Research and Practice of a Self-Learning Based Interactive Teaching Model for Electronic Circuit Course

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Abstract. This paper studies the construction of self-learning model based on network environment. The application in the electronic circuit course is based on the characteristics and development of advanced education and teaching mode at home and abroad. By making full use of the network environment, applying the network' Interactive Q & A and record common problems, teachers can grasp students’ learning status all the time. Teachers preparing teaching on the learning state of students will lead to a substantial increase in classroom teaching efficiency and teaching effectiveness. The learners will have a comprehensive grasp of the basic knowledge of the course and basic ideas. Through the course teaching practice, the model can fully mobilize the enthusiasm of students and cultivate learners' active thinking and self-learning ability, significantly improving the quality of teaching.

Introduction

In recent years, the concern and investment in higher education is increasing. Especially the undergraduate teaching and training has made considerable progress. The development of higher education in China has cultivated a large number of outstanding graduates, conveying a large number of high-quality talents. In recent years, undergraduate college teaching reform has carried out many useful attempts, of which, independent learning is a modern way of education reform [1]. Self-learning is more scientific and efficient than traditional learning methods. The traditional learning is based on class, homework and examination and take the teacher as the main body to complete the teaching goal. While the self-learning through self-reliance, self-discipline, independent completion of exploration research, analysis and practice and take the students as the main body of learning [2]. Effective self-learning cannot be separated from the modern educational resources and environment as well as strict supervision and effective guidance. If there is no such prerequisite, self-learning will become inefficient.

Modern educational resources and environment mainly refers to the computer network [3]. The rapid development of the Internet has greatly broadened people's eyes, but also increased the learning methods. It can be said that the computer network is a strong assistant to self-study [4]. As can be seen from Figure 1, in order to build a self-network learning environment the need for elements to support including "network resources", "computer hardware", "supervision and management system" and "stage evaluation guide" is essential Support elements [5]. In the construction of the network self-learning environment, teachers are also an important part. Because teachers are the leader of the whole process of self-learning and they play an important role in the teaching process optimization and regulation [6]. Therefore, the network self-learning is inseparable from the teachers and the network environment based self-learning model is also a scientific methods and effective means for teacher's teaching [7].
Problems of Traditional Course of Electronic Circuit

Although China’s higher education reform has progressed smoothly and achieved many remarkable achievements, there are still many problems in traditional college courses, especially the Course of Electronic Circuit. In the traditional Course of Electronic Circuit, the traditional teaching model mainly includes the teachers’ teaching and the students’ self-learning. The connection of these two parts is the Q & A. If students encounter difficulties, they can ask the teachers and teachers answer questions for students according to the feedback. The whole teaching process is reasonable, but the problem appears in the Q & A section. Some students may not ask the teacher even if there are problems owing to their shyness; some students are not convenient to find the teacher because of time, location and other factors. The lack of Q & A results in the lack of feedback process, hence teachers are difficult to master the students’ learning situation. The main problems of traditional Course of Electronic Circuit include:

The defect of pre-class preparation: Pre-class preparation should be constantly adjusted, and the adjustment is based on the students’ feedback on the knowledge learned before. However, teachers do not have a good grasp of the students’ learning situation because of the lack of effective communication. Thus, teachers cannot make the appropriate adjustments for pre-class preparation.

The defect of teaching progress in class: At present, the Course of Electronic Circuit is difficult for many students. At the same time, the knowledge and technologies teachers teach are too old. Moreover, the completion of the experimental section is not good. Many universities lack experimental section, affecting the less understanding of theoretical knowledge and hands-on practical ability.

The defect of exercise lesson: Exercise lesson is also an important part of the teaching process. In the traditional exercise lesson, teachers select and explain the typical exercises. There are many shortcomings in this way. Different students encounter different problems, so teachers cannot take into account all the students. And teachers cannot select the common problems owing to the lack of communication between teachers and students, which may affect the quality of teaching.

The defect of traditional Q & A: As discussed before, the Q & A session is the key to the teaching process. The traditional face-to-face Q & A are limited by the time, location and the low efficiency. With the arrival of the information age, Q & A approach has become diverse, including SMS, phone, e-mail, QQ, WeChat, network teaching platform and so on. These Q & A approaches are not subject to time and location constraints, which can greatly improve the efficiency of Q & A.

In view of the problems in the traditional Course of Electronic Circuit, we propose a self-learning based interactive teaching model. On the one hand, a wealth of teaching resources on the Internet can assist teachers in teaching and guide students’ self-learning after school. On the other hand, teachers can build the communication between students and teachers using the real-time property and convenience. So that teachers can receive students’ feedback on learning situation in time, and
effectively adjust teaching progress and teaching strategies to improve students’ learning interest and teaching quality.

Interactive Learning Based on Network Environment

As shown in Figure 2, pre-class preparation, classroom teaching and student self-study in school time are coherence, and network teaching support is the key to the whole process. The main functions and the specific details of self-learning based interactive teaching model are as follows.

Pre-class Preparation

**Teaching Content Preparation:** The preparation of the teaching content is the basic work of the whole teaching work. Instead of mechanized preparing the lesson, teachers should understand students’ learning dynamic through the interaction with the students, making the preparation of teaching content. Keeping up with the development of the times is not enough, teachers also need fully understand the actual needs of students and learning situation.

