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# *Exploration of Experimental Teaching Mode for Digital Electronics Technology Oriented by Engineering Education Accreditation*

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***Abstract:*** This study is dedicated to exploring a teaching model for digital electronics technology experiments oriented towards engineering education accreditation, with the aim of enhancing students' self-directed learning capabilities, fostering their engineering practice and innovative thinking, and better preparing them to meet the future demands of the engineering field. Reforms have been carried out from four key aspects: the integration and optimization of teaching content in digital electronics technology experiments, the innovation of teaching methods, the construction of a project repository for digital electronics experiments, and the evaluation of teaching effectiveness coupled with continuous improvement. These initiatives have not only significantly improved the quality of digital electronics experiment instruction but have also increased students' learning motivation and practical skills, yielding highly positive outcomes. The implementation of this model has effectively bridged the gap between theoretical knowledge and real-world application, providing a sustainable and scalable framework for future engineering education development.

## 1. Introduction

As a core course for majors in information and electromechanical fields, digital electronics technology experimental teaching plays an important role in cultivating students' engineering practice ability and ability to solve practical problems [1]. Traditional experimental courses rely heavily on experimental boxes or benches to build circuits, where students only need to complete circuit connections according to a predetermined process [2]. The purely verification-oriented and rigidly procedural experimental mode inhibits innovative thinking and independent inquiry ability, restricting the effectiveness of applied talent training [3-5]. Document proposes a "four-integration and dual-drive" experimental teaching mode for digital electronics technology, exploring from four dimensions such as teaching content and teaching methods [5]. Document organically integrates ideological and political elements into experimental content and adopts a digital electronics technology experimental teaching mode combining open teaching and classroom teaching, achieving certain results [6]. Document puts forward a problem-oriented (PBL) experimental teaching mode for digital electronics technology, which has achieved good results [7]. To accurately evaluate students' experimental performance, Document proposes a method for evaluating the results of "Digital Electronics Technology Experiment" based on the fuzzy comprehensive evaluation method [8]. Document proposes a progressive experimental teaching method that divides digital electronics technology experiments into three stages: verification-oriented preview, design-oriented experimental verification, and application comprehensive analysis [9]. Document proposes a digital electronics technology experimental teaching mode based on the integration of "ideological and political elements + engineering cases + discipline competitions + undergraduate innovation projects" [10]. Document proposes a reform of digital electronics technology experimental teaching based on "project-based teaching" [11]. Document adopts the project-driven teaching method in digital electronics technology experimental teaching [12]. The above studies have important reference value for digital electronics technology experimental teaching. However, in the context of engineering accreditation, it is necessary to practice the concepts of "student-centered, outcome-oriented, and continuous improvement", which puts forward higher requirements for the teaching of digital electronics technology experimental courses. The above studies provide important reference value for digital electronics technology experimental teaching. However, with the rapid development of science and technology and the renewal of educational concepts, the teaching of digital electronics technology experimental courses is facing new challenges and higher requirements. Based on engineering accreditation standards and aiming at the prominent problems in current experimental teaching, this paper explores the reform of the experimental teaching mode. We must first optimize the experimental teaching content to align it more closely with practical engineering applications, enabling students to better understand and master the core concepts and principles of digital electronics technology through experiments. Secondly, we should innovate experimental teaching methods by introducing diversified approaches such as project-based and inquiry-based learning to stimulate students' interest and enhance their practical and problem-solving abilities. Thirdly, we need to improve the experimental teaching evaluation system, assessing students from multiple dimensions including experimental results, processes, and teamwork, thereby comprehensively reflecting their practical skills and overall quality. These reforms aim to enhance students' independent learning ability, cultivate their engineering practice and innovative thinking, and ultimately enable students to better meet the development needs of the future engineering field.

## 2. Integration and Optimization of Experimental Teaching Content

In digital electronics technology experimental teaching, some experimental projects are outdated, some have overlapping content, and some are too simple. Therefore, in experimental teaching design, following the principle of modular teaching, the experimental teaching content is divided into several modules, each focusing on a core theme. This not only avoids content repetition but also makes teaching more targeted and systematic. To maintain the timeliness of the course, some cutting-edge technologies in digital electronics technology are introduced to replace outdated content. A student feedback mechanism is established to timely understand students' opinions and suggestions on the course content, so as to dynamically adjust the teaching content of the digital electronics technology experimental course.

