

# Teaching Reform of "Digital Electronic Technology" Course in Higher Vocational College

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## Abstract

Based on the characteristics of higher vocational undergraduate students' learning situation and less class hours, the online open course teaching platform and virtual simulation are used to realize hierarchical teaching, maximize students' learning enthusiasm and initiative, and maximize the teaching quality and effect.

## Keywords

Undergraduate major in Higher Vocational Colleges, Less class hours; Virtual simulation; Hierarchical teaching; Online open courses.

## 1. Introduction

"Digital electronic technology" is a professional basic course for undergraduate students majoring in electrical engineering and automation in higher vocational colleges. The total class hours are 42 class hours, and the class hours are relatively small. However, after careful study of the talent training program, it was found that there was no possibility of increasing the number of class hours. Therefore, how to implement teaching in such a small number of class hours and achieve good teaching results has become an urgent problem to be solved and also an urgent issue to be solved. Through teaching practice, using the online open course teaching platform, combined with virtual simulation, the hierarchical teaching is realized, so that the students' enthusiasm for learning is greatly improved, and the teaching quality and effect are greatly improved.

## 2. Analysis on the Learning Situation of Undergraduate Students in Higher Vocational Colleges

### 2.1. There Is A Big Difference in Students' Foundation

The undergraduate students of higher vocational colleges are secondary vocational school graduates, with relatively strong learning ability and relatively good learning attitude. However, the students often come from different majors, some of them are students of electrical and electronics, and some of them are students of other majors; That is, some students have learned electronic technology knowledge, while others have no foundation; Among the students who have studied electronic technology, the degree of mastery varies greatly.

### 2.2. Less Class Hours

According to the talent training plan, the number of class hours of "digital electronic technology" course of electrical engineering and Automation Specialty (Undergraduate major in Higher Vocational Colleges) at level 19 is 42. According to the requirements of the course standard, it is required to complete the digital circuit foundation, logic gate circuit, combinational logic circuit (encoder, decoder, adder, data selector, data distributor, etc.), trigger application circuit (RS trigger, D trigger, JK Trigger, T trigger, etc.) Sequential logic circuits (counters, registers, etc.), and the analysis and design of combinational logic circuits and sequential logic circuits. It can be seen that there are fewer hours and more contents. To

enable students to acquire more professional knowledge in a limited time, the choice of teaching and learning methods is the key.

### **2.3. Students Have Good Learning Attitude and High Enthusiasm**

Higher vocational undergraduate students are selected from secondary vocational school graduates, so they are more active in learning, willing to study, and less dependent on teachers than higher vocational college students. Therefore, teaching tasks with different degrees of difficulty are arranged, and students can use the online open course platform to learn independently, which can improve the effectiveness of teaching.

## **3. Teaching Method Design**

Based on the above analysis, some reform attempts have been made in the teaching contents, teaching methods and assessment methods of the digital electronic technology course for higher vocational undergraduate majors.

### **3.1. Overall Teaching Design**

The task of the course "digital electronic technology" is to enable students to master the basic knowledge of digital electronic technology and have a certain ability of digital circuit application; Cultivate students' ability to analyze and solve problems; Cultivate students' rigorous logical thinking ability and rigorous scientific attitude. It is also a practical course. According to the training objectives of professional talents, the following overall teaching design is made.

#### **3.1.1. Curriculum Goal Design**

##### **(1) Capability objectives**

- 1) Be able to identify commonly used digital electronic devices, know the functions and characteristics of commonly used digital integrated circuits, and be able to simply apply basic digital integrated circuits, providing a good foundation for the follow-up courses on SCM technology and PLC technology.
- 2) Have the ability to understand simple digital electronic circuits, and provide the necessary basis for the electronic product assembly work of the enterprise.
- 3) For common unit electronic circuits, the working principle will be analyzed to provide a basis for electronic product debugging or product quality management in enterprises.
- 4) Have certain basic knowledge, can understand and describe the performance and characteristics of electronic products, and provide the basis for the electronic product marketing position of the enterprise.

##### **(2) Knowledge objectives**

- 1) Understand the basic concepts and terms of digital electronic technology; Understand the basic laws of logic algebra and the simplification of logic functions by formula and Karnaugh map.
- 2) Understand the logic functions and external characteristics of TTL, CMOS gate circuits and various integrated flip flops.
- 3) Understand the functions and analysis methods of common combinational logic circuits, and learn the design methods of general combinational logic circuits (using SSI and MSI devices); Master the functions and analysis methods of common sequential circuits, and learn the design methods of synchronous counters.
- 4) Understand the working principle and application of common pulse waveform generation and conversion circuits.

##### **(3) Quality objectives**

- 1) I love my professional technical work.
- 2) Have good professional ethics.
- 3) Initially master the method of logical thinking and have the ability of logical analysis and design.
- 4) Have team spirit and organization and coordination ability.
- 5) Be innovative.

### 3.1.2. Course Content Design

Based on the characteristics of less class hours, the teaching content can not be comprehensive. The teaching project is used as the carrier to integrate the basic knowledge of digital electronic technology into the teaching cases, reduce the learning pressure and improve the teaching effect. The teaching contents and related teaching items are shown in Table 1.

