

Research on the Teaching Reform Plan of Digital Electronic Technology Course

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Abstract: As a core course for electrical and control-related majors in engineering, the fundamentals of Digital Electronic Technology plays a bridging role. However, in the context of social development in the new century, the classic teaching mode has gradually revealed many problems that need improvement, such as mainly concentrating on imparting knowledge, relatively monotonous teaching methods, lacking direct application scenarios in teaching content, and the course assessment standards being somewhat rigid. It is difficult to meet the demands of the new era society for talent cultivation. Therefore, this study, in line with the current major trend of domestic substitution in the semiconductor industry, attempts to stimulate students' creativity and actively explores new teaching methods for digital electronic technology courses under the new era conditions, including introducing the actual background of product design, new course evaluation methods, and intuitive visualization tool software and other new approaches, to cultivate students' interest in learning. In addition, promoting the integration of competition and teaching and strengthening practical teaching are also the key contents of teaching reform highlighted in this teaching reform paper. In addition, promoting the integration of competition and teaching and strengthening practical teaching are also the key contents of teaching reform highlighted in this teaching reform paper. The introduction of these new methods can effectively enhance the quality of digital electronic technology course teaching and provide strong support for cultivating high-quality talents needed for the development of the new era.

1. Introduction

The Digital Electronic Technology course, as a core and main course for engineering majors such as electronics, electrical engineering, automation, and computer science, is introduced after students have completed basic courses like mathematics, physics, and circuits, playing a bridging role. The Digital Electronic Technology course mainly focuses on the principles and performance of basic logic devices and their design methods in different application scenarios, featuring a distinct combination of theory and practice.

After entering the second decade of the new century, high-tech industries represented by information technology have developed rapidly, and the speed of knowledge renewal has been constantly accelerating. The demand for talents in related industries has also been constantly evolving, which has put forward new requirements for the teaching methods and contents of digital electronic technology courses in colleges and universities. In view of this, we have systematically constructed a series of innovative measures for course teaching from different aspects such as teaching concepts, course teaching methods, assignment forms and assessment models. Meanwhile, we have introduced the requirements and visual design software for digital circuits in analog and RF modules in chip design, enabling students to quickly apply the knowledge they have learned to solve practical problems and intuitively experience the sense of achievement brought by circuit design, thereby further stimulating students' enthusiasm for learning. These measures have achieved remarkable results, promoting a rapid improvement in the quality of subject teaching and laying a solid foundation for students' subsequent courses[1].

2. Problems existing in traditional teaching methods

2.1. Knowledge is mainly imparted by teachers

Digital electronic technology, as a core professional course, in the traditional undergraduate teaching stage, the teaching process is often dominated by the unilateral imparting of knowledge by teachers. The course is taught through the method of explaining and demonstrating the knowledge in the textbooks, while students are often in a passive state of receiving knowledge. This teaching method neglects the students' dominant position in learning, fails to fully stimulate their enthusiasm for learning, and thus also loses the cultivation of their creativity and imagination.

2.2. Monotonous teaching methods

Traditional digital electronic technology mainly teaches the principles of basic logic devices, the design methods and performance analysis of combinational logic circuits and sequential logic circuits, etc. This method enables students to absorb knowledge quickly, but it neglects the cultivation of students' design ability, often resulting in students being able to solve problems but not design, or being able to analyse circuits but not knowing where to start when facing design problems. In addition, the example problems and homework in the course often require students to draw circuits by hand, which makes them lack intuitive experience in circuit design. These drawbacks have affected students' learning outcomes and the cultivation of their innovative abilities, and it is necessary to introduce more innovative teaching methods for improvement.

2.3. Solidified assessment methods

The teaching evaluation standards for core professional courses in colleges and universities are a very important link in the talent cultivation system of higher education. They have a profound impact on assessing teaching quality, promoting the cultivation of teachers' teaching abilities, and enhancing the ability to cultivate talents. The traditional teaching evaluation standards for digital electronic technology courses usually rely solely on examinations. This approach can effectively assist teachers and students in assessing their teaching and learning abilities. However, it also has problems such as a single evaluation method, overly emphasizing students' memory and understanding of knowledge, while neglecting the examination of circuit design capabilities and the assessment of innovative thinking[2].

3. Exploration of curriculum teaching reform

3.1. Implementation of specific plan

The aim of the digital Electronic technology curriculum reform is to meet the new demands for talent cultivation in the new era of social development. It is necessary to establish a curriculum reform concept centered on students. To this end, it is necessary to integrate the traditional teaching objective centered on imparting knowledge, combine the specific characteristics of this course, and construct a new concept aimed at comprehensively cultivating students' circuit design ability.

