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EXPLORATION OF TEACHING REFORM IN ELECTRONIC TECHNOLOGY PRACTICE

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Abstract: Electronic technology practice is a fundamental and practical technical course, one of the compulsory courses for science and engineering students, and an important practical teaching link for shaping high-quality and versatile talents in the new era. This article elaborates on the exploration and implementation measures of the teaching reform of the electronic technology practice course in our school from the perspectives of blended online and offline teaching, virtual and real simulation experiments, CDIO engineering practice teaching, school enterprise collaborative education, and ideological and political education. The implementation effect of the course is good, and students have gained practical engineering experience from experiments, exercised their ability to solve problems, consolidated their professional knowledge, and established correct values.
Keywords: Electronic technology practice; CDIO(Conceive-Design-Implement-Operate); Teaching reform

1 INTRODUCTION

Electronic technology practice is an important part of practical teaching in applied undergraduate colleges. This practical teaching has low requirements for teaching conditions, small investment, and quick results, but it is of great significance for improving students' practical ability, innovation ability, and teamwork ability. The course focuses on engineering practice training, emphasizing the cultivation of students' practical abilities, the ability to independently acquire knowledge, and the ability to propose, analyze, and solve practical problems. It establishes a process foundation platform for students and enables them to acquire modern electronic process knowledge [1-5].

Electronic technology practice is a fundamental and practical technical course, which is one of the important compulsory courses for students majoring in science and engineering at our university. It is also an important practical teaching link for shaping high-quality and versatile talents in the new era. Through training in electronic technology practice, students can gain initial exposure to the practical production of electronic products; Understand and master electronic process knowledge and practical skills; Master the knowledge of safe use of electricity; Cultivate students' hands-on ability and innovative consciousness. Through practice, students are trained in learning ability, practical ability, innovation ability, and teamwork ability, laying a foundation for engineering practice in their future work.

The Electrical and Electronic Experiment Center of our school's Experimental Training Teaching Management Department undertakes the teaching work of "Electronic technology practice" for our science and engineering majors every year, and has been established for a total of 20 years. Based on the actual situation of our school's various professional training programs and the teaching needs of different majors, the electronic technology practice courses are divided into two categories: "Electronic Technology Practice A" and "Electronic Technology Practice B". Among them, "Electronic Technology Practice A" is designed for students majoring in non- electrical engineering at our university, and the teaching content is basic electronic practical experiments; "Electronic Technology Practice B" is designed for students majoring in electrical engineering at our university, with a focus on comprehensive and design oriented electronic practical experiments.

2 COURSE TEACHING OBJECTIVES

Through the study of this course, students will establish a sense of safe operation and establish basic practice operation norms. By standardizing operations and reporting requirements, guide students to prioritize integrity. In different practice content explanations and project training, based on current events and trends, combined with course and professional characteristics, introduce character introductions, case analysis, etc., while imparting course knowledge to students and establishing correct values. Increase labor education for students, organically integrate ideological and political elements, cultivate students' professional skills and innovative consciousness, and cultivate their socialist core values of "patriotism, dedication, and friendliness", enhancing their cultural soft power and core competitiveness.

Enable students to master the knowledge of safe use of electricity, learn the essentials of safe operation, cultivate a rigorous scientific style and a careful and pragmatic work style; Enable students to understand the categories, models, circuit symbols, main performance, and general selection knowledge of commonly used electronic components; Familiarize students with the basic knowledge and principles of electronic product assembly and welding, proficiently master manual electronic welding techniques, and assemble, weld, and debug electronic small products, and master the use of commonly used electronic instruments; Learn the correct usage methods of commonly used electricians, electronic instruments, and electronic devices, as well as measurement techniques for basic parameters of unit circuits; Enable students to master the SMT reflow soldering process and complete the assembly, soldering, and debugging of

the minimum system board for microcontrollers. At the same time, they should also master the use of the professional software Altium Designer to complete circuit schematics, printed circuit board diagrams, and circuit board design and production.

