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Application of Blended Teaching Mode in the Golden Course Construction of Electromagnetic Field

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Abstract

In view of the problems and deficiencies in the theoretical teaching of "electromagnetic field", this paper reconstructs the teaching contents accroding to actual engineering projects and proposes the blended teaching mode in the golden course construction of "electromagnetic field". The blended teaching is carried out based on the internet teaching platform MOOC + Duifene and face-to-face classroom, which emphasizes the dominant position of students and student-teacher interaction to establish the learning mode under the teachers' guidance. The results show that the blended teaching mode can cultivate students' study initiative and enthusiasm and improve their academic achievements, the problem consciousness, critical thinking and innovation ability.

Keywords

Electromagnetic field; Golden course; Blended teaching; Online course; Face–to-face course.

1. Introduction

"Golden Course" is an evaluative term for high-quality courses. Wu Yan, the Director of the Department of Higher Education, Ministry of Education of China pointed out that the "Golden Course" should be full of profoundness- innovation-challenging, which provides direction for the golden course construction [1]. "Electromagnetic Field", which is an important professional basic course in the major of electrical engineering, has its complete theoretical knowledge framework and provides guidance for engineering practices. The course illustrates the field theory of electrical engineering major, while another important theory is the "path" provided by the course of "electric circuit theory " [2-3]. In order to obtain the distribution of the electromagnetic field, students are required to establish the viewpoint of the field, and apply mathematical knowledge to analyze the characteristics of the field source and the boundary conditions, and finally to solve engineering problems. The course itself is full of profoundness and challenging, the development of which embodies the innovative wisdom of generations of electromagnetic masters.

The blended teaching mode of online and offline has been widely used with the development of internet technology. According to the characteristics of the students, the blended teaching mode is adopted in the golden course construction of "electromagnetic field"in this paper. The mode is carried out based on the online teaching platform of Chinese University MOOC and Duifene platform [4], combined with the face-to-face offline teaching. It is important to point out that online course resources are from Professor Zhonghui of Shandong University. Furthermore, practical projects in electronic and electrical engineering are introduced to enrich the teaching contents. It is also very important to design a comprehensive, reasonable and effective assessment scheme. The construction of golden course will make beneficial attempts to cultivate high quality talents of electrical engineers of innovative consciousness, innovative spirit, problem consciousness, deep-thinking ability and practical ability.

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2. Bottlenecks of Electromagnetic Field Theoretical Teaching

At present, there are a series of problems in the theoretical teaching of electromagnetic field, which restrict the efficiency of the teaching [5-6].

(1) The course is not only rich in teaching content, but also abstract and difficult to understand. It includes electrostatic field, constant electric field, constant magnetic field, time-varying electromagnetic field, electromagnetic wave, etc. Vector analysis and field theory are the basic tools for the learning of electromagnetic field course. In addition, Maxwell equations are not only space-time functions, but also need to consider the characteristics of the medium, so that various application problems have different properties, while the undergraduate students have some limitations in the cognitive structure, thus there are difficulties in the course learning.

(2) With the reform and development of the electrical engineering major in colleges and universities, the teaching hours of basic courses of subjects and specialties have been reduced significantly. As a result, it is difficult to complete the existing teaching content in face-to-face teaching form, and the contradiction between content and class hours is intensified. In addition, with the advent of the intelligent manufacturing and the booming development of the electrical engineering, practical engineering problems, especially dynamic electromagnetic phenomena, are emerging in an endless stream. But the existing teaching content update slowly, which can not meet the needs of practical engineering exist in the teaching of electromagnetic field.

(3) The existing teaching mode is still based on classroom teaching, that is, “cracking duck” teaching. It is difficult for teachers to introduce abstract and obscure basic theories to students vividly, by the traditional modes such as textbooks, PPTs and blackboard writing. Especially in large classrooms, with a large number of students, it is impossible for teachers to take care of every student, which brings considerable difficulties to mobilize the learning enthusiasm thus the learning effect is poor.

3. Design of the Blended Teaching Mode

Nowadays, with the rapid development of the multimedia technology and the wide usage of internet, new opportunities and challenges have been brought to the golden course construction of electromagnetic field. At first, the teaching contents have been re-integrated according to the characteristics of students, course content, actual engineering projects and teaching assessment in this article. Then, the blended teaching mode is carried out based on the internet teaching platform of Chinese University MOOC + Duifene online and face-to-face classroom offline. The objective of the golden course construction is to make the learning process student-centered and give fully play to the dominating role of teachers, and at the same time, establish a practical connection between theoretical teaching and actual engineering projects.

