# "Four-in-one" Experimental Teaching Reform and Practice of Electronic Technology Basic Course

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**Abstract.** In order to enhance students' interest and motivation in engaging with practical activities within the realm of electronic technology fundamentals, personalized instruction is employed to ensure each student experiences a sense of achievement. This initiative aims to elevate students' overall capabilities and aligns with the "Two Properties and One Degree" "Golden Course" standard. By combining this with the objective of cultivating high-quality, top-tier talents, a "Four-in-One" reform program for the practical teaching of electronic technology foundational courses is proposed. This program comprises four components: the construction of information-based teaching resources, the design of personalized practical projects, the implementation of a blended teaching mode, and comprehensive assessment and evaluation. These components are closely interconnected and mutually reinforcing. Over the course of recent years, the implementation of this program has yielded positive results. It has led to heightened student enthusiasm, initiative, engagement, collaboration, and competitiveness. Simultaneously, students' capacity for knowledge innovation and overall quality enhancement has significantly improved.

**Keywords:** electronics technology; experimental teaching reform; four-in-one

## 1 Introduction

Higher education institutions bear the vital responsibility of nurturing students' practical acumen, innovation capabilities, and comprehensive aptitudes. The rapid advancement of information technology continuously drives innovation in educational reform and practical teaching methodologies. The approach of information-based instruction offers a novel perspective for current practical teaching reforms [1]. Guided by the "Two Properties and One Degree" "Golden Course" standard, the judicious utilization of contemporary information technology tools is pursued. This includes the proactive development and application of information-based practical teaching resources, as well as the implementation of blended practical teaching encompassing both online and offline modes through platforms such as the "rain classroom." This endeavor holds significant


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significance in guiding students towards authentic learning and genuine skill development, rationally augmenting academic demands to enhance students' academic rigor, igniting their learning enthusiasm and professional aspirations, and ultimately achieving the objective of talent cultivation. This pursuit is instrumental in establishing world-class universities.

## 2 Analysis of the Current Situation of Electronic Technology Basic Laboratory Teaching

The laboratory teaching of the electronic technology basic course constitutes a pivotal element for solidifying students' theoretical knowledge and cultivating their integrated abilities to solve intricate problems, as well as advanced engineering application-oriented thinking. This process aims to elevate knowledge innovation capabilities and comprehensive qualities. Presently, teaching reforms and explorations for the theoretical classroom components of foundational electrical courses have garnered significant attention and yielded substantial research outcomes. However, the corresponding emphasis on practical teaching reforms has been comparatively insufficient, resulting in fewer research initiatives. Through research and practice, several specific issues have been identified [2]:

(1) Scarcity of informatized practical teaching resources, characterized by limited methods and approaches for information-based instruction. Notably, within engineering disciplines, foundational electronic courses lack scientifically and systematically developed information-based teaching resources. Additionally, the methods and techniques employed for practical instruction through information technology remain relatively limited.

(2) Absence of innovation and challenge in practical content. Traditional experimental projects are typically structured around specific knowledge points, resulting in a lack of logical consistency and comprehensiveness. This absence undermines innovation, challenge, and contemporary relevance. Furthermore, learning outcomes lack inquiry-based and personalized elements, rendering them unstimulating for students and inadequately fostering engineering innovation and hands-on practical skills.

(3) Outdated teaching modes, with few practical teaching modes conforming to the standards of "Two Properties and One Degree." Limitations stemming from practical equipment and facilities, as well as constraints posed by online teaching resources, curtail the full manifestation of blended teaching's efficacy in practical instruction. This applies particularly to the limited prevalence of online-offline blended and other information technology-driven teaching modes in the practical segments of courses.

(4) Singular practical assessment methodologies, incapable of achieving comprehensive assessment. Presently, there is a considerable demand for diversified assessments that encompass the entire course. However, effective means of authentically assessing capabilities and qualities, using vast learning data records on platforms like the "rain classroom" to provide accurate evaluations, and designing standardized and rational assessment processes remain unresolved challenges [3].

