Research on the design and model of ideological and political teaching of the "Digital Circuit and Logic Design" course

Yanfen Gan [1,2], Jixiang Yang [3,*], and Lian Huang[3]

[1] School of Computer and Information Engineering, Guangdong Polytechnic of Industry and Commerce, 510000 Guangzhou, China
[2] School of Computer Science, South China Business College Guangdong University of Foreign Studies, 510000 Guangzhou, China
[3] School of Electronic and Communication, Guangdong Mechanical and Electrical Polytechnic, 510000 Guangzhou, China

Abstract. Since the Ministry of Education put forward the requirements of promoting the ideological and political construction of college courses, colleges, and universities have actively designed and explored various professional courses' ideological and political teaching construction. Taking "Digital Circuit and Logic Design" as an example, this paper constructs the teaching design, teaching model reforms, and the evaluation method of the practical approach by analysing the course's characteristics, objectives, and current situation. It discusses the implementation path of promoting the ideological and political education of the "Digital Circuit and Logic Design" course.

1. Introduction

As early as May 28, 2020, the Ministry of Education issued the Guiding Outline of Ideological and Political Construction of Curriculum in Colleges and Universities, which requires that the ideological and political construction of curriculum in colleges and universities be comprehensively promoted, the role of each course in educating students be well played, and the quality of talent training in colleges and universities be improved. The Outline clearly defines the objectives, requirements, and contents of the curriculum‘s ideological and political construction. It points out the direction for the curriculum‘s ideological and political construction in colleges and universities. Although rich theoretical research and educational practice results have been achieved in implementing curriculum ideology and politics, there are significant differences in implementing curriculum ideology and politics due to the differences between different disciplines, majors, and courses. In the process of promoting curriculum ideology and politics, engineering electronic information major courses are faced with such problems as an insufficient combination of curriculum ideology and politics elements with curriculum content, an inadequate supply of curriculum ideology and politics resources construction, outdated curriculum ideology and politics teaching methods, lagging assessment and evaluation methods [3]. "Digital Circuits and Logic Design" is a required and core introductory course for engineering electronic information students. Based on the characteristics of the course, this paper makes clear the goal of talent training, excavates the ideological and political elements of the course, integrates them into the course content, constructs the teaching design and model, and reforms the assessment and evaluation model, to make up for the deficiencies in the existing research and teaching practice, and provides a reference scheme for the ideological and political teaching of electronic information courses.

2. Characteristics, objectives, and current situation of ideological and political teaching of the "Digital Circuit and Logic Design" course

"Digital Circuits and Logic Design" is offered in the fourth semester based on circuit analysis, analog electronic technology, and other courses, with 64 hours and four credits. This course[1-2] mainly introduces digital logic, logic algebra, combinational logic circuits, latches and triggers, sequential logic circuits, semiconductor memory, pulse waveform transformation and generation, digital-to-analog, analog-to-digital converters, etc. This course aims to provide students with the basic knowledge of digital circuits to master simple digital logic circuit design and skilled application of standard simple logic devices to lay a solid foundation for the study of subsequent professional courses. Through the study of this course, students will learn to identify and judge the critical factors of engineering problems related to digital circuit systems, analyze and verify the rationality of logical functions of corresponding circuits according to the composition and basic principles of digital circuits, and demonstrate the feasibility of design schemes. In addition, students will demonstrate the ability to solve complex engineering problems and a sense of innovation. The course will realize the organic unity of knowledge, thinking, and

* Corresponding author: jansonyoung@foxmail.com

ability from four aspects: value guidance, knowledge inquiry, capacity building, and attitude cultivation.

As a relatively mature course, the teachers of the professional course "Digital Circuit and Logic Design" have begun to explore the ideological and political teaching entry point of this course. However, there are still the following significant problems in ideological and political teaching [4]: (1) The combination of curriculum content and ideological and political content is not high, the lack of a complete system of curriculum ideological and political content is easy to ignore the vital role of curriculum content in ideological and political education, and it is difficult to achieve the goal of "combining knowledge imparts with value guidance"; (2) The traditional course of "Digital Circuit and logic design" generally adopts lecture-style teaching, and the way and method of integrating into the curriculum's ideological and political thinking are single, lacking interaction and practice links, which can not stimulate students' enthusiasm and creativity. (3) In the experiment, most teachers attach importance to the verification, design, and implementation of digital circuit functions, and it is easy to ignore the integration of ideological and political education. The traditional assessment methods mainly rely on written tests and computer experiments, which can not accurately reflect students' comprehensive quality and actual ability.

3. Probe into the ideological and political teaching reform of the "Digital Circuit and Logic Design" course

3.1. Construct the ideological and political teaching design of the course "Digital Circuit and Logic Design".

To combine the education of Marxist positions, viewpoints, and methods with the training of the scientific spirit, the course of "Digital Circuit and Logic Design" needs to skilfully integrate ideological and political education elements into course resources, project analysis, and design, and teaching cases [5]. We sort out the ideological and political elements closely related to the course and strengthen the application of these elements in the course teaching, make up for the shortcomings of ideological and political education in the course teaching, and improve the operability of the course ideological and political education. The ideological and political elements[6] corresponding to the knowledge points are listed in Table 1.