Experimental projects are mainly divided into verification-oriented experiments, comprehensive experiments, and design-oriented experiments. In the design of experimental teaching content, the number of purely verification-oriented experiments is reduced as much as possible, and the content of verification-oriented experiments is integrated into comprehensive or design-oriented experiments. For example, it is impossible to arrange so many purely verification-oriented experiments to verify the functions of various circuits, such as commonly used integrated gates, adders, encoders, decoders, flip-flops, counters, and data selectors that students need to be familiar with and master. For example, the function verification of integrated gates such as AND gates, NOT gates, NAND gates, and OR gates is not set as separate verification-oriented experiments, but a design-oriented experiment of "fire alarm circuit" is set up, which is: "A fire alarm system is equipped with three types of fire detectors: smoke detector, temperature detector, and ultraviolet light detector. To prevent false alarms, the alarm system generates an alarm signal only when two or more types of detectors detect a fire signal. You are requested to design a control circuit to generate a fire alarm signal using only AND gates, NOT gates, NAND gates, and OR gates." Obviously, students must first verify the functions of these types of gates, and on this basis, design a logic circuit to realize the function of fire alarm. This design-oriented experiment is closely related to daily life, which can stimulate students' learning interest. It integrates purely verification-oriented experiments, solves the problem that overly simple purely verification-oriented experiments are not conducive to ability cultivation, and solves the problem of experimental repetition. Moreover, it can comprehensively train students' practical ability to solve practical problems using the theoretical knowledge they have learned and cultivate applied talents who can integrate theory with practice.

In the digital electronics technology experimental course, typical artificial intelligence chips can be introduced, such as Huawei's Shengteng 910 and Nvidia H20, to cultivate students' innovative awareness and forward-looking thinking, and inspire them to establish the lofty ideal of developing high-end chips to solve the country's "bottleneck" problems. A design-oriented experiment can be set up to realize the circuit function of a small part of the chip, so that students can know that no matter how complex a circuit is, it is composed of some basic combinational logic circuits.

## 3. Innovation of Teaching Methods

In digital electronics technology experimental teaching, constructing problem-based teaching scenarios is an important way to stimulate students' learning interest and improve their problem-solving ability. Instructors, during experimental teaching, can guide students to think about the knowledge of digital electronics technology involved by asking them about familiar electronic products such as mobile phones and computers. For example, you can ask students: "How does a mobile phone realize the call function?" "How does the CPU in a computer work?" These questions can stimulate students' learning interest, make them pay more attention to the application of digital electronics technology in daily life, and thus develop a stronger interest in the experimental course.

It is also possible to combine common circuits, such as air-conditioning remote controls or page-turning pens used in classes, to guide students to analyze the digital electronics technology problems involved, and let them think about how to select appropriate electronic components, design a reasonable circuit structure, and conduct circuit debugging. You can also ask students: "Why can digital circuits realize logical operations?" "What are the key technologies in the manufacturing process of integrated circuits?" These questions can stimulate students' curiosity and prompt them to explore the mysteries of digital electronics technology more deeply, thereby consolidating and expanding their knowledge reserves.

When introducing a certain experimental principle, students can be guided to think about the application scenarios and importance of this principle in subsequent courses. In this way, when students study subsequent courses, they can better understand and apply relevant knowledge points, forming a virtuous cycle of knowledge system.

In terms of professional direction extension, teachers can guide students to pay attention to industry frontiers and future development directions by putting forward questions related to the development trends of digital electronics technology. For example, you can ask students: "In which directions will digital electronics technology develop in the future?" "What are the integration points between new technologies such as artificial intelligence and the Internet of Things and digital electronics technology?" These questions can broaden students' horizons and inspire them to think about and plan their future career development.

Through strategies such as creating vivid problem scenarios, guiding students to conduct independent inquiry, organizing group discussions and exchanges, combining experiments for verification, and summarizing and reflecting, teachers can effectively implement problem-based teaching scenarios in the classroom and improve students' learning enthusiasm. This not only helps to improve the quality of digital electronics technology experimental teaching but also cultivates students' innovative ability and practical ability, laying a solid foundation for their future development.

In experimental teaching, various teaching methods such as heuristic and discussion-based methods are adopted to guide students to think actively in theoretical learning and explore actively in experimental operations. Through questioning, discussion, and case analysis, students' learning interest and curiosity are stimulated, enabling them to continuously improve their learning ability and innovative ability in the interaction between theory and practice.

## 4. Establishment of a Reasonable Experimental Project Library

In constructing the digital electronics technology experimental project library, experimental projects are closely centered on the theoretical knowledge learned, basically corresponding to the key knowledge points and skills in the course, so as to deepen the understanding of theoretical knowledge and learn how to apply theoretical knowledge to solve practical problems.

Experimental projects should be comprehensive, helping students integrate the knowledge they have learned and cultivate their systematic thinking ability. By designing experiments that cover multiple knowledge points and skills, students can learn how to correlate different concepts and methods in the process of solving practical problems, thereby improving their comprehensive application ability.

Experimental projects should be application-oriented, closely combined with real life or engineering practice, so that students can intuitively feel the practical value of the knowledge they have learned. Instructors can design experimental projects related to actual application scenarios, such as a digital clock design or the implementation of a traffic signal control system. These projects can not only stimulate students' learning interest but also improve their practical ability.

Experimental projects should encourage innovation. Innovation is the key driving force for promoting scientific and technological development. Therefore, in the design of experimental projects, attention is paid to cultivating students' innovative awareness and ability. This can be achieved by setting open experimental tasks and providing space for independent design. For example, students can be allowed to design a digital circuit system by themselves and encouraged to use the knowledge they have learned to solve practical problems or realize specific functions.