By combining theory with practice and hands-on practice, deepen the understanding of theoretical knowledge such as electronic circuits, and improve the ability to identify, analyze, and solve problems; Master the basic knowledge, methods, and skills of electrical experimental internships; Practice evidence-based academic discussions, write complete experimental records in a standardized manner, accurately process experimental data, scientifically and rigorously present results, and cultivate a scientific attitude of seeking truth from facts, being rigorous and trustworthy.

In different practice content explanations and project practices, based on current events and hot topics, combined with course and professional characteristics, introduce character introductions, case analysis, etc., while imparting course knowledge to students and establishing correct values. Increase labor education for students, organically integrate socialist core values and excellent traditional Chinese culture education, and establish the "Four Confidences" of socialism with Chinese characteristics. While cultivating students' professional skills and innovative consciousness, we should guide and educate them to establish a Marxist worldview and methodology, cultivate students' rigorous and pragmatic scientific attitude and academic ethics, cultivate students' scientific spirit of continuous exploration, courage to climb new heights, perseverance, and innovation, cultivate students' patriotism, and strive for the ideals and beliefs of realizing the Chinese Dream.

3 COURSE TEACHING DESIGN

3.1 Integrating Online and Offline Blended Teaching Practices

Establish an online course resource library using the Chaoxing Learning Platform. Complete practice project content in offline laboratory, provide course resources online, publish course assignments, upload assignments, and complete assignment review. Online teaching has a better effect on understanding knowledge and skills. In terms of cognitive level, it is relatively effective in knowing, comprehending, and applying knowledge. Offline teaching can better promote the comprehensive development of morality, intelligence, physical fitness, aesthetics, and labor skills. In terms of cognitive level, it is relatively effective for analysis, evaluation, and creation. Differentiated teaching content and objectives are necessary to maximize the unique advantages of blended learning, both online and offline.

Starting from the autumn semester of 2021, this course has undergone a small class online and offline smart classroom electronic technology practice teaching reform. In teaching, we use the Learning Pass mobile teaching platform to record the classroom teaching process, including check-in, questioning, investigation, in class discussion, uploading experimental phenomena, etc., to create an online classroom. Using Chaoxing Learning Platform for online intelligent teaching, the number of course activities has reached 64826, the cumulative number of course visits has reached 416096, and the cumulative number of interactions has reached 1191 (data statistics as of August 1, 2024).

3.2 Combining Virtual and Real to Ensure Efficient Implementation of Internship Practice

The electronic product production training workshop has a Surface Mounted Technology (SMT) production line, but students have limited practical workstations, high equipment operating costs, difficult observation of equipment component operation, and difficulty in hands-on operation. Through SMT virtual manufacturing simulation experiments, diversified teaching methods such as scenario simulation and interactive experience are adopted to enable students to have a sensory understanding of the SMT production line production scene, comprehensively understand the production process, equipment and operation process of the production line, display the operation of each component of the equipment in a 360 degree manner, complement the real teaching content in reality, combine reality and virtuality, enable students to operate on the real production line, cultivate their practical and innovative abilities, expand teaching capacity, and improve teaching efficiency.

The SMT process virtual simulation experiment teaching project, as shown in Figure 1. For the full process simulation of SMT electronic technology, virtual simulation experiments of the entire process of SMT electronic technology production line can be conducted online. By simulating the circuit board production workshop and corresponding equipment, and simulating the real circuit board mounting environment, students can have a clear understanding of current production technology and learn the experimental operation content of corresponding machines, providing strong support for future hardware production.