Hence, undertaking research and practical implementation in the realm of informatized blended practical teaching, guided by the "Two Properties and One Degree" standard, holds immense significance. This article explores and investigates a comprehensive "Four-in-One" practical teaching program aligned with the "Two Properties and One Degree" standard. It focuses on the construction of practical teaching resources, hierarchical project design, teaching organization and implementation, as well as assessment methods, aiming to cultivate students' integrated abilities to solve complex problems and advanced thinking. As shown in Figure 1.

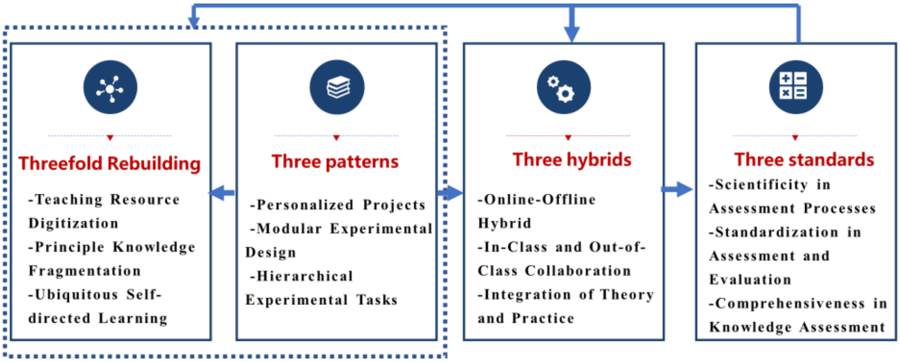


**Fig. 1.** "Four-in-One" practical teaching program

# 3 Design and Implementation of the "Four-in-one" Practical Teaching Program

## 3.1 Informatized Teaching Resources Construction

Compared to traditional practical guidebooks, informatized practical teaching resources offer an array of multimedia materials such as high-definition images, videos, audios, animations, and more. These resources provide students with a rich, expandable, and interactive learning experience. Due to variations in teaching content and conditions among each university, current informatized practical teaching resources are less than satisfactory. Therefore, in alignment with our school's curriculum, we have independently established a diverse and vibrant practical teaching resource library. This initiative integrates traditional textbook content with micro-course videos, fragmenting relevant principles and challenging knowledge components. This approach constructs teaching resources that stimulate students' proactive learning motivations, leading to a ubiquity of self-directed learning. This contributes to the creation of novel forms of information-based practical teaching resources. The resources developed encompass:

(1) a targeted electronic technology experimental guide; (2) a series of experimental guidance micro-video, specifically divided into equipment and experimental chapter;(3) the experimental pre-test courseware; (4) the experimental courseware; (5) the pocket experimental board / PCB board; (6) the component pinout diagramt; (7) the experimental report template; (8) the experimental score evaluation table.

### 3.2 Personalized Practice Project Design

Guided by the "Two Properties and One Degree" and "Golden Course" standards, and based on students' practical feedback, professional backgrounds, and the latest developments in electronic technology, we engage in innovation and optimization of practical teaching content [4]. By optimizing and integrating electronic technology practical teaching content, we structure clear task hierarchies and well-defined module compositions for practical course projects. We introduce a flexible elective mechanism to form a hierarchical, modular, and personalized "Three-in-One" electronic technology practical teaching project group. This approach supports a tiered practical teaching method that respects individual student differences and tailors instruction accordingly. It caters to the needs of contemporary development, disciplinary growth, and talent cultivation.

One of the practical projects conducted by our institute is the design of a simple shooting-targeting circuit. In terms of topic selection, since live ammunition shooting training is a mandatory subject for every student at our school, the statistical analysis of training results is an essential aspect. In light of this background, designing a circuit that simulates shooting operations and automatically displays the shooting training results is not only meaningful but also closely related to students' lives. This project employs themes relevant to students' daily training activities to integrate concepts from digital circuits, including gate circuits, combinational logic, sequential logic, pulse units, etc. This integration enhances the project's appeal, fully engaging students' interest and enthusiasm for hands-on practice.