Based on imparting knowledge, various methods are introduced to comprehensively cultivate students' interest in circuit design. New learning tools are introduced to strengthen the cultivation of students' practical and innovative abilities, which is conducive to laying a foundation for subsequent course learning and students' employment.

3.2. New tools introduced actively to promote classroom innovation

In the "China Education Modernization 2035" document issued by The State Council in 2019, it was explicitly stated that "modern technology should be utilized to accelerate the reform of the talent cultivation model and achieve an organic combination of large-scale education and personalized training." The Digital Electronic Technology course is one of the suitable platforms to implement the above requirements. As this course requires students to independently design circuits according to the requirements, it is very suitable for cultivating students' innovative ability.

For instance, in the chapter introducing the principles during the introduction period, multimedia content such as videos, pictures and animations are introduced to visually present the more complex basic concepts of semiconductor physics and semiconductor device physics to students. These methods can not only enhance students' thirst for knowledge, but also enable them to understand complex physical principles in a more intuitive way, helping them get started more easily. When teachers grade students' homework, they can utilize the rapidly developing artificial intelligence tools to analyze the common problems that occur in students' homework, grasp the overall learning progress and knowledge mastery level of students, and thereby provide data support for targeted explanations of relevant knowledge. When teaching the chapter on circuit design, teachers can introduce visual teaching software such as Multisim, Logisim, LTspice and other software tools, enabling students to better observe the design process and simulation results of circuits, thereby improving the learning effect. Students can master the operational effects of DC regulated power supplies, basic amplification circuits, integrated operational amplifiers, gate circuits and combinational logic circuits, flip-flops and sequential logic circuits, etc. through intuitive simulation results[3].

3.3. Promote learning through competitions and enhance practical experience

Traditional digital electronic technology courses focus on the acquisition of theoretical knowledge while neglecting practical circuit design. Even if there are experimental courses, most of the students' experimental projects lack comprehensiveness and cannot apply the knowledge they have learned to solve specific problems. Moreover, the experimental process is more about repeating the experiments step by step according to the established procedures, which cannot effectively stimulate students' enthusiasm for learning and may even cause them to develop a dislike for studying.

To solve the above problems, efforts need to be made from two aspects. On the one hand, it is necessary to arrange design-oriented assignments after teaching specific chapters, using simulation

software to design and complete the design topics provided by the course instructor. When conducting this stage, the instructor can select the digital circuits used in the analog/RF module design as the topic. For instance, in the design of phase-locked loop circuits, a frequency divider module is required. This is a module that can be accomplished by applying the knowledge from the digital electronic technology course and has practical significance. During the design process, students can have an early experience of the possible work or research content they might engage in in the future, and it can also provide a direct understanding of their future career paths after graduation[4].

On the other hand, by integrating course contents such as digital electronic technology, analog electronic technology, computer architecture, Verilog language, and principles of automatic control, the departments hold electronic design competitions to assess students' abilities in circuit design, circuit simulation, and chip programming. At the same time, it can also provide design examples for related courses in daily teaching and update the content of example questions in the courses in a timely manner. The approach of promoting learning through competitions can stimulate students' enthusiasm for learning and cultivate their innovative ability, practical ability, cooperative ability, communication ability and other multi-faceted abilities.

3.4. Expansion of course assessment and evaluation contents

The course assessment system has been expanded from a single knowledge assessment to a multi-dimensional evaluation system. Besides retaining the traditional knowledge assessment method, the design assignments of relevant chapters and the comprehensive design projects at the end of the term have also been included in the scoring system, which can occupy different proportions, such as 60%, 20%, and 20% of the weight. This can enhance students' attention to design projects and objectively ensure the effective implementation of the cultivation of students' design abilities. For the design assignments at the end of the term, they can be evaluated through project presentations and reviews, providing students with a platform to showcase their individuality and comprehensively evaluating their circuit design abilities. Through multi-dimensional evaluation criteria, it is possible to better understand students' learning situations and innovation capabilities, and also provide targeted suggestions for students to further improve their abilities. The multi-dimensional evaluation system not only helps the instructor to comprehensively understand students' learning situations and provide a basis for the reform of teaching methods in the future, but also offers students an opportunity to comprehensively enhance their learning abilities[5].

4. Conclusion

The reform achievements of the digital electronic technology courses mentioned above, including the update of teaching concepts, the introduction of simulation tools and artificial intelligence tools, the increase in the proportion of practical elements in the courses, and the expansion of the assessment standards, have broad reference value and promotion significance. These achievements also have certain value for the reform of other related courses, such as automatic control principles, analog electronic technology, and computer architecture, and can provide some ideas for the improvement of these courses.

By implementing the above contents, the teaching quality of the digital electronic technology courses has been significantly improved, and has made certain contributions to the cultivation of talents who can adapt to the current social development.

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