Study on the Hybrid Teaching Mode of “Circuit and Analog Electronic Technology” in the Age of Internet Plus

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Abstract. Online teaching is an effective means and inevitable trend of modern education development. This paper discussed the teaching of “circuit and analog electronic technology” through hybrid teaching model in the era of "Internet plus". The traditional teaching and flipped classroom teaching were analyzed. We try to combine the two different modes to give full play to their respective advantages. The hybrid teaching mode based on flipped classroom is designed. The process of teaching mode, teaching design and teaching effect were introduced in detail. Finally we improved the mode of course assessment. The teaching practice proves that these reforms and explorations have achieved better teaching results, which can effectively improve the students' capabilities of circuit analysis, design and application.

Introduction

“Circuit and Analog Electronic Technology” is the specialized basic course of computer science, laying a foundation for digital electronic technology, computer composition principle and microcomputer principle and so on. And also lay a solid foundation for students to engage in engineering practice. There are three main problems in the traditional teaching at present. (1) “More content, less time”. This phenomenon exists in many universities, including our own. How to improve the quality and effectiveness of teaching in a limited time? Only change the traditional teaching mode, and look for new teaching models. (2)"irrigative teaching" mode. It is shown that the teachers are very tired, but the students are tired of learning. There is little time for students and teachers to interact. Students cannot be adequately and effectively tutored. (3)Emphasis on theory, contempt of practice. Focus on theoretical knowledge teaching, and do not pay attention to the training of engineering practice ability. In order to solve these problems, combining with our teaching situation, we make full use of powerful network resources and other new technologies to research and explore the "mixed" teaching mode for the course.

With the rapid development of information technology and internet technology, the degree of education informatization has been continuously strengthened. In the 1990s, with the emergence of E-learning (Network Teaching), information technology and various subject courses are continuously integrated. Blended learning refers to the learning that combines traditional learning and digital or networked learning. In 2011, Salman Khan, the U.S. young educator, put forward the new teaching method at the TED Conference—flipped classroom, which aroused the concern of the majority of educators. And then the flipped classroom quickly became popular in the United States and affected all over the world. Foreign studies on flipped class mainly focus on teaching practice, comparing with the traditional teaching mode and the application effect combing with the other teaching methods or techniques. Professor Robert Talbert from Franklin College in the United States advocated that knowledge is transferred before the class, and the knowledge is absorbed in the class [1]. Jon Bergmann and other people emphasize that flipped classroom should not be replaced by video teacher. It is the way to increase teacher-student interaction [2]. The domestic research and practice for flipped classroom has just started, stay in the introduction and digestion stage. At present, the
domestic research on flipped classroom mainly focused on the introduction and inspiration by foreign studies and the discussion of teaching modes and the teaching model design with less empirical research, especially the application of a specific course [3].

Based on the above analysis, the flipped classroom is introduced into the teaching of “Circuit and Analog Electronic Technology”. The internet technology is used to build the new hybrid teaching mode based on "flipped classroom". A variety of pre-class self-learning materials are designed based on "flipped classroom". Using a variety of modalities (video, audio, pictures, material object and so on) to improve students' participation in learning and to construct a new hybrid teaching model in order to effectively improve the quality of blended teaching.

Design of Mixed Teaching Mode Based on Flipped Classroom

**Flipped Classroom Connotation**

Flipped Classroom / Inverted Classroom, as the name suggests, is a reversal of traditional classroom instruction. In teaching, it still retains the two steps of information transfer and knowledge internalization. However, contrary to the traditional classroom teaching, it places the process of information transfer outside the classroom, mainly by means of video and audio materials, which is completed by the students themselves. Knowledge internalization takes place in the classroom. It is a kind of Blending Teaching which is a combination of traditional classroom and online teaching [4]. Blending Learning refers to the combination of the advantages of traditional teaching and online teaching. It not only plays the leading role of teachers in guiding, enlightening and monitoring the teaching process, but also embodies the initiative, enthusiasm and creativity of the students as the main body of learning [5]. "Flip" allow students to control the rhythm of their own learning so that we can well solve the aforementioned "more content and less time" problem. In this paper, the practice of "hybrid" teaching mode is carried out by flipped classroom form.

**Flipped Classroom Instructional Design**

To flip the course better, we must carefully design the course organization and teaching process from three aspects: before class, during class and after class [6]. At the beginning of class, we should focus on cultivating students' autonomous learning ability, guiding students to explore deeper thinking in class in order to tap the potential of students' learning and give play to the initiative of students. After class, strengthen the understanding of what they have learned. Figure 1 shows the teaching structure diagram of flipped classroom.

![Flipped classroom teaching structure diagram](image)

**Before Class.** Firstly prepare a mix of teaching resources to identify multi-platform online support system. Record teaching demonstration projects into videos, make animations, etc. At the same time, prepare hybrid teaching resources such as e-courseware, e-learning materials, lecture videos, online tests and test questions libraries; then select the curriculum support platform including digital learning platform and mobile learning Platform and so on. We have chosen our school-based curriculum learning center platform based on SuperStar(erya), which belongs to SPOCS online learning mode. Finally, the hybrid teaching resources are uploaded to the course online support platform and we set learning tasks, build online discussion, Q & A and other learning environment, and publish learning task notification. Teachers can carry out curriculum construction, teaching
monitoring and resource sharing on the learning center platform; Students can make use of the platform's various educational resources to learn independently.

