Application of Project-problem-based Learning in the Electronic Circuit Courses

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Abstract. Based on the current problems and characteristics of the electronic circuit courses in the undergraduate education, a project-problem-based learning teaching mode is proposed by learning the experience of the advanced teaching modes of the domestic and foreign universities. This mode introduces the project-problem-based learning method, the seminar method, the network teaching platform and tutor mode into the teaching system of the electronic circuit courses, which further embodies the "student-centered" teaching purpose. This mode receives more prominent teaching effect, and creates better conditions for the training of related majors. Through the teaching practice, the mode can significantly improve the teaching effect, improve students' understanding and application ability of related knowledge, and has been widely welcomed and praised by the students.

Introduction

Electronic circuit courses are important basic specialized courses, which forms the three core courses groups of the school of electronic and information engineering in the undergraduate stage with the signal process courses and the radio wave propagation courses. And the courses cover almost all of the knowledge about electronics during the undergraduate studies. Such courses pay more attention to developing the electronic practice ability of students, which requires students to master the essential knowledge of electronic circuits and promote the ability of practice. Whether the students have a good comprehension of the content has important influence on their future study of specialized courses and capability of electronic design.

However, due to complex electronic circuit, theory and formula, and boring traditional teaching mode, students’ enthusiasm for learning isn’t very high, and the effect of learning doesn’t achieve expectation. So some schools adopt the project-based learning method, which construct the course with a series of projects [1-2]. Project Based Learning (PBL) is a teaching method which gives students knowledge and skills to investigate and respond to a complex question, problem or challenge by working for an extended period of time [3]. Someone also teaches with the flipper classroom method [4].

Such methods have their own characteristics and advantages which benefits learning, but there is still a lot work to do on how to interact with students in and after class, how to feedback the teaching effect and how to instruct students effectively.

The Problems in the Traditional Courses

Although the undergraduate education in China has made great progress, the quality of graduates is increasing year by year, however, the current university undergraduate education in Higher Education in China has many problems, and these problems seriously affect the quality of undergraduate education. Through 7 years of teaching practice, we find the main problems existing in the electronic circuit course can be listed below.
Class Teaching Effect Needs to Be Improved

Through the analysis of students' feedback, attendance rate and examination, we find that there are some problems in the class teaching, such as the class time is not adequate, the knowledge of course is wide, the content is difficult to understand and the examination result is below expectation.

Student’s Awareness of Active Learning Needs to Be Improved

Electronic circuit courses need to be practiced to combine knowledge and practical application. However, because of students’ weak active learning consciousness and lack of chance to practice, the effect of learning is not ideal.

Teachers Can't Know the Teaching Effect in Time

As most of Chinese students are shy and without adequate hours in class, even if the students have difficulty in learning during class, they will not ask the teacher to answer questions face-to-face. Such can result in the decline in the quality of learning and the lack of comprehensive understanding and mastery of the basic knowledge required by the course.

Students Need Specific Professional Guidance

The stage of the university is an important time for students to build their scientific thoughts and world outlooks. It is necessary to receive specific guidance from a tutor to promote their research abilities and working methods. But such opportunities are often hard to acquire.

Project-problem-based Learning Mode

To solve these problems mentioned above, we propose a project-problem-based learning mode in the courses of the electronic circuit. The mode consists of the problem-based learning method, project-based learning method, seminar method, network teaching platform and tutor mode. That can further embody the purpose of "student-centered". The details of this mode list below.

Using problem-based Learning Method in Class Teaching

The main reason why the effectiveness of the class teaching is low is that the students lack interest in the course. We know: success = passion × effort^2. It can be seen that the learning effect of a course is proportional to the passion. Therefore, we reform the class teaching in two aspects. One is to improve the enthusiasm of students and the other is to enhance the class teaching’s acceptance.

To improve the enthusiasm of students, more questions are proposed and using these questions to establish the structure of the chapters. And we convert the formulas into the visual pictures by the simulations to deepen the students’ understanding of the knowledge.

To enhance the class teaching’s acceptance, we use four skills, reviewing before class, writing more on the blackboard, multimedia teaching and class tests, which can help the students absorb more knowledge in class time.

Combining Project-based Learning and Seminar Method in the Spare Time

In order to improve the learning effect in the spare time, we use the project-based learning and seminar methods. That is, aim to finish one project, some knowledge required for the project is allocated to the students to learn by themselves. The students do some research and write a report. After that, the students and teachers will discuss this report in the seminar method to improve the learning initiative of students.

In the process of the project-based learning method, the teachers should arrange the contents of projects, and put forward the specific indexes required. The students can build teams freely, decompose problems, and write the thesis proposals. According to the proposals, the teachers should instruct students to access what they have to acquire in the next step. After completing the projects, the students will summarize what they have learned in the projects.
The seminar method is used when the students report their research results. That is, the teachers and other students should debate with the ones reporting bilaterally. After that, the teachers give the comprehensive evaluations, and point out what need to be improved. At last, the teachers give out questionnaires and make the judgments on teaching effectiveness.

**Using Network Teaching Platform to Feedback in Time**

Aiming at the problem that learning feedback is not in time, we use the network teaching platform to achieve class-spare integration teaching mode. By this mode, the teachers can acquire the students' learning situation dynamically, so they can adjust the teaching progress, the teaching content and methods according the actual situation at any time to achieve the best teaching effect.

With the network teaching platform, the teachers should answer the questions proposed online timely, analyze the source of the difficult problems, find out a suitable way to explain to the students, upload the teaching resources and so on. The teachers should participate in and master the whole learning activities of students, and correct their teaching methods and content according to the students feedback continually and timely. The teaching workload is increased, and the teachers need to pay more energy. So the teachers must have the professional dedication and sense of responsibility.

**Using Tutor Mode to Guide Students**

During the project-based learning process, the students' theoretical knowledge and practical ability have been improved. At the same time, the tutors have some knowledge of the ability of students in the teaching process. Therefore, the project tutor mode can meet the students' concerns in the professional guidance and spiritual communication, and also help the teachers find out the students who have scientific interest and potential early.

However, the tutor mode must abide three principles of combination: the combination of science and ideology, the combination of knowledge imparting and ability training and the combination of tutor leading and students' initiative. The tutor mode influences each other and promotes each other. Based on the constructivist philosophy of education, the tutor should give the students comprehensive guidance in the professional knowledge, the academic interest, the moral cultivation, the scientific research ability, the academic attitude and training talents.

**Summary**

In the past 7 years, the project-problem-based learning mode has been implemented on about 300 students each year. Through the students' learning effect, the students’ evaluation and feedback from the experts of the university, we find the teaching effect is well. So the mode can be popularized in other courses.

Meanwhile, under the trend of MOOCs and excellent video open courses, we are going to construct MOOCs and make full use of various advanced teaching methods to achieve better teaching results.

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