In addition, full consideration is given to the difficulty level of experimental projects. Overly simple experiments may not fully challenge students' abilities, while overly complex experiments may frustrate students. With the continuous development of science and technology and the rapid advancement of digital electronics technology, it is necessary to timely integrate new technologies, methods, and application cases into experimental projects to maintain the cutting-edge and practicality of teaching content. Instructors should adjust and improve experimental projects based on students' feedback and teaching evaluation results to better meet students' learning needs and teaching objectives.

For example, some comprehensive and design-oriented experiments have been constructed, such as "Design and Implementation of Four-Channel Intelligence Competition Answering Device", "Design of Music Doorbell Based on 555 Timer", "Design of Wire-Breakage Anti-Theft Alarm", "Design of Voice-Controlled Delayed Nightlight Circuit", "Design of Simple Electronic Organ", and "Design of 8-Digit Digital Flowing Light".

## 5. Evaluation of Teaching Effects and Continuous Improvement

To comprehensively understand the effectiveness of experimental teaching reform, student feedback was collected through various forms such as questionnaires, face-to-face interviews, and group discussions. Students generally reported that they highly recognized the problem-based teaching and project-based experimental teaching methods, and their practical operation ability has been significantly improved. They also put forward some suggestions, such as that individual experimental projects are too difficult and are more suitable for course design.

## 6. Conclusion

Through the reform of digital electronics technology teaching, the quality of digital electronics technology experimental teaching has been significantly improved, and students' learning enthusiasm and practical ability have also been enhanced. Through the feedback on teaching effects, some shortcomings have been found, and continuous improvement will be made to further enhance the effect of digital electronics technology experimental teaching, laying a solid foundation for the all-round development of students.

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## References

*[1] Xiaohu Zhao, Yiying Wang, Min Fan, et al. Teaching Reform of "Fundamentals of Digital Electronics Technology Experiment" Course [J]. Modern Information Technology, 2022, 6 (14): 177-180.*

*[2] Wanting Xu. Analysis on the Teaching Reform Strategy of Digital Electronics Technology in Higher Vocational Colleges [J]. Journal of Wuhu Institute of Technology, 2017, 19 (2): 22-25.*

*[3] Yang Cui, Zhaolan He, Kaili Zhang, et al. Practice and Exploration of "Electronic Technology" Teaching Reform under the Background of First-Class Courses [J]. Journal of Electrical and Electronic Education, 2021, 43 (4): 19-21.*

*[4] Lijun Peng, Hang Han. Reform of Comprehensive Experimental Projects of Electrical and Electronic Technology under Engineering Education Professional Accreditation [J]. Research and Exploration in Laboratory, 2018, 37 (7): 178-181.*

*[5] Qing Li, Zhenhuan Ye, Zhiwu Gao, et al. Exploration on the Reform of Digital Electronics Technology Experimental Teaching under the "Four-Integration and Dual-Drive" Mode [J]. Journal of Zunyi Normal University, 2025, 27 (03): 144-148.*

*[6] Qing Li, Zhiwu Gao, Changguo Yan, Yong Bao. Exploration on the Teaching Reform of Digital Electronics Technology Experiment Based on the Concept of "New Engineering and Curriculum Ideology and Politics" [J].*

*Modern Business and Industry, 2024, 45 (02): 266-268.*
*[7] Nana Wu, Yanfei Liu, Jingjing Yang. Design and Implementation of Digital Electronics Technology Experiment Cases Based on PBL Mode - Taking "Traffic Signal Control Circuit" as an Example [J]. Henan Education (Higher Education), 2024, (12): 92-94.*
*[8] Xuelian Ma, Wudi Wei, Ruiling Ren. Evaluation of "Digital Electronics Technology Experiment" Results Based on Fuzzy Comprehensive Evaluation Method [J]. Communication and Information Technology, 2022, (01): 89-91.*
*[9] Chengbin Ye. Reform and Practice of Progressive Experimental Teaching of Digital Electronics Technology [J]. Microcomputer Applications, 2021, 37 (11): 86-89.*
*[10] Qing Li, Changguo Yan, Dengqiu Ma, et al. Exploration on the Reform of "Four-Integration" Teaching Mode for Digital Electronics Technology Experiment [J]. Modern Business and Industry, 2025, (14): 42-44.*
*[11] Jianhua Zhu, Guili Dong. Reform and Practice of Project-Based Teaching in Digital Electronics Technology Experiment [J]. Research and Practice on Innovation and Entrepreneurship, 2022, 5 (04): 38-40.*
*[12] XianlongWang, Bitie Lan, Xuejiao Wei, Yao Zheng, Jincheng Zhang. Exploration on the Reform of Digital Electronics Technology Experimental Teaching under the Background of Professional Accreditation [J]. The Guide of Science & Education, 2023, (06): 74-77.*