Journal of Education and Educational Research
ISSN: 2957-9465 | Vol. 18, No. 2, 2026

The Implementation of Project-Based Teaching Method for the "Fundamentals of Electronic Technology" Course at OBE

Fangyuan Zhong, Ya Li

College of Intelligent Manufacturing, Chengdu Jincheng College, Chengdu, Sichuan, 611731, China

Abstract: Addressing current challenges in the teaching process--including students 'weak theoretical foundations, monotonous theoretical content, and insufficient practical experience--we integrated the OBE project-based teaching approach, aligned with the university's educational philosophy of "cultivating high-quality, interdisciplinary, and application-oriented talents" and the specific characteristics and realities of the Fundamentals of Electronic Technology course. Implementation results demonstrate enhanced students 'engineering project thinking, practical skills, and overall course teaching quality, contributing positively to the institution's talent development and significantly improving educational outcomes.

Keywords: Fundamentals of Electronic Technology; OBE; Teaching Practice.

1. Introduction

"Fundamentals of Electronic Technology" is a compulsory foundational course designed for third-year students in the Mechatronics Design program pursuing undergraduate advancement. This course equips students with essential theories, knowledge, and skills in electronic technology, provides an overview of its development, and lays a solid theoretical foundation for subsequent specialized courses. However, the current teaching of this course faces the following challenges:

Due to the generally weak theoretical foundation among students, their understanding of fundamental circuit terminology and basic formulas remains superficial during the learning process; The course "Fundamentals of Electronic Technology" covers both analog and digital circuits, which are independent subjects that students struggle to integrate, resulting in a lack of holistic perspective; Practical challenges such as high experimental material costs, scheduling conflicts, and safety concerns have led to a disconnect between theory and practice—a common issue faced by most universities today.

Therefore, the course team has integrated the OBE project-based teaching philosophy into the practical instruction of the "Fundamentals of Electronic Technology" course. The OBE approach is a student-centered, outcome-oriented educational methodology [1-2]. By implementing OBE, educators clearly define what students should ultimately achieve, prioritize their learning and developmental needs, and employ reverse-engineered instructional design to align teaching activities and course structures with students 'actual circumstances and expected goals. This enhances teaching quality, enables students to attain phased competencies, and cultivates high-caliber technical professionals capable of adapting to future societal demands [3-5]. Practical experience demonstrates that incorporating the OBE project-based approach into the "Fundamentals of Electronic Technology" course significantly enhances students' mastery of circuit principles—including integrated operational amplifiers, binary decoders, encoders, and data selectors—as well as practical applications such as traffic light fault detection circuits, alarm circuits, and water level detection systems. This approach deepens students' understanding and appreciation of the course content.

2. Teaching Design

2.1. Teaching Objectives

In accordance with the talent cultivation program and teaching syllabus for the Mechatronics Design major at our institute, the following teaching objectives are established: During their theoretical studies, students will acquire essential fundamental theories of electronic technology, gain an overview of its development, understand the electrical conductivity principles of semiconductors, and master the structure, conductive characteristics, parameters, and practical applications of diodes and transistors. They will also study the circuit architecture and operating principles of integrated operational amplifiers, their applications in signal processing, logic gates and combinational circuits, as well as flip-flops and timing logic circuits. Specifically, this course focuses on practical applications of combinational logic circuits, requiring students to design such circuits based on control requirements while integrating theory with practice. This approach lays a solid foundation for verifying fundamental principles in subsequent basic electrical engineering experiments and enhances students' communication skills, problem-solving abilities, and teamwork capabilities through group discussions, teacher-student interactions, and instructor-guided learning sessions.

2.2. Teaching Methods

Courses related to electronic circuits share similar challenges in teaching. Specifically, topics such as static and dynamic analysis of amplification circuits, waveform generators in operational amplifiers, decoders and data selectors in combinational logic circuits, and flip-flops—all covered in theoretical knowledge—often suffer from overly abstract principles, formulas, and terminology. This makes lectures dull and unengaging, leaving students confused and with minimal learning outcomes.

To address the aforementioned issues, guided by the OBE

(Outcomes-Based Education) philosophy, this approach encourages students to solve problems through project-based learning and proposes improvements to existing teaching methods. For instance, when explaining practical applications of combinational logic circuits, the process begins by posing questions to stimulate student thinking: What functions do basic logic gate circuits possess? Can they be converted into state tables based on their logical descriptions? Can the relationships between circuit inputs and outputs be identified from these state tables? Can logic circuit diagrams be drawn? The lesson then proceeds by reviewing the design processes of fundamental logic circuits such as the three-person voting circuit, before moving on to the analysis, design, and simulation of practical examples including a traffic light fault detection circuit and a water level monitoring circuit.

