

Exploration and Practice of Online and Offline Blended Teaching Mode of Circuit Foundation

Han Wu*, Wei Yang, Guangming Li

School of Physics and Electrical Engineering, Liupanshui Normal University, Liupanshui 553004, Guizhou, China

**Author to whom correspondence should be addressed.*

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Abstract: As a basic course in electrical specialty, Circuit Foundation has strong theoretical and professional characteristics. It is difficult for students to learn. Traditional teaching methods are mostly centered on textbooks and theoretical teaching, which is not conducive to the understanding and flexible use of knowledge points. It cannot promote the cultivation of students' innovative ability. The online and offline teaching modes have changed the traditional classroom teaching mode, which can fully mobilize students' learning enthusiasm and creativity. Enhance students' interest in learning. In this paper, taking the course of "Circuit Foundation" as an example, the online and offline hybrid teaching mode is constructed, and the teaching design is carried out. The practice results show that the blended teaching method has achieved good results and is superior to the traditional teaching method. It is more conducive to students' understanding and mastery of knowledge. The results can provide a reference for further teaching reform of the course "Basic Foundation".

Keywords: Circuit foundation; Online and offline; Blended teaching mode; Curriculum reform

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1. Introduction

Fundamentals of Electric Circuits is a compulsory course for electrical engineering and automation, automation, electronic information engineering, measurement and control technology, and other science and engineering majors. Basic courses, which mainly study the basic laws and analysis and calculation methods of circuits, play an important role in the whole personnel training. On the one hand, it is based on higher mathematics, engineering mathematics, and physics. It is also the basis of the follow-up technical basic courses and professional courses. It is not only an important cornerstone of the electrical knowledge system, but also an important theoretical basis for students to engage in professional and technical work after graduation. It is an important part of students' professional knowledge structure and plays an extremely important role in the development of intelligence and ability.

However, the teaching method of this course is still the traditional teacher-centered teaching method, and students passively accept knowledge. The enthusiasm for previewing before class and reviewing after class is not

high, which leads to a poor effect on the whole teaching. Students' mastery of theoretical knowledge in books is limited, and their ability to use the theoretical knowledge to carry out scientific and technological innovation is even more limited. Therefore, this traditional teaching method also has certain restrictions on the cultivation of students' creativity.

In recent years, especially after the large-scale online teaching practice since 2020, Online and offline blended teaching will become a new trend of teaching reform in colleges and universities in the future ^[1]. Online and offline blended teaching is a teaching method based on traditional classroom teaching. While using the teaching resources of the online teaching platform, the advanced teaching tools are used for online teaching. It is a brand-new teaching mode to realize the organic integration of information technology and traditional classroom teaching. The online and offline blended teaching can not only play the leading role of teachers, It also allows students to learn independently through online rich teaching resources, to achieve personalized learning goals. In this paper, the blended teaching mode is applied to the course of "Circuit Foundation" to explore its impact on the teaching effect. It provides a reference for the teaching reform of this course.

2. Current teaching situation and analysis

In recent years, the teaching reform of the course of Circuit Basis has been increasing. The traditional teaching mode has also made great contributions to the training of electronic and electrical talents in China ^[2]. However, with the increasing development of international exchanges, we must also be aware of the direct gap with the advanced teaching level of foreign countries. We need to actively absorb the experience of foreign curriculum construction. The teaching system and content of the circuit course in our country keep their own characteristics. It gradually emphasizes the subjective status, pays attention to the engineering application background of the circuit, and keeps up with the latest technology. There are still some problems to be solved in the current teaching practice:

- (1) In terms of teaching mode, teachers are still the center, and classroom teaching mostly adopts the teaching method of "cramming". Students still have the phenomenon of passive acceptance of knowledge. This kind of teaching mode is beneficial for teachers to play their leading role in the classroom, but it ignores the initiative and creativity of students. It cannot well reflect the main role of students in classroom teaching, and often gets half the result with twice the effort.
- (2) In terms of curriculum content, the teaching content is still biased towards theory rather than practice. Although in recent years, colleges and universities have increased their investment in practical teaching, the development prospects of experimental teaching content are also very optimistic. However, compared with foreign countries, the content of our circuit experiments is relatively small, and the research is also relatively lacking. There is a clear gap with the latest situation of contemporary scientific and technological development.
- (3) In the teaching evaluation system, the single assessment of students is determined by the final examination. It makes students stick to the problem-solving in the PPT courseware and fall into the lazy learning of score-oriented ^[3]. This evaluation system makes it difficult for students to give full play to their subjective initiative. It is even more difficult to tap the potential of students and cultivate their lifelong learning ability.

3. Design of blended teaching mode of “Circuit foundation”

The teaching process of blended teaching in the course of Circuit Foundation is mainly divided into three stages: before class, during class, and after class. Through problem-oriented online autonomous learning before class, the theoretical teaching of the key and difficult points in class, and the online learning of the comprehensive test after class. It not only enables students to master theoretical knowledge but also cultivates the ability to solve complex problems independently and innovate.

