# Research on Digital Electronic Technology Course in the Background of New Engineering

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**Abstract.** In the background of New Engineering, the cross-fertilisation of applicability and design of engineering education is required, which puts forward higher requirements for talent cultivation in applied undergraduate colleges. In view of the characteristics of Digital Electronics Technology Course and its current situation, we adopt the online-offline blended teaching with cross-cutting projects, embedding the elements of Civics and optimising the assessment methods, aiming at improving students' learning initiative, exercising their hands-on ability, practicability and innovativeness.

**Keywords:** New Engineering, cross-cutting projects, curriculum Civics, blended teaching model.

## 1 Introduction

New engineering to artificial intelligence, integrated circuits and other new-generation electronic information technology to promote human society into the era of intelligent connection of everything, greatly changing people's way of life and mode of thinking, but also make the teaching reform and innovation of electronic information courses has become an important task in the new era of talent cultivation and the construction of New Engineering[1].

Digital Electronics Technology Course is a basic course for electronics-related majors, which plays an important role in the training of professional talents. The teaching goal is to enable students to apply modern digital system design methods to carry out complex engineering design and innovation, and to become innovative talents with socialist core values and craftsmanship. Therefore, the teaching of Digital Electronic Technology Course should, on the one hand, enable students to master the subject knowledge of the course and apply it in practice, and on the other hand, it should strengthen moral education and implement ideological and political education into the whole process of teaching the course. In the teaching reform practice in recent years, the course team has reorganised the teaching content and formed the current teaching method of hybrid+cross-cutting projects, while fully exploring the nurturing resources of the course, accurately setting the ideological and political teaching objectives of the


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course, so as to achieve the co-construction of the course and the ideological and political education.

## 2 Basis of the Study

In order to improve students' low interest in learning, enhance practical ability and innovation, this reform mainly replaces the bland assembly line lectures with blended+through advanced project teaching, adds electronic practical training, and replaces the traditional pure offline mode of PPT+scripts with online-offline blended teaching to strengthen practical ability and teamwork ability. Teamwork ability is strengthened.

Outcome-Based Education (OBE) is an advanced educational philosophy that emphasises the following four aspects in the design and implementation of teaching and learning: the training objectives should be demand-oriented, the graduation requirements should be oriented to the training objectives, the curriculum system and the teaching of the courses should be oriented to the graduation requirements, and the allocation of resources should be oriented to the support of the graduation requirements and the attainment of the training objectives [2-3].

Specifically for Digital Electronics Technology Course, taking our school as an example, there are three main training objectives:

Course Objective 1: To master the basic concepts and basic applications of digital electronics; to be able to access professional information on digital electronics; to be able to complete the analysis of simple digital circuits and design digital circuits using suitable small and medium scale digital modules.

Course Objective 2: To be able to learn and practice digital electronic technology in a cooperative way; to complete the design of small-scale digital systems through teamwork and rational use of digital circuit chips; to build up a sense of teamwork.

Course Objective 3: With the fundamental goal of Establishing Morality and Nurturing People and the school motto of Mingzhi, Erudition, Cultivation and Practice, the ideological values and spiritual connotations embedded in the knowledge system of the course will be refined, and students will be cultivated to be patriotic and strive for patriotism, to take charge of the enterprising spirit of science, and to be courageous in exploration and the pursuit of excellence. It also aims to cultivate the scientific spirit of patriotism, commitment and enterprise, the innovative spirit of exploration and pursuit of excellence, and the practical ability of seeking truth from facts and solving problems.

## 3 Main Ways to Research

According to the objectives of the course, the main initiatives of the research are as follows:

### 3.1 Introducing High-quality Online Courses and Self-Built Special Online Resources

Introduce the national boutique online course Fundamentals of Digital Electronics Technology (Huazhong University of Science and Technology, Luo Jie) in the form of MOOC, and participate in the management and improvement of the online course. The complete knowledge system of the course allows some students with poor foundation who cannot keep up with the progress of classroom teaching to learn by regurgitation outside the classroom[4]. At the same time, the content of the course is reasonably optimised, and the Number System and Code System, which is duplicated with the content of the basic computer course, is only for review and check; the logic gate circuits, which are at the lower level, are only for the understanding of the content; all the logic chips are explained in a way that reduces the analysis of the internal principles of the functional devices, and increases the expression of the parameters of their use and the precautions[5].