### 3.3 Practical Teaching Organization

Utilizing information technology, we reform the practical teaching model and methods, innovate the organization of practical teaching processes, and optimize the structure and guidance methods of practical instructors' knowledge. Through this, we break the constraints of time and space between in-class and laboratory practical sessions. We adopt a hybrid online-offline, in-class-out-of-class, and theory-practice integrated organizational implementation mode. This mode facilitates interaction between teachers and students throughout the practical teaching process, incorporating knowledge, skills, and qualities into the entire course implementation process, thereby enhancing the challenge level of practical experiences.

We decompose practical project content and integrate it into regular theoretical teaching sessions. For typical circuit modules such as basic amplification circuits, operational circuits, digital display circuits, and counters, we assign circuit design and simulation homework after relevant theoretical teaching sessions. We use pocket-sized experimental boards to construct partial circuits, combining virtual and real-world components for extracurricular practical exercises. This approach provides students with a solid foundation in designing and simulating the functionality of these typical circuits. In the practical phase, students only need to design module circuits and provide comprehensive scheme explanations tailored to specific practical requirements. This approach achieves the dual goals of not increasing the workload of students' practical exercises while enhancing their comprehensive practical abilities.

Practical teaching is carried out through a combination of online and offline methods using the "rain classroom" platform. The implementation process involves three major stages: pre-practice preview, independent practice, and summarization. Pre-practice preview and summarization mainly occur outside of class using online platforms and pocket-sized experimental boards. Independent practice takes place offline. Each stage involves teacher and student activities, as well as interactions between teachers and students and among students themselves, strengthening the guidance provided by teachers and fostering evaluation and collaboration among students.

### 3.4 Evaluation of the Whole Practical Process

Following a student-centered core philosophy, we implement a practical assessment plan that emphasizes the evaluation of abilities and qualities. This plan involves tracking and assessing students throughout the entire practical process, focusing on their overall performance. We establish a standardized and feasible assessment procedure, creating scientifically quantified assessment criteria [5].

The final practical grades are composed of four weighted components: pre-practice scores, independent practice, experimental extension, and experimental summary reports, as shown in Figure 2. Detailed and feasible scoring criteria are established for each component. Among these, pre-practice and experimental summary report scores are evaluated online using the "rain classroom" platform. Independent practice scores are based on on-site comprehensive performance during the practical session, including the quality of experimental completion and the defense segment. Experimental extension scores are set for the optional extension part of the hierarchical practical projects.

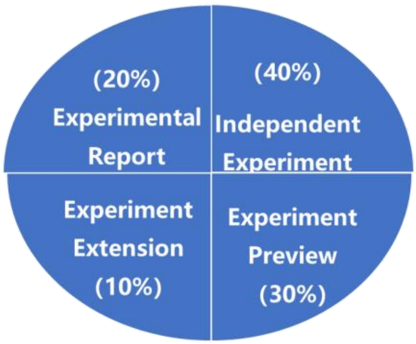


**Fig. 2.** Experimental Performance Composition Chart

## 4 Conclusion

The reform of the "four-in-one" electronic technology basic course practical teaching has to a certain extent addressed issues such as limited teaching resources, students struggling with comprehensive, exploratory, and personalized practical exercises, outdated teaching organization models, and one-sided assessment. Through implementation in recent years, we have achieved certain results. The students' interest and motivation in hands-on practice have significantly increased, with each student experiencing a sense of achievement and accomplishment in their practical work. Through these practical experiences, students have demonstrated noticeable improvements in their ability to identify, analyze, and solve real-world problems, leading to enhanced innovation skills and overall quality.

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