



# Teaching Reform and Practice of Electrical and Electronic Technology Courses Against the Background of Emerging Engineering Education

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**Abstract.** Emerging engineering education is the necessary road, strategic support and leading force for building a strong education country in China. Electrical and electronic technology course as a professional foundation course plays a key role in the realization of professional talents training objectives. In this paper, the reform is carried out in terms of modularization of teaching contents, modernization of teaching methods and diversification of teaching evaluation, focusing on the integration of curriculum ideological and political education, the implementation of online and offline hybrid teaching methods, application of simulation software, keeping the course contents up-to-date and integration with competitions and industries, etc. The comprehensive reform of the whole teaching process is carried out. Practices show that the reform has been recognized by students and has improved students' performance and the teaching level of the teaching team.

**Keywords:** Emerging engineering education · teaching reform · OBE concept · integration · hybrid teaching

## 1 Introduction

Since February 2017, the Ministry of Education has been actively promoting the construction of emerging engineering education, which is based on the background of new economy and new industry, focusing on the new concept of engineering teaching, new structure of disciplines and specialties and new mode of talent cultivation, building a new structure of disciplines and specialties combining new engineering and traditional engineering, exploring and implementing "new mode" of engineering education talent cultivation, "new quality" of engineering education with international competitiveness, and establish a perfect "new system" of engineering education with Chinese characteristics [1, 2]. Emerging engineering education is the necessary road, strategic support and leading force for building an education power in China [3]. The new engineering education requires us to explore a new knowledge and curriculum system with new knowledge, new technology and new content, adopt a new mode of education and teaching, and cultivate new talents of various types for the development of new technology and new industry [4].

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The course of Electrical and Electronic Technology is a professional foundation course in electrical and electronic technology for non-electric undergraduate majors, which provides non-electric undergraduate students with the necessary basic knowledge of electrical engineering, electronic information engineering and control engineering, cultivates their ability to solve electrical and information technology problems, helps students broaden their horizons, establish engineering awareness, focus on interdisciplinary integration, and promotes students' innovation [5]. This course is one of the early professional foundation courses for non-electrical majors to contact after entering school, so this course not only has an enlightening and pioneering role in guiding students to master the basic knowledge of electrical and electronic technology, cultivating students' engineering thinking, innovation ability and craftsmanship, but also the construction and teaching quality of this course directly affects students' cognitive degree of the major and their interest in learning subsequent courses. Therefore, under the background of new engineering, in order to meet the national development needs and adapt to the new scientific and technological revolution and industrial changes, the electrical and electronic technology course must keep pace with the times, with the fundamental task of establishing moral education, with the development of students as the center, with the learning output as the guide, with the goal of meeting the graduation requirements, with continuous improvement as the guarantee, to create a first-class course with "profoundness, innovation and challenge". In order to cultivate high quality applied and innovative talents who can adapt to the development of society [6, 7].

## 2 Objectives of Curriculum Reform

In accordance with the curriculum standard of profoundness and innovation and challenge of the Ministry of Education, based on the fundamental task of establishing moral education, the curriculum team sets the objectives of the curriculum in four aspects of knowledge, ability, quality and value, and achieves the goal of lifelong learning through independent learning, cooperative learning and inquiry learning. As shown in Fig. 1.

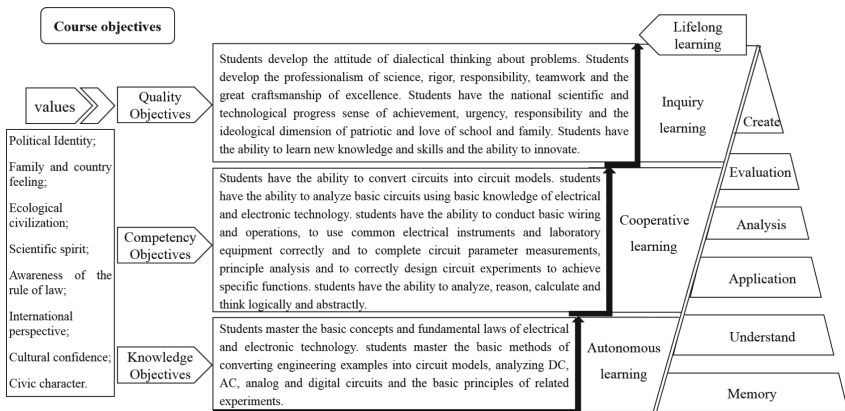


Fig. 1. Teaching Objectives of Electrical and Electronic Technology

### 3 Content of Curriculum Reform

#### 3.1 The Implementation of Curriculum Ideological and Political, Moral Education

The electrical and electronic technology course is a course that teaches electrical and electronic circuit analysis and design methods in terms of knowledge, and its content is more theoretical. In terms of quality it is a critical period for students who have just completed the transformation of their university identity, the transformation of all aspects of learning, thinking, life and interpersonal interaction, the formation of three views and habits. It is also an important node to establish the sense of responsibility for engineers. In the teaching process, the introduction of education and guidance content on students' outlook on life, values and worldview can help students establish a correct outlook on life, cultivate the quality of engineers with craftsmanship, and help students establish a sense of love and pride for their country and school, and then stimulate their sense of commitment and dedication [8].