Self-built online resources that can dynamically update the content, in the form of SPOC to push the relevant extension videos and literature according to the teaching progress, to expand students' knowledge and academic horizons.

### 3.2 Introducing Cross-curricular Projects to Link up all Teaching Contents

Course teaching around the basic digital logic, combinational logic circuits, flip-flops and latches, timing logic circuits, waveform conversion circuits to start, the design of through the advanced project, layer by layer and expansion, before and after the echo, so that the student's design is more coherent and diverse[6]. Through the project-driven teaching form organised throughout all teaching activities[7-8]. In order to break through the hardware teaching resource constraints, make full use of the simulation software, design and verify their own circuits at any time, but also for the physical hardware welding to provide a certain degree of accuracy. This design contains two parts: virtual simulation and electronic practical training. Students can simulation software, such as Proteus or Multisim for circuit analysis and design. After verification of circuit is correct, students can welding and debugging, exercise hands-on ability, from virtual to real, virtual and real combination [9].

The cross-cutting project used for the Grade 2022 Electronic Information Engineering programme was the design of a robocaller, although the project content is simple, but closely related to the knowledge points of the textbook, if the design of a completely unique programme of their own, it can be effectively linked to all the content of the teaching. The knowledge points associated with the project and the requirements are shown in Table 1.

**Table 1.** The corresponding knowledge points and project requirements of the cross-cutting projects.

| Project name | Related Knowledge Points | Project requirements |
|---|---|---|
| 1、basic robocaller | combinatorial logic circuit | Realise eight-way robocall, dial switch input, digital tube display |
| 2、junior robocaller | Latches and Flip-Flops | Change inputs to flick switches, add moderator control buttons |
| 3、senior robocaller | Pulse waveform generation and conversion | Add a countdown timer for robocalls |

The system block diagram of the basic robocaller in the table is shown in Figure 1, the system block diagram of the junior robocaller is shown in Figure 2, and the system block diagram of the senior robocaller is shown in Figure 3. As can be seen from the block diagram, the project gradually add the corresponding teaching content, not only will not let the students at once afraid of the difficulty, but also can increase the difficulty of the gentle slope, and in their own original design based on the improvement of the sense of achievement. Due to the variety of implementation chips for each module, such as integrated encoder 8-wire-3-wire priority encoder CD4532, 8-wire-3-wire priority encoder 74LS148, 9-wire-4-wire BCD priority encoder 74LS147, the logic function of these chips is roughly the same, but there are different control pins as well as the effective level of each circuit to match up with, can be derived from a larger number of Each circuit can be derived from a variety of design solutions, stimulating the students' creative enthusiasm. Due to the different chips used, the level matching and the control of logic ports in the process of chip connection need to be handled reasonably.