3.2. Construct the ideological and political teaching model of the "Digital Circuit and Logic Design" course.

The core of realizing the reform and innovation of ideological and political course teaching mode lies in students. The reform and innovation of ideological and political courses should be "student-centered and problem-oriented. “Based on the new era, voice for the times, a pilot for students, and enhanced the efficiency of education.

In ideological and political construction, teaching method reform is an important direction. To achieve effective teaching, we should be student-centered and adopt different teaching methods to incorporate different ideological and political elements, such as the presentation and reporting method, competition method, and comparison method, to increase students' participation. At the same time, we pay attention to students' sense of experience and let each student feel the classroom temperature by mobilizing students' enthusiasm and differentiated teaching. In addition, information technology diversifies teaching resources and means, such as animation, video, etc., to make teaching more colourful and interesting.

To improve the classroom teaching process, we divide it into three stages: self-inquiry before class, improvement of classroom teaching, and consolidation and improvement after class. In the self-inquiry stage before class, open questions are designed for students to provide them with the direction of thinking so that they can consult materials, contact and understand the knowledge points of the next class, and prepare for class discussion. In the classroom teaching stage, teachers should introduce relevant pictures, animations, and other ways to introduce learning objectives and use participatory learning to complete knowledge transfer, including the explanation of curriculum ideological and political cases and teaching knowledge points, analysis of important and difficult points, heuristic questioning, and interaction between teachers and students to discuss social hot spots. Then, through the design of in-class test questions to check the students' grasp of the course’s content, summarize the knowledge points of the class, clear the critical and difficult points, and achieve ideological sublimation. In the after-school consolidation stage, teachers should release homework, answer students' doubts, and consolidate curriculum knowledge.

The practice teaching reform is mainly realized through the demand-oriented teaching design, the cooperative and integrated teaching mode, and the knowledge cultivation idea of integrating knowledge and practice.

(1) Demand-oriented, classified training, innovative and diverse classroom teaching design

Considering the diversity of the industry's demand for talents and the difference in student development, the classroom teaching objectives, contents, and links of individualized teaching and classified training are determined. Through the design of knowledge point series, professional extension problem discussion, and other forms, focus on students' theoretical knowledge and technical application ability training; Develop students' ability to deal with complex engineering problems by expanding theoretical methods and analyzing practical issues.

(2) Coordination between the upper and lower levels, integration of the inside and the outside, to explore the diversity of classroom teaching modes

Relying on the "online" resources of the MOOCs platform and taking the classroom and laboratory as the

"offline" platform, it adopts the form of online and offline collaboration, in-class and out-of-class integration. It explores the blended teaching mode of immersion, inquiry, and flip. "Online" takes the form of guidance, lecture, lecture notes, sorting out knowledge logic, question answering, testing, etc., to strengthen the learning of fundamental theoretical knowledge and methods; "Offline" enhances the understanding of knowledge logic methods and professional cases, design computer experiments using computer tools to realize academic problems, pay attention to ability training.

(3) Integration of knowledge and action, student-driven, and silent knowledge cultivation concept

Table 1. The ideological and political elements corresponding to the knowledge points in each chapter.

Chapter	Knowledge point	Ideological and political elements	Implementation mode
Chapter 1 Introduction	History of development of digital circuit	With the introduction of high-speed rail, aerospace technology, and the Beidou navigation system, China has these technologies in the world's leading position. It enhances students' national pride. Highlight the concept of independent innovation and core science and technology. "ZTE incident" and "Huawei core break" make students understand science and technology's significance in rejuvenating the country.	1. Combining knowledge with case studies
Chapter 2 The Foundation of Logic Algebra	Number system operation and two-valued logic	Through the story of Boolean algebra, students are encouraged to have the spirit of excellence and the courage to challenge the frontier of the discipline.	1. Combining knowledge with case studies
Chapter 3 Logic Gate Circuit	Introduction to the history of semiconductor devices	By introducing the history of semiconductor development at home and abroad and the spirit of TSMC technical expert Mr. Hayashi Ben-ken in the research of wafer lithography technology, students understand that they should achieve the craftsman spirit and strive for excellence in technical research.	1. Combining knowledge with case studies 2. Class discussion
Chapter 4 Combinational logic circuit	Design of combinatorial logic circuits	Through the practical problems of designing traffic light alarm circuits, students can realize the importance of preciseness and earnestness and cultivate the craftsman spirit of seeking truth, pragmatism, and striving for excellence.	1. Combining knowledge with case studies 2. Class discussion
Chapter 5 Sequential Logic Circuit	Analysis and design of synchronous sequential circuits	Purpose-driven: By exploring the mystery of timer timing and comprehensive application of knowledge to complete the design practice. Guide students to look at the essence through the phenomenon and cultivate the global consciousness, innovation consciousness, and scientific spirit of daring to explore. By analyzing the factors affecting the timing accuracy of the timer, it is emphasized that the circuit design should avoid the cumulative effect of the error of "the difference is as big as a thousand miles," take into account the cost performance, and cultivate the spirit of craftsmanship and good professional quality.	1. Class discussion 2. Experiment
Chapter 6 Pulse waveform transformation and generation	555 timer	Introduce the standardization and technology of integrated circuits, the current international semiconductor device design and parameters, expand students' vision and enhance science and technology feelings. Guide students' careful inquiry spirit and cultivate students' rigorous scientific attitude.	1. Combining knowledge with case studies 2. Class discussion
Chapter 7 Digital-to-analog and analog-to-digital conversion	D/A converter A/D converter	By explaining the design examples of the analog-to-digital conversion function in the digital circuit system, students can deeply understand the interrelation between the subsystems and guide them to establish the value of valuing national interests and better achieving their personal goals.	1. Combining knowledge with case studies 2. Class discussion