The electromagnetic field course is facing sophomore students, whose interest and enthusiasm for learning are at their peak. They are interested in the engineering cases and have certain practical operation abilities. However, they are easy to retreat from difficulties because of their insufficient mathematical knowledges, poor learning sustainability and inertia. Therefore, in the golden course construction, the teaching concept is updated in order to cultivate talents with problem consciousness, critical thinking, innovation ability and world vision. First, the modular design of teaching content is carried out with the engineering examples used as guidance. Second, classroom time is used for efficient deep learning, and a large number of basic knowledge teaching are moved out of class, which is completed independently by students after class. Third, teaching method such as task-driven method and group discussion teaching are adopted to inspire students to discover and solve problems proactively, and cultivate students' innovative ability. And finally, the assessment method is reformed, and the usual performances

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of students are included in the final assessment, so as to fully mobilize the enthusiasm of students in learning.

3.1. Design of Teaching Contents

According to the contents of the course, the modular design of teaching content is carried out. Combined with textbooks, histories, teachers' experiences, students' experiences and industry situations, the corresponding engineering projects are introduced for each unit module. At first, the electromagnetic field model of practical engineering projects are summarized at the pre-class stage, then the theoretical basis of the analysis model is discussed in class. It is more important to guide students to summarize and apply the knowledges to the new engineering projects after class. The modular teaching content is designed according to the practice-theory-practice approach, which conforms to the students' cognitive law, and students could be cultivated with problem consciousness, critical thinking, innovation ability and world vision. The specific design of each unit is shown in Table 1.

Table 1 Actual engineering projects in each teaching module

Teaching module	Actual engineering projects
Electrostatic field	1. Design of high voltage coaxial line 2. Dielectric insulation design 3. Influence of impurities on dielectric insulation 4. Electrometer and electrostatic voltmeter
Constant electric field	1. Grounding resistance 2. Step voltage 3. Design of substation grounding grid
Constant magnetic field	1. Design of transformer core 2. Principle of rotating motor 3. Design of magnetic shield 4. Voltage transformer. Current transformer
Time-varying electromagnetic field	1. Principle of generator 2. Principle of electric motor 3. Principle of transformer
Quasi-steady state electromagnetic field	1. Electromagnetic analysis of coaxial cable 2. Bundle conductor 3. Principle of induction cooker 4. Electromagnetic shield
Plane electromagnetic wave	1. Electromagnetic analysis of coaxial cable 2. Bundle conductor 3. Principle of induction cooker 4. Electromagnetic shield
Uniform transmission line	1. Impedance matching 2. Overhead transmission circuit design 3. Electric energy transmission 4. Lightning protection design of transmission line

3.2. Design of Blended Teaching Process

The content of electromagnetic field is various but the class hours are few. It is difficult to complete the learning tasks with high quality only in class. Thus, in order to fully mobilize the enthusiasm and initiative of students before and after class, online and offline blended teaching mode is used in the golden course construction so that students could become the main body of learning. The design of the blended teaching process is shown in Figure 1. The teaching process is divided into three parts : pre- class, in-class and after-class. In each process, teachers

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and students are assigned different tasks, then it is essential to assess students' learning effects according to tasks.