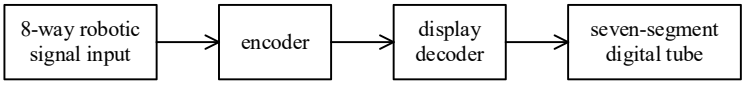


**Fig. 1.** System block diagram of the basic robocaller.

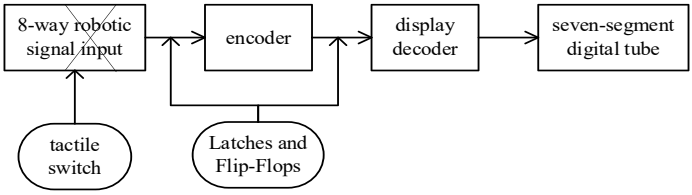


**Fig. 2.** System block diagram of the junior robocaller.

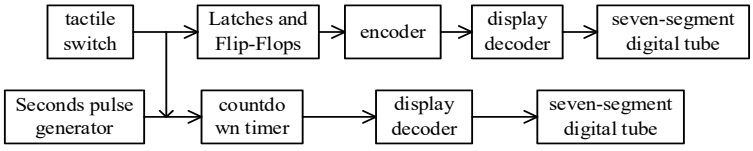


**Fig. 3.** System block diagram of the senior robocaller.

The use of cross-cutting project teaching, the entire implementation process is as follows: first of all, students online self-study of the corresponding theoretical knowledge, offline teaching when the teacher through the online platform released classroom tests, as shown in Figure 4; student representatives were randomly selected to answer the questions, as shown in Figure5; the teacher, after the theoretical part of the explanation, put forward the project design requirements and methodology, and give the project's structure of the block diagram, in order to achieve the block diagram of the Various functions, students need to consult the information under the guidance of the teacher, the use of different logic chips to complete, as shown in Figure 6; chip to determine, the use of simulation software Proteus or Multisim to build the circuit, as shown in Figure 7; student representatives on the stage to show their own design, as a way to improve the verbal expression and self-presentation ability, the same group of students can be supplemented, as shown in Figure 8; finally Teacher summary.

**Fig. 4.** Modern Teaching Tools Released for Classroom Testing.

**Fig. 5.** Student representatives answering questions.

**Fig. 6.** Students consult chip information to design circuits.

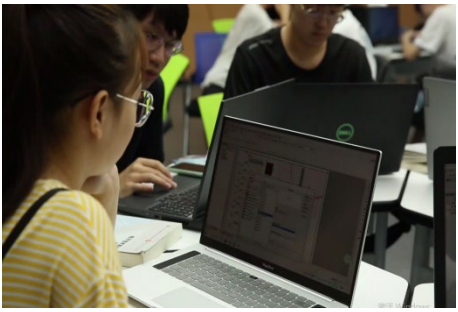

**Fig. 7.** Students build circuits using simulation software.

**Fig. 8.** Student representatives on stage to present design ideas.

### 3.3 Digging Deep into the Elements Of Course Civics and Politics to Cultivate Students' Correct Three Viewpoints

Facing the construction of New Engineering, the teachers of the course group practice the concept of course civic and political education, and determine the objectives of course civic and political construction to cultivate the spirit of craftsmanship of excellence, strengthen the education of engineering ethics, and stimulate the sense of mission of serving the country with science and technology [10]. Digging deep into the elements of Civics and Politics, we cultivate the engineering thinking of students to correctly understand the problem, analyse the problem and solve the problem, and help students form the correct three views.

First of all, update the teachers' concept of education, teaching and educating people is always one and the same, nowadays teachers not only need to teach skills and knowledge, but also need to have a Big Civics and Politics pattern of education, mobilise the students' interest in learning, cultivate practical hands-on ability, pay attention to the students' ability to solve complex engineering problems, and at the same time, constantly cultivate students' sense of social responsibility. In addition, it is also necessary to improve the high quality of the courses. In addition, it is also necessary to improve the higher-order nature of the courses, especially the digital electronics technology such as the course of the times, should be orientated to the new era, exercise students' higher-order thinking and creativity.

Secondly, students' learning concepts should be updated. Cultivate students' independent learning ability, adopt various resources and methods to guide students to learn actively, love to learn, and from this to the other, even if they encounter new things or new knowledge that they have not learnt, they can actively explore and practice on their own initiative.

Finally, the teachers of the course team excavate and refine the course's political thinking elements in an all-round and multi-dimensional way, and establish a political thinking case base. For example, the course explains the history of the development of electronic technology, the development of chips and the development of integrated circuits in the introductory part. China's chip industry has long been restricted by others, even if there are like the Galaxy supercomputer these 'face' on the product, its 'inside' with foreign imports of chips. China in the core field of integrated circuits, 'lack of core less nuclear', to stimulate students' patriotic feelings and enthusiasm for national glory, to build the national sense of responsibility and professional sense of honour, etc. [11].

### 3.4 Adopting N-dimensional evaluation System, Focusing on Course Process Evaluation

Adopting a diversified evaluation system, as in Figure 9, using the data function of the online platform to carry out statistics and evaluation of the whole process of students' online independent learning, the process can be retrospective and reflective improvement. The usual grades account for 60% of the total course grades, and the final paper grades account for 40%, reducing the proportion of the final grades and changing the pattern of a test. The usual grade is set as follows: 21% of the total grade is based on the online learning effectiveness of the platform, 12% on the three offline quizzes, 21% on the cross-cutting group project, and 6% on the offline classroom performance. The cross-cutting project mainly assesses students' teamwork ability, innovative design ability combining theory and practice, and comprehensive expression ability, and the grade consists of teacher's evaluation, inter-group mutual evaluation and intra-group self-assessment, with a weighting of 5:3:2, respectively, so as to enable students to cultivate fair and impartial character through participating in the evaluation of the project and assignment.