3.1. Design of teaching links

3.1.1. Online autonomous learning stage before class

Teachers will publish learning tasks, teaching courseware, micro-lesson videos, exercise banks, and other supporting curriculum resources according to the syllabus and teaching objectives. On the platform of Superstar Learning Link, Students can use scattered time to study independently according to the published tasks on the mobile phone platform at any time and anywhere. Based on the dormitory, a study group of 4 to 6 people was formed to conduct group discussions. Each student is responsible for different content around a theme. In the process of learning, students can leave messages about their problems in the discussion area, and when answering questions, whether students or teachers. You can get involved. Teachers can summarize the feedback from the discussion area and make necessary adjustments for the next classroom teaching. In this link, the platform will also automatically analyze the online autonomous learning situation of students, as shown in **Figure 1**. Such as the number of videos watched, the length of time watched and the number of discussions participated in. Teachers can understand mastery of knowledge points and teach students in accordance with their aptitude by looking at statistical analysis data.

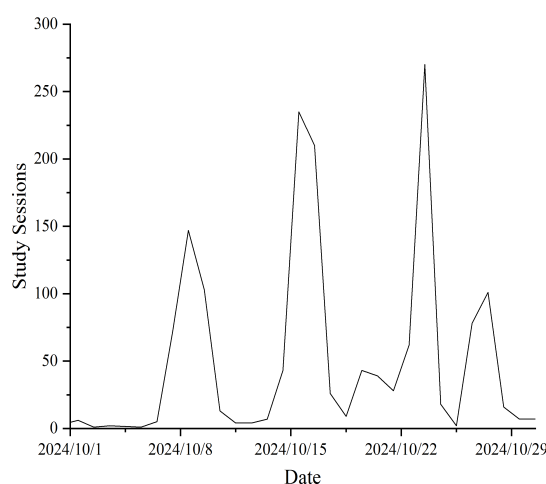


Figure 1. Statistics of students' autonomous learning before class.

3.1.2. The stage of teaching the key and difficult points in class

The second stage of offline teaching is the advanced teaching stage. In the pre-class preview stage, students study independently and discuss in groups according to the tasks issued by teachers. In classroom teaching, using mind mapping, teachers first let each group leader make a simple online learning report. And put forward the problems encountered by the group to help students build a knowledge system. Since students have already learned the basics of this lesson online, Teachers can focus on the key and difficult points of this lesson and the

problems encountered in the group report. The application of the flipped classroom for inquiry-based teaching enables students to have a new understanding of each knowledge point. In the process of teaching, teachers can introduce the frontier and research hotspots of the subject in light of the research progress. Improve students' learning interest and efficiency^[4]. At the same time, we should integrate the education of ideological and political education, humanistic quality, and scientific spirit into classroom teaching through classical cases. Then, in the form of group discussion, students can deepen their understanding and mastery of key knowledge, and at the same time, they should pay attention to the students' team spirit. To mobilize learning initiative, it is more important to guide students' ability to find and solve problems. Cultivate students' ability to acquire new knowledge and innovation. Teachers can also publish questions on the learning link, so that students can consolidate the knowledge points in the form of rushed answers. Before the end of the class, students take an in-class test in the online course to measure the effectiveness of classroom learning.

3.1.3. Online promotion stage after class

According to the completion of the teaching tasks in the first two stages, teachers should summarize the problems and highlights in the teaching process in time. Students can also be surveyed on a small scale, and students can be invited to evaluate the teaching methods and content. Then we should reflect on the teaching carefully, organize and supplement the teaching content in time, to optimize the teaching plan^[5]. It uses the learning platform to arrange comprehensive test questions for students online to consolidate classroom teaching, and at the same time, according to the evaluation results. Teachers can find out the knowledge points that students can't grasp well in time, and answer them through live broadcasting, posting, and discussion. In order to improve the teaching effect, the common questions should be answered centrally, and the individual questions should be answered separately. The platform will automatically count the completion of each homework, as shown in **Figure 2**.

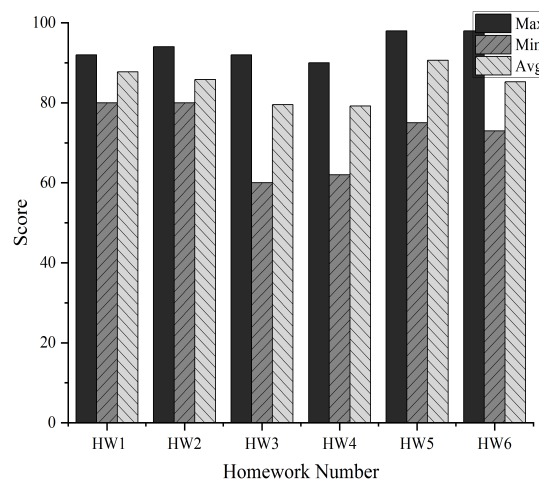


Figure 2. Statistics of students' homework performance.