**During Class.** In the classroom, teachers focus on the students' pre-class online learning situations and extract difficulties and key points for students to analyze and discuss. Through the combination of discussion-based learning, inquiry learning and collaborative learning, etc. the teacher completes the classroom training project to achieve consolidated training purpose. Among them, inquiry learning can effectively stimulate students' initiative in seeking knowledge. During the process of inquiry, students' autonomous thinking will be better reflected. Regardless of the outcome of the inquiry, the process of inquiry inevitably benefits students greatly [7]. Teachers first designed a number of targeted, instructive, open-ended issues. Through questions, students are guided to build knowledge and development capabilities in the process of solving problems. The problems extracted from the actual production and living more aroused students' interest. As an example, for the daily used FM radio, frequency can be adjusted to listening to different stations, which leads to the concept of resonance. The electrical signal output by the sensor is usually a slowly changing small signal, which is often amplified with the amplifier, usually made up of in-phase proportional and subtraction operational circuits. Then the operating principle of the two circuits is introduced.

In order to improve the efficiency of students' extracurricular learning, group learning is organized in groups in the classroom. The grouping adopts the principle of independent combination and proper regulation so as to avoid the combination of students with high learning enthusiasm and those with weak learning initiative respectively, which ensures that the more motivated students can help other students to complete the group task together. They can help each other in learning and make progress together. Classroom discussions use the way of random group and group members, so as to avoid some students muddling through. Group learning not only improves learning methods and effectiveness, but also cultivates the students with teamwork skills.

**After Class.** In the after-school extension stage, the teacher arranges homework assignments or study tasks for the students. The members of the group should define their own division of labor, consult the materials, and negotiate and discuss. If necessary, they may use network resources to finish the assignments. At this stage, students can reflect on problems that may exist and summarize the existing problems to enhance their understanding of what they have learned. Teachers release online training programs and use fragmented time to guide students and to train their knowledge and skills to migrate.

**Theoretical Teaching Design**

**Teaching Content Selection**

Through perennial teaching experience, not all contents of Circuits and Analog Electronic Technology courses are suitable for flipping. In general, theoretical contents with strong abstract and logical continuity are not suitable for flipping, such as semiconductor devices and transistor amplifier circuits. However, the contents with applicability strong are more suitable for flipping, such as the basis of circuit analysis, DC power circuits. So it is necessary to analyze the teaching content, and still use the theoretical teaching method for the content that is not suitable for flipping. The contents suitable for flipping are summarized in Table 1 below.
Table 1. The choice of teaching content.

<table>
<thead>
<tr>
<th>Suitable for flip</th>
<th>Not suitable for flip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit basic concepts and theorems; circuit analysis methods; integrated operational amplifier; DC power supply; sine wave oscillation circuit</td>
<td>Sinusoidal AC circuit; circuit transition process; semiconductor device; basic amplifier circuit; negative feedback in amplifier circuit; power amplifier circuit</td>
</tr>
</tbody>
</table>

Application of Modern Information Technology

On the theoretical teaching design, the advanced mobile communications software, such as QQ, WeChat are used to change the classroom. Teachers and students all use mobile phones to download the software named “LEARNING KNOW” developed by Superstar company. The software can effectively intervene the learning process of students. For example, teachers release pre-class preview tasks and PPT for students to preview. The software can effectively finish real-time monitoring on the students whether they have read the tasks, so that each student can be given an objective assessment of the usual performance. What's more attractive is that “Learning through” provides the "attendance sign" function. The students are needed to upload their own real-time picture, so that it can effectively avoid the impostors. And it is instantly completed and significantly improves teaching efficiency. After class, the core knowledge is made into ten minutes of micro-video, which is uploaded to the online teaching platform for students to watch repeatedly, so as to improve learning efficiency.

Examination Reform

The traditional assessment methods only focus on theoretical knowledge, rigidly adhering to the final test and ignore the learning process assessment and evaluation of practical ability. The hybrid teaching mode based on flipped class is more conducive to make an objective evaluation of the students. The evaluation criteria is formed based on students’ participation, awareness of co-operation, research methods and work achievements in the usual learning activities, which can reflect the students' ability to analyze and solve problems. Students' online learning time can be automatically recorded through the system. The effect of online learning can be assessed through the pre-designed self-test system. Teachers can also learn about students’ autonomous learning through the data of system statistics. The scores of this part is 30% of the total score. Site design, adjusting and the actual operation can reflect their practical application level. Therefore, the actual operation accounts for 20% of the final assessment. Finally, 50% of the total score belongs to the final examination. This diversified evaluation method can better reflect the overall quality of students.

The Effect of Teaching Practice

We have attempted to develop a hybrid teaching model for the second semester of the 2016-2017 school year. The research group selected 50 students from our class as experimental subjects to carry out the teaching mode based on hybrid learning. In addition, the other 50 students were selected as the comparative class to implement the traditional teaching mode. After a semester of study, the average score of the class with blended-teaching mode reached 85.78 points, compared with the average score of 75.63 points for the comparative class adopting the traditional teaching mode. The result shows that the teaching effect of hybrid teaching model is better than the traditional teaching model. Students in the experimental class generally believe that the high degree of freedom of hybrid learning can be freely arranged online learning time, and the problems that cannot be solved in the classroom can be solved by using the abundant learning resources on the platform.
Summary
The hybrid teaching mode based on flipped classroom takes the students as the main body and allows students to fully experience the learning initiative. Moreover, stimulate students' research interests and improves students' ability to analyze and solve problems. It is the combination of observation, thinking and conclusion, and emphasizes "Student-Based "teaching process. From the results of teaching practice, it can be seen that after the flipping the classroom, the extra-curricular learning time has been increased and the teaching effectiveness and teaching satisfaction have been improved. The students' curiosity and exploration desire have also been stimulated to a certain extent. The teaching mode can be well adapted to the feature of "more content, less time", so that teachers and students can all benefit from it.

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References