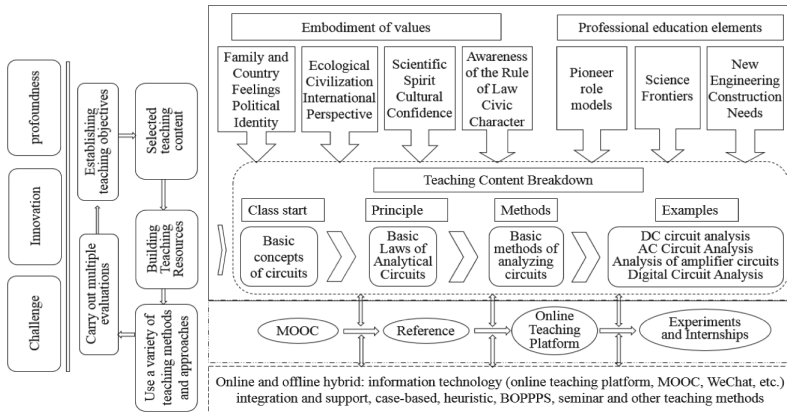
It is necessary to control the time and ensure the quality of teaching on the premise of introducing the content of curriculum ideological and political education as imperceptibly as possible, so that students can unconsciously identify with the moral education content of the curriculum ideological and political education and practice it in their life and study. In order to achieve the above purpose, this course adopts the teaching design of "theme + infiltration", dividing the content of the curriculum ideological and political education into theme teaching points and infiltration teaching points, which are used throughout the teaching process.

The teaching goal of the ideological and political education in electrical and electronic technology course is to cultivate the future pillars of the country. Given that this course is a basic compulsory course, it mainly cultivates students' research spirit of basic science and deep national feelings. First, in the first class at the beginning of the school year, students will be informed of the course's objectives of the ideological and political objectives of the course, so as to provide students with obvious moral education teaching and ideological guidance from the front. Second, there are thematic thinking objectives of the chapter in each chapter on the learning online platform, so that ideological and political education will be carried out throughout the teaching process. Third, at the beginning of the PPT of each lesson, a famous quote is used to introduce the topic, thus achieving the effect of enlightening students' minds.

The infiltration teaching point is based on the premise of the whole curriculum ideological and political education objectives, combined with the curriculum ideological and political education theme of each chapter, through a random, hidden, subtle way, by the teacher before class in connection with the current social hotspots and topics of concern to students, to educate and integrate the students' thoughts, so that students unknowingly receive ideological and political education.

#### 3.2 Rearrange Knowledge Points and Update Teaching Content

According to the new engineering and OBE concept [9], the "knowledge points" are rearranged and combined, and the knowledge points of the traditional curriculum are



**Fig. 2.** General design of electrical and electronic technology course

deconstructed in the teaching context according to the requirements of different professional training models in engineering. We design a learning situation that integrates teaching, learning and doing, and build the electrical and electronic technology course into an innovative emerging engineering course that integrates theory and practice, theory and competition, teaching and competition, and meets the needs of students from different majors to promote the learning of their own disciplines through interdisciplinary intersection, penetration and integration.

The course content is updated with artificial intelligence, Internet + and economic development, and new knowledge, technology, techniques and cases are introduced into the course in time to provide students with a knowledge system that meets the need of the time. Each section of the course is designed with “Learning objectives”, “Curriculum ideological and political education”, “Course summary” and “Knowledge expansion” as the main lines. Each section begins with a summary of the content and learning objectives, so that students can have a clear goal before studying; at the end of each section, the main knowledge points are summarized. This is shown in Fig. 2.