3.2. Design of assessment and evaluation system

The course assessment method is a combination of process assessment and final assessment. Among them, the process assessment results accounted for 40%, including classroom interaction accounted for 10%, online chapter learning accounted for 20%, and discussion and communication accounted for 20%. Homework accounts for 30%, and ideological and political courses account for 20%. At the end of the course, the final examination is

conducted in a closed-book form, which accounts for 60% of the total score. The combination of various forms of assessment methods greatly reduces the weight ratio of the final examination, so that students can spend their time in peacetime. It has effectively changed the passive examination-oriented learning style of students. In the subsequent optimization of the assessment system, we will further integrate the engineering case resources. The ideological and political elements and professional content are better integrated. Through the continuous optimization of assessment methods, it provides support for the cultivation of innovative and applied talents.

4. Practical effect

The blended teaching mode establishes an effective online and offline communication channel for students, teachers and students, so that students can learn in the classroom at the same time. They can also use the rich online teaching resources for autonomous learning^[6]. From the spring of 2020, the author began to carry out the blended teaching mode for the course of “Circuit Foundation.” After nearly five years of teaching practice, it has been found that the enthusiasm and initiative of students to participate in learning have been significantly improved. Students have changed from passive learning and confused thinking in class to active participation in pre-class learning and classroom teaching. The ability to analyze and solve problems has been significantly improved by boldly communicating their ideas with teachers and classmates. The classroom atmosphere has also been greatly improved.

Through the comparative analysis of the final grades of electrical engineering and automation specialty since 2019, the effectiveness of the blended teaching model has been significantly verified. As can be seen from Figure 3, since the adoption of blended teaching, the proportion of low segments (0-39 points) has shown a continuous downward trend. Among them, the peak proportion of low segments in Grade 2019 is 25.9%, which reflects the problem of insufficient teaching adaptability in the early stage, while the proportion of Grade 2023 has dropped to 2.0%. Explain that blended teaching may help reduce failure rates. The change in the distribution of scores in the middle segment (40–69) showed a gradual dispersion of above-average scores to higher segments. The proportion of high segments (above 70 points) jumped from 17.2% in 2019 to 61.0% in 2023, with the group above 90 points breaking through 6.1% for the first time. It is confirmed that the model plays a promoting role in the cultivation of outstanding talents.

Through the empirical analysis of the five-year performance data, it is confirmed that blended teaching has a significant role in improving the quality of electrical professional training:

- (1) The reduction of the elimination rate of low scores coexists with the breakthrough of high scores, which is in line with the educational equity goal of “supporting the bottom and topping the top”.
- (2) The progressive improvement curve of teaching quality reflects the two-way adaptability of teachers and students.

In future teaching practice, teachers should continue to optimize the mixed teaching mode and design differentiated evaluation tools for the middle section. Reduce the fluctuation of performance distribution, and establish a dynamic adjustment mechanism of blended teaching, combined with learning analysis technology, to achieve precise intervention.

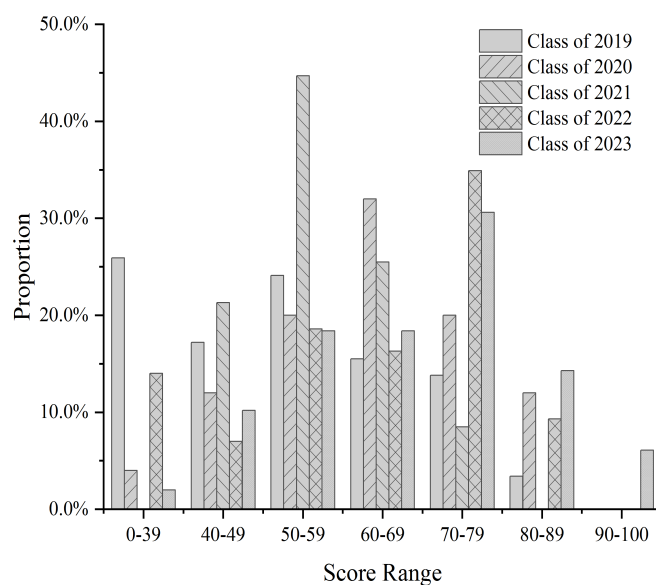


Figure 3. Final Exam Grade Distribution for Electrical Engineering and Automation Cohorts (2019–2023).

5. Conclusion

In this paper, the online and offline blended teaching mode of the course “Circuit Foundation” is constructed based on the learning platform. It uses two kinds of teaching resources of “online and offline”. Realize the teaching mode reform of the three stages of “pre-class online learning + in-class key and difficult points + after-class online promotion.” This mode integrates ideological and political courses into classroom teaching, which not only exercises independent thinking ability and innovative ability, but also improves students’ ideological and political education. It also greatly enhances the students’ sense of teamwork. The assessment and evaluation system has changed from the previous single evaluation method and has combined the process assessment with the final examination. Pay more attention to the comprehensive performance of students in the learning process. The practice effect shows that the teaching effect of blended teaching has been greatly improved compared with the traditional teaching method. It not only fully mobilizes students’ learning initiative and creativity, but it also gives full play to the leading role of teachers in guiding and inspiring the teaching process.

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Disclosure statement

The authors declare no conflict of interest.

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