Through the introduction of realistic scenes, the problems are solved in three stages through heuristic interaction with students, unification of theory and practice, and progressive layer-by-layer. The first stage is to understand the problem and the definition, connotation, and boundary of the problem. The second

stage is to analyze the situation, determine the problem's nature, identify the problem's bottleneck, and grasp the central contradiction. The third stage is to solve the problem; teaching people to fish is better than teaching people to fish with the help of computer means to solve the problem.

Through the ideological and political teaching mode of the "Digital Circuit and Logic Design" course[7], students' learning interest and participation can be improved, students' understanding, and mastery of the course content can be strengthened, students' innovative thinking and practical ability can be cultivated, and students' all-round development can be promoted. At the same time, it can help students to clarify their social responsibility and sense of mission, enhance their patriotism and social awareness, and help them become moral, cultural, and responsible talents in the new era.

3.3 Construct Reform the evaluation method of the "Digital Circuit and Logic Design" practice course.

The evaluation method of the theoretical course[8] is relatively mature, so we focus on the overall design of the evaluation system of the practical approach of this course, including the evaluation subject, evaluation dimension, evaluation index, and the planning of the proportion of the score, as listed in Table 2. In addition, we have designed the evaluation elements for each project and strengthened the proportion of points accounted for by professional literacy elements. Specifically, the evaluation is carried out in the aspects of circuit design, simulation verification, welding process, function realization, debugging process, and task time, and pays attention to whether students operate in a standardized manner, whether they follow the 5S standard to keep the training room clean and tidy, whether they pay attention to the economical use of consumables, whether the use of tools is standardized and conforms to safety standards, and whether the selection of instruments is appropriate. At the same time, we focus on teamwork, professional standards, and other aspects of the assessment.

Table 2. Comprehensive Evaluation Criteria for Practice Courses

Evaluation category	Evaluation subdivision	Evaluation requirement	Mark
Practical Class	Circuit Design	Students are required to choose the appropriate digital circuit and logic design scheme according to the specific application scenario;	20
	Simulation Verification	Students must correctly use simulation software and experimental equipment to simulate digital circuits.	15
	Welding Process	Students are required to master the welding methods and skills of electronic components; Students are required to be able to correctly use all types of welding equipment and tools and maintain welding quality and safety; Students are required to be able to assess problems and risks in the welding process and take appropriate measures and preventive measures.	15
	Function Realization	Students are required to be able to convert digital circuits and logic design schemes into actual circuits according to the design scheme; Students are required to be able to verify the copy function of the circuit and to test and record relevant parameters; Students must be able to provide timely solutions and suggestions to the problems and challenges encountered in the circuit implementation process.	10
	Debugging Procedure	Students are required to be able to accurately diagnose circuit faults and take corresponding measures according to specific circumstances; Students are required to be able to use standard instruments and equipment to debug and optimize circuits; Students must be able to document the debugging process and draw lessons for dealing with similar problems.	10
	Operating Specification	Students are required to comply with laboratory safety regulations and operating procedures to ensure laboratory safety and environmental hygiene; Students should be able to use laboratory equipment and tools correctly and keep laboratory materials and documents properly; Students must be able to standardize the writing format and content of the experimental report, including the experimental purpose, method, result, analysis, and summary.	10
Vocational Competence	Professional Quality	Students are required to understand and abide by professional ethics; Students are required to be able to understand and respect the opinions and perspectives of others and to express their views and positions;	10

	Teamwork Ability	Students are required to be able to work with others to solve practical problems in digital circuit and logic design; Require students to be able to assume their due responsibilities and obligations in team cooperation; Students must communicate and coordinate effectively to solve conflicts and problems within the team.	10

4. Conclusion

This study explores combining ideological and political education with engineering courses to improve the quality of education level of digital circuit and logic design courses. Through the analysis and summary of relevant theories and practices, we put forward some feasible ideological and political teaching designs and models to meet the needs of talent training in the current digital age. However, integrating curriculum ideology and politics with professional courses takes time and effort and needs long-term exploration and practice. As the organizers of teaching activities, teachers need to constantly enrich their ideological and political theory knowledge, explore ideological and political elements, improve teaching methods, and improve their ideological and political teaching ability to achieve a synergistic effect and deepen the goal of education.

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