### 3.3 Integration of Theoretical and Practical Courses to Improve Students' Comprehensive Ability

Through the integration of theory and practice courses externally driven, experimental teaching of electrical and electronic technology is conducted to improve students' comprehensive ability and scientific literacy. Teachers require students to meticulously, rigorously and conscientiously follow the specifications for practical training operations, record data completely and condense the spirit of craftsmanship. Resolutely resist the phenomenon of modifying data, and cultivate students' realistic and rigorous scientific attitude. When the experimental results do not match with the theory, guide the students to analyze the reasons and solve the problems. After the practical training, students are required to return the components and wires according to the placement before the practical training, forming good habits and professionalism. Law verification makes students establish the scientific spirit of “practice is the only criterion to test the truth”.

Through the internal drive of students' participation in extracurricular scientific and technological activities, disciplinary competitions, innovation competitions, independent choice of analytical thinking methods, expand students' innovative consciousness, to achieve integration with this professional knowledge, integration of theory and practice links, integration with advanced frontier knowledge and theoretical systems and integration with the implementation of curriculum ideological and political education, as well as internal and external drive has been integrated.

### **3.4 Adopt the Whole Nested Multiple Evaluation System to Improve Students' Self-learning Ability**

The electrical and electronic technology classroom teaching model is centered on student development and focuses on cultivating students' self-learning ability and the ability to apply knowledge to solve problems. The course explores various types of assessment methods to make examinations an intermediate part of continued learning and to achieve process-based assessment. The assessment system emphasizes honesty, with teachers scoring strictly according to the assessment methods. Reinforces the concept of time, with no points awarded for failure to attend classes and turn in assignments on time. Sets motorized points to motivate students to study actively and aggressively. The fair, open and timely assessment results not only provide timely feedback to teachers' teaching and students' self-study, but also in the process students get integrity education and improve their sense of competition. As showing in Fig. 3. Figure 4 shows the breakdown of the usual performance assessment of electrical and electronic technology courses.

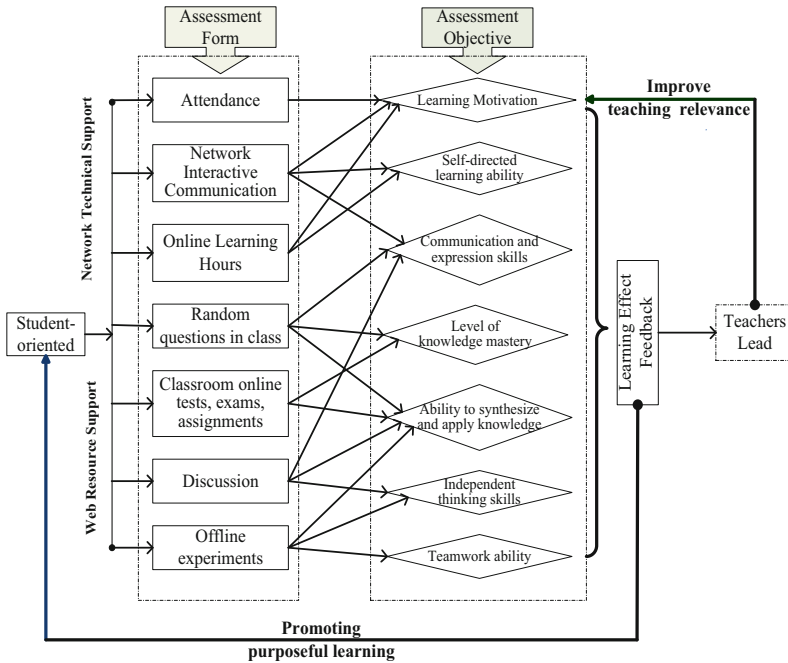
### **3.5 Implementation of BOPPPS Teaching Model Innovation to Improve Classroom Efficiency**

This course uses the online teaching platform to connect the teacher side, mobile side and management side, and integrates student learning, teaching practice and teaching management into one, fully carrying out BOPPPS teaching, which on the one hand improves students' enthusiasm for classroom learning, on the other hand ensures sufficient practice time for students, consolidates students' skills of analysis and design of circuits, and has a significant effect on the improvement of students' engineering application ability. It has a significant effect on the improvement of students' engineering application ability [10, 11]. The specific implementation cases are shown in Table 1. The case was adjusted according to the class situation, and the objectives and pre- assessment were advanced to the preview stage, which was completed online by students after studying the preview courseware.