**Table 1.** Teaching content of digital electronic technology course

Numble	Content of courses	Teaching project design	Reference class hours
1	Basic theory of digital electronic technology	Talk about digital signal and digital circuit	2
2	Fundamentals of logical algebra	Establishment of logical function expression	4
3	Logic gate circuit	Using gate circuit to realize three person voting	6
4	Combinational logic circuit	Understanding and application of integrated encoder, decoder and data selector	10
5	Integrated trigger	Design of answering machine	4
6	Sequential logic circuit	Design of arbitrary decimal counter	10
7	555 timer application	Design of simple electronic organ	6
8	Total		42

## 3.2. Teaching Implementation

### 3.2.1. Using Online Open Course Platform to Realize Online and Offline Mixed Teaching

A series of teaching videos, tests, assignments, examinations, etc. are provided on the course platform, and posts can be posted to discuss and exchange learning experience, mainly for preview before class and review of homework after class. Offline teaching is dominated by classroom teaching. Each class uses the preview quiz on the platform to realize the flipped classroom teaching mode. The teacher teaches the main knowledge points, the students raise difficult problems and discuss them, and the teacher finally analyzes and concludes.

### 3.2.2. Using Virtual Simulation Platform to Realize Hierarchical Teaching

A series of simulation experiments are designed and released through the online open course platform, which is convenient for students to break through the limitations of space and time, do experiments anytime and anywhere, learn knowledge and improve skills. It is also convenient for students with different learning abilities and learning bases to determine their learning progress according to their own characteristics and realize hierarchical teaching.

See Table 2 for the simulation experiment case design of "digital electronic technology".

**Table 2.** Simulation experiment

Numble	Name of simulation experiment roject	difficulty
1	Diode switching characteristic test	easily
2	Transistor switching characteristic test	easily
3	Mutual transformation of logical relation representation methods	secondary
4	Function test of TTL integrated gate circuit	easily
5	Design and test of voter circuit	difficult
6	Encoder simulation test	secondary
7	Decoder simulation test	secondary
8	Data selector simulation test	secondary
9	Simulation test of competition and risk in combinational logic circuit	difficult
10	Simulation test of basic RS flip flop composed of NAND gate	easily
11	Basic RS flip-flop simulation test composed of NAND gate integrated flip-flop simulation test	secondary
12	555 timer function test	easily
13	555 timer function test: circuit simulation test of multivibrator composed of 555 timer	secondary
14	Function test of 555 timer simulation test of Schmitt trigger circuit composed of 555 timer	secondary
15	Simulation test of simple electronic piano circuit	difficult
16	Simulation test of ambulance sound alarm circuit	difficult
17	Integrated counter function simulation test	easily
18	Design and Simulation of n-ary counter	secondary
19	Design and Simulation of large capacity counter	difficult
20	Design and Simulation of D/A and A/D conversion circuits	secondary
21	Design and Simulation of multifunctional digital clock	difficult

Due to the large difference in electronic technology foundation among the undergraduate students of higher vocational colleges, a detailed survey should be conducted before class to divide the students into three categories. The first category is that they have a good foundation in digital and electrical engineering, the second category is that they have a weak foundation in digital and electrical engineering, and the third category is that they have hardly studied digital and electrical engineering. According to the hierarchical teaching concept, students of the first category are required to complete the relatively difficult and medium level experiments in Table 1, students of the second category are required to complete the easy and medium level experiments in Table 1, and students of the third category are required to complete the easy and part of the medium level experiments.

### 3.3. Assessment Scheme Design

Students can participate in the final theoretical examination only after they have participated in the teacher's classroom teaching, completed the relevant simulation experiments shown in Table 2, submitted their own training reports, and completed all the relevant pre class preparation, post class homework and online tests on the online open course platform. The overall scheme design of the assessment method is shown in Table 3.

**Table 3.** Assessment scheme design

Numble	Project content name	Evaluation score
1	Online ordinary score (platform record)	30
2	Classroom performance	10
3	Experimental practice	20
4	Final theoretical examination	40
5	Total score	100

Online grades include video viewing, preview, homework, tests, examinations, discussions, notes, etc. experimental practice includes comprehensive training platform operation scores and simulation experiment scores.

#### 4. Effect of Teaching Reform

The teaching reform of the "digital electronic technology" course with less class hours for Higher Vocational Undergraduate Majors Based on online open courses has improved students' enthusiasm for learning, taken more initiative in learning, and significantly improved teaching quality due to the adoption of the flipped classroom and hierarchical teaching mode in the teaching process and assessment methods. The survey of teaching satisfaction is shown in Table 4.

**Table 4.** Teaching satisfaction survey (Digital electronic technology, survey object: Automation undergraduate major 1801 and 1802 students, 50 in total)

Numble	Survey items	Satisfied	Basic satisfaction	Dissatisfied
1	Are you satisfied with the way of preview before class?	48	2	0
2	Are you satisfied with the classroom teaching method?	49	1	0
3	Are you satisfied with your homework?	46	4	0
4	Are you satisfied with the course module setting ?	49	1	0
5	Are you satisfied with the simulation experiment design?	50	0	0
6	Are you satisfied with the assessment method?	49	1	0

#### 5. Concluding Remarks

The teaching reform of "digital electronic technology" in Higher Vocational Colleges Based on online open courses has achieved some results. Students' evaluation of teaching, supervision and evaluation of classes are relatively high, but there are still some problems. Students with poor foundation feel that they are struggling to learn, and their ability to solve problems is insufficient. They have a strong willingness to ask teachers for after-school guidance. In the future, they will strengthen team cooperation and reduce the workload of teachers through the way of students leading students, Further improve the teaching effect.

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