

Research on the Curriculum Reform of Circuit Basis in the Era of New Engineering and Curriculum-Based Political and Virtuous Awareness

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Abstract. The circuits basis is a professional fundamental course offered by electrical and electronic information majors in ordinary undergraduate universities. In many universities, theoretical knowledge of circuits basis is overemphasized and the explanation and analysis of practical cases are ignored. Under the situation of new engineering and curriculum-based political and virtuous awareness, how to enhance students' practical awareness and patriotism has become an important reform content of the circuit basis course. In the reform measures, we import project tasks and objectives, and display project results by using Multisim and Proteus virtual simulation software. On the other hand, we explore the ideological and political elements of the curriculum from five aspects: "research spirit", "mission and responsibility", "historical perspective", "philosophical thinking", and "unity and cooperation". From the effectiveness of the reform, students' political awareness and practical abilities have been improved.

Keywords: Curriculum Reform of Circuit Basis; New Engineering; Curriculum-Based Political and Virtuous Awareness.

1. Introduction

Since February 2017, the Ministry of Education has actively promoted the construction of new engineering disciplines, forming the "Fudan Consensus"[1], "Tianda Action"[2], and "Beijing Guidelines"[3]. It has also issued the "Notice on Conducting New Engineering Research and Practice" and the "Notice on Recommending New Engineering Research and Practice Projects", fully exploring the formation of a Chinese model and experience that leads global engineering education. In 2020, the Ministry of Education issued the "Guiding Outline for Ideological and Political Construction of Higher Education Curriculum"[4], which requires comprehensive promotion of ideological and political construction of higher education curriculum. The electronic information major is one of the main driving forces for the development of new engineering and is also one of the most active fields of innovation in the information era. The rapid development of technology and the talent demand in related industries have put forward new requirements and challenges for the education of electrical and electronic information majors in universities, which is bound to trigger changes and innovations in curriculum teaching. The circuit basis course is a professional foundation course offered by electrical and electronic information majors in ordinary undergraduate universities[5]. The main content of the course generally includes circuit laws, analysis of resistive circuits, dynamic circuit analysis, sinusoidal AC circuits, and two-port networks. This course was offered relatively early in universities with a certain depth and difficulty of teaching.

From the perspective of Nanfang college, circuit basis course plays a crucial role in various disciplines of the School of Electrical and Computer Engineering. In the national electronic design competition, 80% of the award-winning contestants need to use circuit basis as the core of electronic circuit design. In their graduation project, 50% of students majoring in Electronics and Communications will choose topics related to circuit design. In the process of employment, 60% of students majoring in electronics and communication will prioritize industries related to circuits. However, there are still several issues that need to be addressed urgently in the current teaching process of circuit basis.

Firstly, the teaching method is relatively single. The course content is taught to students through blackboard writing and multimedia. Although multimedia can directly display pictures, videos, and results to students, teachers have always been in a dominant position, and students' participation is too low. Although this can impart more knowledge to a certain extent, it is not easy to stimulate students' enthusiasm for learning, resulting in insufficient enthusiasm for students. The interaction between students and teachers is poor, and students unilaterally receive knowledge, which is more passive and not conducive to cultivating students' independent thinking ability.

The second problem is insufficient cultivation of students' practical and operational abilities. Students fail to meet the standards of integrating, mastering, and flexibly applying all content. They do not fundamentally understand the working principles of various functional modules of electronic components.

Thirdly, the distribution of theory and practice in homework is not reasonable, and there are currently more theoretical related homework than experimental homework, which leads to a lack of improvement in students' practical operation ability. The teaching content of the course lacks practical projects as guidance, which also leads to students not knowing what designs or projects can be done for circuit basis.

Finally, as an engineering course, how to perfectly combine course content with curriculum-based political and virtuous awareness needs to be further explored.

In order to change the traditional teaching mode of circuit basis and eliminate the disadvantages in Nanfang college, it is inevitable to reform circuit basis course.

2. Reform Content and Objectives

2.1 Reform Contents

The reform content of this paper can be organized as follows:

Firstly, based on the needs of application-oriented transformation, we fully investigate the talent needs of enterprises in the fields of electrical and electronic information, and update the teaching syllabus and textbook content. Constructing a student-centered and ability cultivation oriented engineering case teaching method, we address the traditional classroom cramming teaching model, and strengthen process education and active learning model. Combining the teaching mode of the "flipped classroom" course, we drive students to conduct case analysis and report in PPT format.