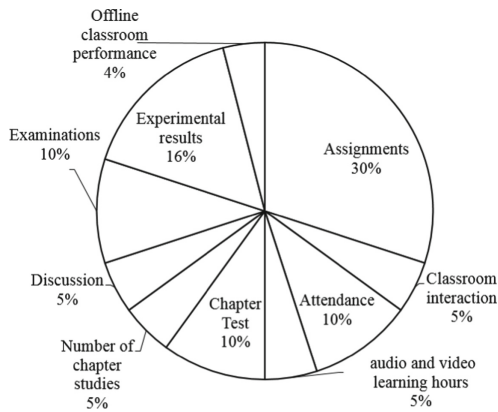
## **4 Effectiveness of Curriculum Reform**

### **4.1 Students' Academic Performance Has Been Improved**

The teaching reform of the course has been practiced for two rounds for the students of mechanical design and manufacturing and automation in the classes of 2019 and 2020. The results of the practice show that the reform has positively contributed to the



**Fig. 3.** Feedback mechanism of examination method of electrical and electronic technology course



**Fig. 4.** The breakdown of the usual performance assessment of electrical and electronic technology courses

improvement of students’ performance, as shown in Table 2. From the table, it can be seen that not only the average grade, pass rate and course goal achievement of students have been improved, but also the gap between students’ performance has been decreasing.

**Table 1.** Example of BOPPPS teaching design for electrical and electronic technology class

serial number	Teaching Process	Teaching content (Kirchhoff's law)
1	Objective: Help students clarify course objectives and grasp key points.	The online platform chapter resource "Guide" informs students of the knowledge, ability, quality objectives and key points of the lesson.
2	Pre-assessment: Improve classroom efficiency and student achievement.	Online quizzes are conducted through the online testing function on the online teaching platform to find out the difficulties of students' learning and to be learning-centered.
3	Bridge-in: Learn the method of comparative analysis of problems, exercise comparative thinking and the courage to discover the essence of the spirit of exploration.	Using quotes from famous people and a comparison of simple and complex circuits, we introduce the most fundamental law that needs to be learned to solve circuit problems: Kirchhoff's Law.
4	Participatory Learning: Helps students gain a deeper understanding of learning content and achieve learning objectives.	Task 1: learning the concepts of branch, node, loop and mesh. Task 2: learning KCL. Task 3: Learning KVL; Task 4: Integrate KCL and KVL to solve circuit problems.
5	Post-assessment: Conduct brainstorming and active discussion to improve knowledge transfer.	Post accompanying tests and collaborative group discussions to derive extensions of Kirchhoff's Law applications.
6	Summary: Develop students' summarization and induction skills.	Students will summarize KCL and KVL, and the teacher will guide to add and improve them. Practice analyzing complex circuits to prepare for the calculation of potentials in the next lesson.

## 4.2 The Teaching Level of the Teaching Team Has Been Recognized by Students

The teaching ranking of all the teachers in the Electrical and Electronic Technology course team has improved significantly, and the teachers' teaching ranking in the past two years had been ranked in the top 20% of the college. And the feedback from the questionnaire at the end of the latest semester also shows that students recognize the reform effect of the course. As showing in Table 3.

**Table 2.** Comparison of student performance before and after curriculum reform

Time	Average value	Sample size	Standard deviation	Passing Rate	Highest score	Lowest Score	Full distance	Achievement of course objectives
Before the reform	65.43	145	16.38	67.78%	92	32	60	0.7496
The first reform	69.84	167	14.25	77.85%	95	45	50	0.7689
The second Reform	75.53	124	12.56	79.98%	95	51	44	0.8362

**Table 3.** Feedback form for students of the teaching reform model

Evaluation Projects	Number of student ratings A rating of 5 to 1 represents a gradual decrease in student approval				
	5	4	3	2	1
The Need for Teaching Civics Content in Professional Courses	115	1	1	1	1
The degree to which the teacher's performance in terms of ideals and beliefs, moral sentiments, solid knowledge and benevolence influenced your moral character	110	5	2	1	1
Recognition of the adopted online and offline hybrid teaching	116	3	0	0	0
Satisfaction with the introduction of new knowledge, skills and processes into the curriculum	109	4	4	1	1
Degree of integration of courses with subject competitions and scientific and technological activities	115	3	0	1	0
The need to integrate simulation software into the curriculum	110	3	4	1	1
Recognition of evaluation methods	112	5	0	0	2



## 5 Conclusions

The change of the world industrial revolution has promoted the transformation and upgrading of China's industry. Thus, the industry needs more innovative and complex talents with solid foundation, broad knowledge and strong ability. Therefore, under the environment of new engineering, the reform ideas and methods of the electrical and electronic technology course proposed in the article are based on the cultivation of professionalism and good learning habits, the modular design and reorganization of teaching knowledge points, the updating of course contents, the active integration of course contents with industries and competitions, the adoption of offline and offline mixed teaching methods, and the continuous improvement of assessment methods, etc. The reform and practice have been carried out. Curriculum reform has laid a good foundation for students to learn the subsequent course and achieve the goal of cultivating new engineering talents.

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