2.3. Teaching Process

A.Pre-class session.

Through the school's online platform Jincheng Online, preparatory course materials are distributed in advance, requiring students to master the general steps of combinational logic circuit design: analyzing logical requirements → creating logic state tables → formulating logic expressions → simplifying using logic algebra → drawing logic diagrams, thereby enhancing their self-directed learning capabilities. Course materials and videos are uploaded, along with practice questions based on real-world combinational logic circuit design examples. Teachers assess students' pre-class preparation through self-test results, ensuring they achieve the predetermined learning objectives.

B. In-class activities

In line with the school's advanced classroom requirements, students are divided into groups to collaboratively complete the entire process of design, verification, and presentation. The flipped classroom approach is implemented flexibly to enhance students' motivation for self-directed learning. During class, test questions are integrated—such as: "What is the function of an AND NOT gate?" or "What is the role of a relay in the fault detection circuit for the traffic light shown in Figure 1?" These questions are distributed via the Learning Platform in a questioning format, fostering students' habit of approaching problems from an engineering perspective and allowing real-time assessment of their knowledge mastery. By the end of the lesson, students are capable of designing combinational circuits based on circuit control requirements, achieving the competency goal of integrating theory with practice.

C.Post-class Activities

Through Jincheng Online, homework assignments are distributed, and supplementary learning materials are pushed via Xuexi Tong to broaden students' horizons. The "One Lesson, One Project" initiative involves designing a water level detection circuit during after-class time. When filling the water tank, first fill it to 25% level and activate the corresponding light-emitting diode (LED). As the water level rises, the LEDs are activated sequentially at 50%,75%, and 100%. When the last LED lights up, it indicates that the tank is full.

2.4. Simulation Verification

The previous section outlined the design steps and methods for combinational circuits. Next, students will use the Proteus simulation software to implement the traffic signal system according to the specified requirements: under normal conditions, the red light (R) illuminates – indicating a stop; the yellow light (A) illuminates – indicating a preparation phase; and the green light (G) illuminates – indicating a go signal. Only one light should illuminate under normal operation . Any failure—whether none of the lights illuminate, all lights illuminate, or two lights illuminate simultaneously—is considered a malfunction. The students will then simulate and verify their designed traffic signal fault detection circuit and water level detection circuit.

Figure 1 shows a traffic light fault detection circuit designed by students using knowledge of combinational logic circuits. The circuit employs three switches as input signals: when a switch is activated, the corresponding traffic light illuminates normally. The circuit primarily utilizes AND gates and OR gates. As illustrated in Figure 2, when both the red and green lights are activated simultaneously, the output of the first-stage AND gate becomes 1, and the output of the second-stage OR gate also becomes 1, causing the fault alarm light to illuminate. Figure 2 also presents a water level monitoring circuit completed by students during extracurricular time. During water filling, switches control the filling levels from low to high: 25%,50%,75%, and 100%. Each time the water reaches a specific level, the corresponding indicator light turns on sequentially. As the water level rises, all four LEDs light up one after another; when the last LED illuminates, it indicates full water filling. Figure 3 shows an elevator control system designed by students.

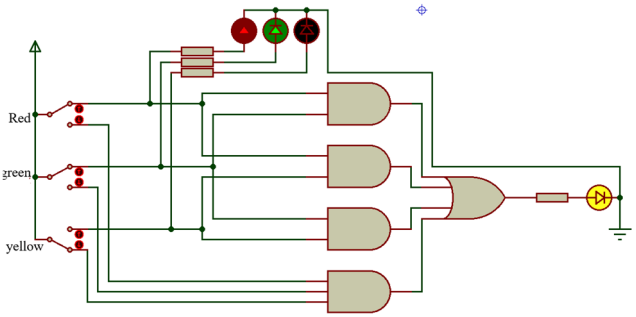


Figure 1. traffic light fault detection circuit

2.5. Assessment Criteria

In alignment with our university's educational philosophy of establishing an applied university and the course syllabus, this course incorporates formative assessments such as online tests, classroom interactions, and interactive teaching videos. The weight of students' experimental design and presentation scores has been increased from 20% to 30%. During class, students select topics and collaborate in groups to conduct simulation verification, while completing their experimental presentation PPTs during after-class time. Teachers implement a flipped classroom approach, guiding students in group presentations that cover the design process, experimental verification steps, and any challenges encountered. Teachers provide immediate feedback and assign final grades.