Secondly, combining virtual simulation software with project cases, we aim to achieve a higher level of reform in the engineering application curriculum of "teaching, learning, and doing" through innovative educational methods for new engineering. Based on the level of students of Nanfang college, following the basic laws of ability development, we integrate and optimize teaching content based on real projects and design typical cases and learning tasks from simple to complex.

Thirdly, introducing the power of enterprises to construct project cases of circuit basis courses, we integrate course content with the technical points of enterprise projects.

Finally, curriculum-based political and virtuous awareness for building circuit basis is explored from five aspects: "research spirit", "mission and responsibility", "historical perspective", "philosophical thinking", and "unity and cooperation". We integrated these points into teaching content in a subtle and silent way.

2.2 Reform Objectives

Based on the learning characteristics of students in Nanfang college, the application cases of project development tools such as Protuses simulation software, Multisim software are integrated into the independently written textbooks. The various knowledge points of the project are dissected and analyzed, and the course content is integrated with the knowledge points in a step-by-step manner.

Changing the teaching mode and constructing a project scenario based teaching mode, while ensuring regular teaching, students are assigned to independently design experimental questions and solve complex engineering problems. Furthermore, we drive them to conduct case analysis and report in the classroom using PPT, which can realize the goal of learning for use, and also achieve a "flipped classroom" teaching mode.

Improving the cooperation model between college and enterprises, it is necessary to build a higher level teaching staff for circuit basic course. Those young teachers lack project experience in enterprises and need to be sent to enterprises for training and learning related practical projects for providing students with higher levels of project-driven teaching.

Adhering to the main line of "strengthening students' ideals and beliefs, educating students to love the party, the country, the people, and the collective", we highlight value guidance in circuit basis course.

3. Reform implementation

The implementation method of this project mainly consists of four links: "ideological and political guidance", "engineering introduction", "formulation of plans", "implementation plans", and "achievement display and evaluation". Among them, engineering driven teaching runs through all links.

Firstly, in the process of "curriculum-based political and virtuous awareness guidance", we follow the concept of "curriculum ideological and political education and ideological and political courses going together". curriculum-based political and virtuous awareness education in the curriculum teaching process is carried out from five aspects: "research spirit", "mission and responsibility", "historical perspective", "philosophical thinking", and "unity and cooperation". Coordinating and unifying teaching methods to realize curriculum-based political and virtuous awareness goals can be organized as five methods: "heuristic", "discussion", "inquiry", "interactive", and "flipped classroom".

Secondly, in the "project introduction" phase, the activities of the teacher can be organized as three aspects. (1) Using Multisim and Proteus virtual simulation software, we import project tasks and objectives, display project results, and provide students with an intuitive understanding of the project before assigning specific learning tasks. (2) Using project scenario based teaching methods, different project roles are set for each group of students. We allow each students to clarify the specific tasks, as well as what project knowledge and level they can learn after completing the tasks. (3) On the basis of considering students' existing knowledge and ability levels, incremental driving of completed projects is carried out by using collaborative learning methods. And higher-level and deeper questions are arranged to guide students' thinking and design solutions to complete the problem.

Thirdly, in the "plan making" stage, students analyze the task objectives of the project through self-directed learning and group collaborative learning, determine the various elements involved in the task. They fully apply the knowledge and determine the implementation steps of the task. Sufficient preparations are need to be done for the implementation of the task. They select relevant electronic components and list the required components for the project in Multisim and Proteus simulation software.

Fourthly, in the "implementation plan" phase, students gradually complete project tasks using simulation software. Teachers use the effects generated by simulation software to guide students in implementing norms, and provide deeper project requirements for excellent students. Students complete course tasks by applying the knowledge they have learned, and master project development skills and team collaboration.

Fifth, in the "presentation and evaluation" section, flipped classroom teaching is used. Students present their project results in the form of PPT presentations in the classroom, and receive feedback from others and teachers. At the same time, during the process of reporting and listening to

classmates' reports, students identify shortcomings by comparing their own achievements with classmates, and reflect on the reasons for their failures or incomplete projects.

4. Summary

The issues in the reform of circuit basic courses in the era of "new engineering" mainly lie in the difficulty in understanding the principle of circuit equivalence, the difficulty in contacting sinusoidal AC circuits, the difficulty in implementing three-phase circuits, and the difficulty in integrating principles with engineering. In order to help students solve the above difficulties and reflect the characteristics and innovation of this paper, we have established five major cognitions: understanding cognition, structural cognition, simulation cognition, ideological and political cognition, and engineering cognition.

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