**Teaching Means Design:** Through the design of teaching means, we can enrich the classroom content. Bring network video, actual case and other teaching resources to students can improve the effectiveness of teaching and enhance students’ interest in learning.

**Preparation of Counseling Materials:** The perfect teaching system is inseparable from the study of counseling materials. According to the rich resources of the Internet and the feedback of students’ learning situation, we can compile the study counseling book objectively. They focus on the basic knowledge of the course and basic skills, and provide the corresponding exercises, so that students can learn through counseling materials missing, consolidate the knowledge learned.

**Curriculum Practice Design:** Traditional electronic circuit course does not pay attention to curriculum practice, leading to students’ theoretical knowledge and practice losing connection. This part focus on curriculum practice design which makes students can improve their practical ability through the careful design of the curriculum practice project. By our method, students are able to skillfully use the knowledge to solve practical problems, master the general use of knowledge.

Teaching Session

**Inspired Interactive Teaching:** Teachers in the classroom teaching process should avoid spoon-fed teaching. On one hand, it will reduce the students’ interest in learning and independent thinking ability. On the other hand, it will affect the students’ understand of the knowledge. Teachers should be more interaction with students by heuristic teaching methods to guide students to independent analysis and independent thinking.

**Teaching Incentives:** In the inspiration interactive links, we use scores to improve student motivation, encouraging students to interact with each other.
Exercises: Through the network-assisted teaching system of difficult problem statistics, we could analyze the common problems encountered by the students during learning process and solve students' problems by compiling the learning materials and the exercises.

Self-study after School

Classroom Preview, Review: To encourage students to prepare before class, after school review, we provide students with appropriate prerequisite and review materials through the system, including reference materials, teaching videos, technical lectures, after-school exercises, teaching materials and test questions and other network resources.

Innovative Curriculum Design: It combines extracurricular knowledge and classroom knowledge so that the two complement each other and comprehensively improve the students' comprehensive ability.

Feedback: It’s the key of this session. Without feedback, all the various parts of the content will exist in isolation, cannot be organically combined. Through online feedback, teachers can grasp the dynamic of students and targeted design teaching contents.

Network Teaching Aids System

Network teaching aids system is the integration of self-learning based interactive teaching model. It involves the collection of teaching resources, the construction of network platform, the arrangement of auxiliary system and the design of supervision and management and evaluation guidance mechanism.

Online Q & A: Online question and answer is the main way for teachers to communicate with students. Students who have doubts during lesson could ask questions online in time. All teachers, teaching assistants and students can see, discuss and answer questions.

Problem Statistics: Students can put forward the teacher’s post-class homework or the network question bank in the difficult exercises. Teachers focus on certain problem to explain on the lesson, remaining problems can be discussed in the online interactive Q & A.

Feedback: Students can submit their opinions and suggestions to the instructor through the Internet by online feedback. The assistant can be responsible for screening meaningful and valuable suggestions and helping teachers to adjust the teaching program.

Others: From a variety of dimensions, we collect some teaching videos and produce open classes based on these ideas. We also host science and technology lectures and excellent course design show.

Teaching Practice Results and Analysis

In the practice of the interactive teaching model, we selected the Harbin Institute of Technology "The Electronic Circuit Basic" course as a pilot practice pilot course. We randomly divided the students into two groups, including an experimental group of 55 students, the contrast group of 100 students. They will learn "The Electronic Circuit Basic" course in the same period. The quantized 2016 network-based self-learning interactive teaching model result is shown in Table 1.

| Statistical item                                      | Statistical result |
|-------------------------------------------------------|--------------------|
| Number of students in teaching practice               | 55                 |
| Total number of questions discussed in online Q&A     | 103                |
| Percentage of coverage of the knowledge               | 87%                |
| Total number of participants                          | 189                |
| Per capita participation in the discussion            | 3.4                |
| Average grades of students participating in the teaching practice | 77.6              |
| Average grades of students in control group           | 68.4               |

It can be seen from Table 1 and Figure 3 that the interactive teaching mode of self-learning is not limited by the time and place, and it is possible to improve the enthusiasm of the students in Q & A.
interaction. The Q & A coverage of knowledge points and the number of students involved in the discussion are very impressive. A student’s problem can be reported to teachers anytime while other students can also join the thinking and discussion which will deepen the understanding of knowledge. From the examination results and performance distribution map, the experimental group of students have a significantly better score than the contrast group results. This kind of internet-based interactive teaching self-learning model has benefit the students.

![Figure 3. The self-learning based interactive teaching model student grade result comparison diagram.](image)

**Summary**

This paper first analyzes the problems existing in the teaching of university courses and puts forward the implementation plan of undergraduate electronic circuit course teaching mode based on interactive teaching and self-learning. Then, the model introduces a network-assisted teaching system, which combines pre-class preparation, class teaching and self-study after school to form a new integrated teaching program. Next, through the teaching practice results, it can be seen that the implementation of the program enrich the teaching resources and educational methods and improve students' enthusiasm for learning. Teachers and students can build effective communication so that teachers can master the students learning status in time. Teaching and Q & A are more targeted at the same time and students can take the initiative to participate in self-learning and discussion. In this way students can deepen the understanding and mastery of the course and improve academic performance and practical ability.

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