course. According to the design of the syllabus, combined with the assessment materials of each teaching link (including after-school homework, classroom performance (including attendance rate, classroom questions, classroom tests), basic experiments and final exams, it is also necessary to make a comprehensive evaluation of the course. Considering the reform trend of existing teaching reform methods and curriculum achievement evaluation, the proportion of process evaluation in comprehensive evaluation has been increased, which is significantly different from the traditional evaluation method of “grading for life”. See Table 4 for specific evaluation methods.

Table 4 list of comprehensive evaluation of courses

Evaluation method	Evaluation content	Evaluation score	
Process evaluation	Homework after class	20	
	Classroom performance	10	
	Practice link	Basic experiment	10
		Project assessment	20
Summative evaluation	Final exam	40	

5.epilogue

In order to solve the increasingly prominent contradiction between the needs of employers and the quality of College Students’ training, further deepen the reform of engineering education, try to introduce the concept of project-based teaching into the classroom teaching of “circuit theory”, and carry out reform and exploration in the aspects of teaching implementation plan and assessment methods, in order to enhance students’ professional skills, engineering ability and cooperation ability, Meet the social demand for engineering and technical talents. But at the same time, it will also be found that due to the increase of process evaluation indicators, the workload of teachers will increase to 2-3 times of the past, including class roll call, class test, after-school homework, experimental report review, project guidance and review of project materials, test paper correction, etc. In order to reduce the workload of teachers and achieve objective and efficient teaching evaluation, it is recommended that teachers master all kinds of teaching apps, upload all assignments or reports that need to be reviewed to the network, generate scores directly from objective questions (such as classroom tests), and it is more convenient and fast for subjective questions or reports to be reviewed on the network.

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