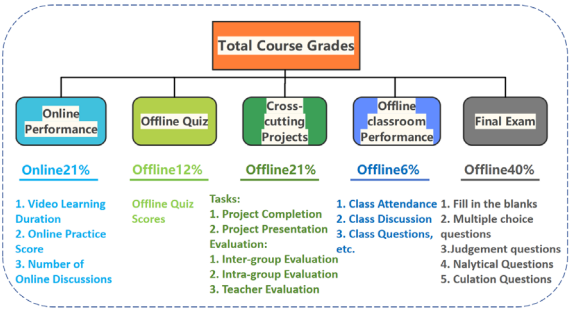


**Fig. 9.** Diversified assessment and evaluation system.

# 4 Reform Effectiveness and Results

## 4.1 Improvement of Academic Performance and Stimulation of Enthusiasm for Learning

Through the three-year curriculum reform, the students' overall assessment scores have been raised from about 70 to about 75, and the passing rate has also been raised from about 80% to about 90%. In addition, students' learning interest and enthusiasm have been improved, practical innovation ability has been obviously strengthened, in recent years the national college students electronic design competition have won a better ranking, in addition to college students innovation and entrepreneurship competition, Internet+ and other competitions, the number of students enrolled in the competition is also increasing year by year. 2021 the course leader and the students applied for utility model patents together.

## 4.2 Improvement of Academic Performance and Stimulation of Enthusiasm for Learning

Teachers' teaching ability is improved, students' evaluation is excellent, and the satisfaction of questionnaires is high. 2021, this course was recognised as a first-class online and offline hybrid undergraduate course in Fujian Province; 2022, a project was set up for the exploration of the application of the teaching mode based on 'Mucous Class-Virtual Simulation-Electronic Practical Training' in Digital Electronics Technology for the university-level teaching reform; In 2022, the team's research result Digital Electronics Technology Curriculum Construction Based on Cross-cutting Project Realisation in the Context of New Engineering Science was selected as the Excellent Teaching Cases of New Engineering Science in Fujian Province; in 2023, the 'Mixed Teaching Practice of Digital Electronics Technology Based on Cross-cutting Project Driven in the Context of New Engineering Science' was awarded as the Best Teaching Case in Fujian Province in 2023. In 2023, the Blended Teaching Practice of Digital Electronics Technology Based on Cross-cutting Project Driving in the Context of New Engineering won the second prize of Typical Cases in the Decade of Catechism in Fujian Province; in 2022, the project of School-level Civics and Politics (Digital Electronics Technology) was set up.

## 4.3 Preparation of Course Materials and Continuous Updating of Resources

The teaching team published the teaching materials of Digital Electronics Technology in 2021.8 by Dalian University of Technology Press, which has adjusted the teaching content accordingly. At present, the second edition of the textbook has signed a contract with Electronic Industry Press and is expected to be published in 2025.1. This revision is mainly to add a through the project and related elements of the ideological and political elements, and in the chapter at the addition of QR code, students can scan the chapter video, post-course exercises, project analysis and other resources, the textbook to

truly realize the information technology, three-dimensional, and enhance the autonomy and flexibility of students' learning, for the majority of students and teachers to provide a more comprehensive and diversified teaching materials supporting services [12].

## 5 Conclusions

The curriculum reform of Digital Electronics Technology in the background of new engineering disciplines adopts a new mode of hybrid and cross-cutting teaching, which solves the problem of synergistic enhancement of students' comprehensive quality and test-taking level; taps the elements of Civic and Political Studies from six aspects and establishes a Civic and Political Studies Case Resource Bank of the curriculum, so as to achieve unity in education and teaching; weakens the proportion of the final examination, emphasises the process of assessment, and the evaluation system is more diversified and fairer.

However, teaching reform is a long-term and continuous process, and there are still a lot of problems to be solved, such as the perfection and advancement of the blended teaching resources, the diversity of the cross-cutting progression projects and the examination of the contents of the Civics and Politics, etc., which need to be further explored and explored.

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