As a foundational professional course, theoretical knowledge constitutes a vital component of the assessment, with lower-order assessment accounting for 40%, intermediate assessment for 30%, and higher-order assessment for 30%, primarily focusing on topics such as circuit analysis and circuit design. This comprehensive evaluation assesses students' mastery of knowledge,

cultivates their scientific thinking skills and ability to solve complex problems, and fosters sound values.

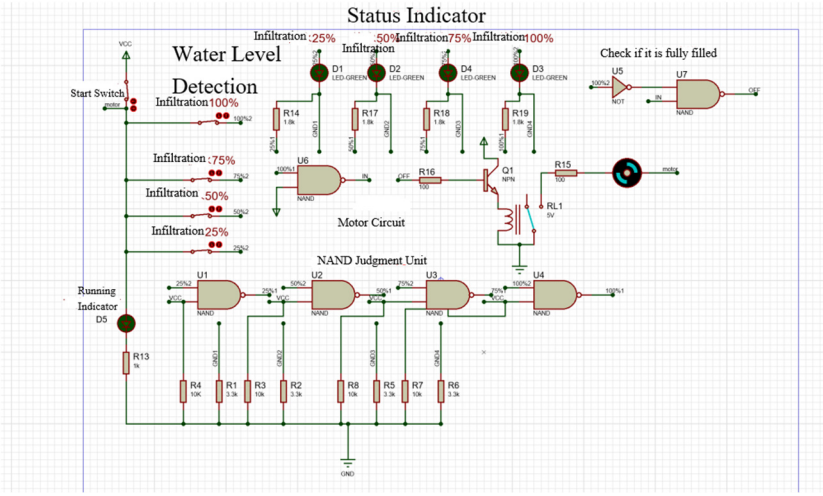


Figure 2. water level detection circuit

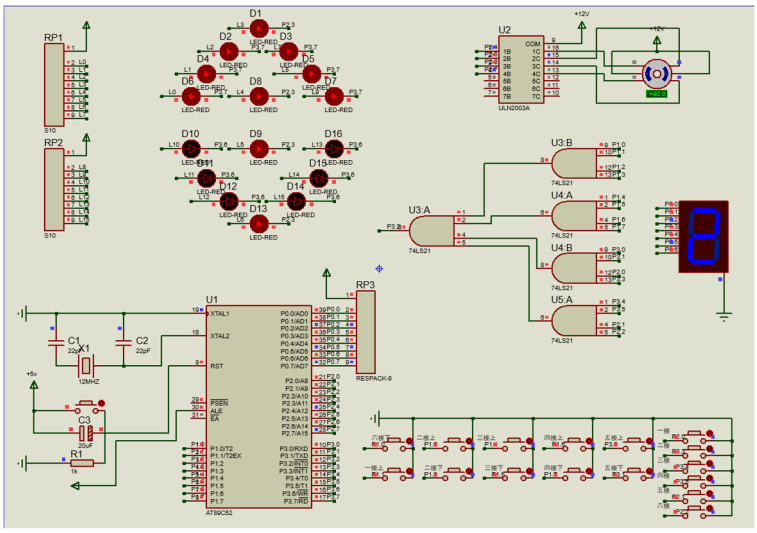


Figure 3. Elevator control system designed

3. Conclusion

In implementing the project-based teaching approach for the "Fundamentals of Electronic Technology" course, we prioritize student-centered learning guided by project objectives, clearly define student outcomes, and enhance student participation in classroom activities. This aligns with the university's educational philosophy of "cultivating high-quality, interdisciplinary, and practice-oriented applied talents." Based on the OBE project-based teaching framework, this paper redesigns the course's teaching objectives, methodologies, and a three-phase instructional process (pre-class, in-class, and post-class), along with the implementation of Proteus simulation verification and assessment criteria. Practice has demonstrated that adopting the OBE project-based teaching model has improved students 'engineering project thinking and course teaching quality, yielding positive impacts on the university's talent development.

References

[1] Liang S, Wang G .Research on the Teaching Reform Path of “Situation and Policy” Course Based on OBE Education Concept[J].Journal of Educational Research and Policies, 2025, 7(1):63-66.

[2] Liu Y, Huang S.Research on the Implementation Approach of the Course Construction of Safety Principle Based on OBE Model[J].Journal of Higher Education Teaching,2024,1(2).

[3] Chu M .Teaching Design and Practice of Human Resource Management Course Based on OBE Concept[J].Journal of Higher Education Teaching,2024,1(2).

[4] Jin X .Research on Open Education Practice Teaching of Engineering Majors Based on OBE Concept[J].Journal of Research in Vocational Education,2024,6(12):23-27.

[5] Song T. Research on Online Course Construction under OBE Concept—Taking Economic Law Course(CPA Perspective) as an Example[J].Frontiers in Educational Research,2024,7(8).