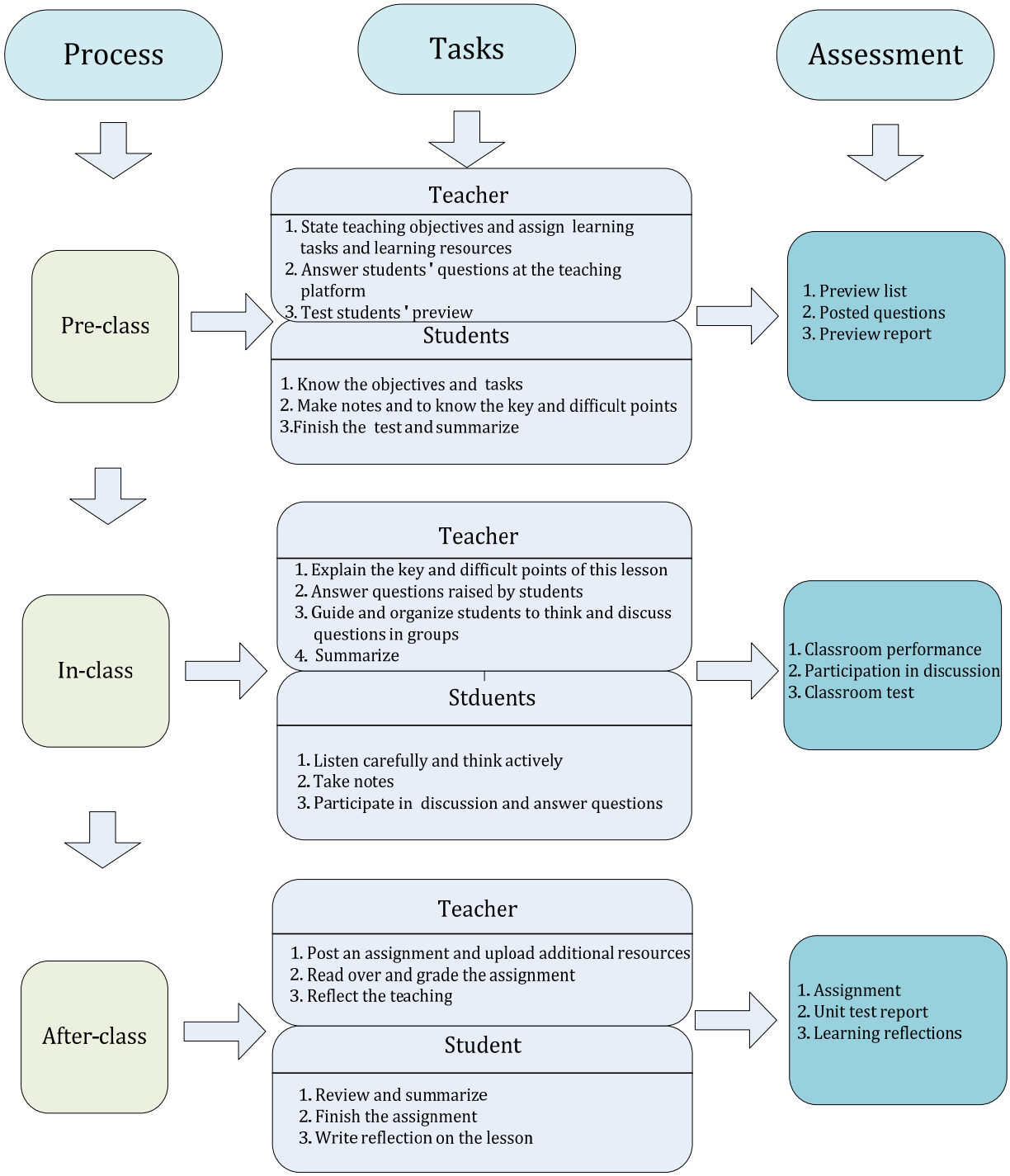

Figure 1. Blended teaching process design

According to the teaching content, reasonable distribution of online and offline teaching content is the first to do. The content that needs to be intensively taught in class offline includes the basic theories, concepts and formulas related to this unit, such as Maxwell's equations, and the common problems encountered by students before class. Combining the connotation and extension of the law, teachers can explain the theoretical knowledge in depth, thoroughly and systematically, which is conducive to students' systematic and orderly mastery, so as to play the professional advantages of teachers. On the other hand, the basic knowledge of college

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physics electromagnetics, engineering practical cases, the contents that need a lot of mathematical knowledge but difficult to understand are put out of class for students to learn after class. At this stage, we should focus on guiding students to master efficient learning methods and cultivate profoundness thinking. In addition, in the teaching process, flexible teaching methods such as problem inquiry method and group discussion are adopted according to the teaching content. Much more attentions to the cultivation of students' creativity and the capacity of reason are throughout the whole blended teaching process.

3.3. Design of Assessment Method

In this paper, we make full use of the score book of duifene teaching platform, which could automatically add up the attendance, online practices, assignments, tests, etc. in the system, then analyze and export the results according to the weight set by the teacher. Finally, the comprehensive scores of preview test, preview report, classroom performance, participation in dicussion, classroom test, assignment, learning reflections, science and technology papers and semi-open papers are taken as the final assessment. Thus, it is convenient to make a comprehensive and accurate quantitative assessment of students' learning achievements, and it also greatly reduces the workload of teachers.

4. Conclusion

This paper reconstructs the teaching contents accroding to the actual engineering projects and proposes the blended teaching mode in the golden course construction of “electromagnetic field”. Teaching practices show that the implementation of the blended teaching method for two semesters can effectively mobilize the enthusiasm of teachers and students, and make the learning process student-centered and give fully play to the dominating role of teachers.At the same time, it establishes a practical connection between theoretical teaching and engineering practice so that an atmosphere of scientific research can be created to stimulate student learning interest. Engineering awareness, teamwork spirit and innovative thinking ability of the students have been improved obviously.The effect of reform is getting better and better, and the teaching quality is constantly improving.

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