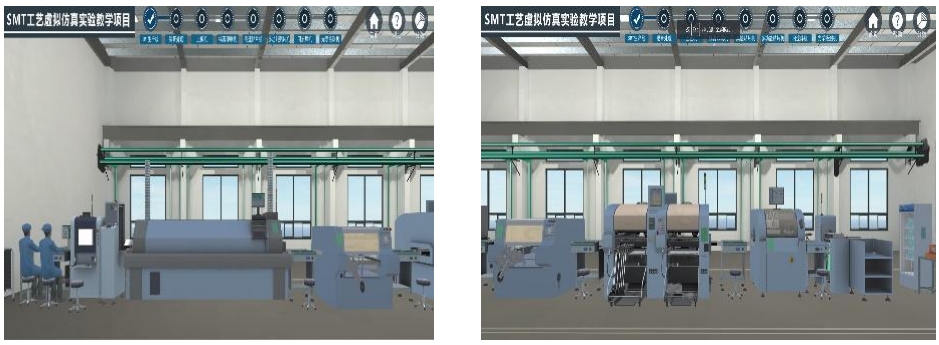

Figure 1 The SMT Process Virtual Simulation Experiment

3.3 Based on CDIO Engineering Practice Teaching

Constructing a CDIO project practical course teaching model for electronic technology practice courses guided by the new engineering concept. Using practical projects as the carrier, students as the main body, and teamwork as the form of cooperation, problem-based learning is adopted, and various teaching methods such as case teaching, discussion based learning, and experiential learning are used to effectively combine theoretical knowledge with practical application, guiding students to explore and innovate independently in the process of project implementation, closely integrating course content with actual production, and increasing the practicality of course content. At the same time, emphasis should be placed on the intersection, infiltration, and integration of curriculum, innovation and entrepreneurship education, and subject competitions, to achieve multi-party collaborative education in practical teaching [6]. The practical teaching process of CDIO project is shown in Figure 2.

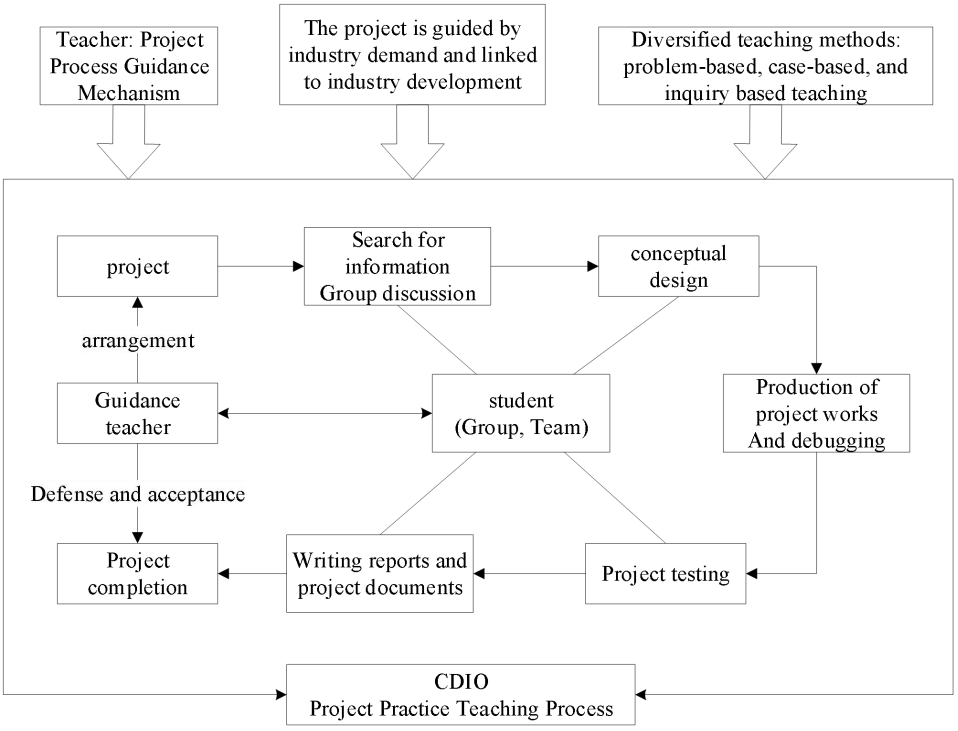

Figure 2 CDIO - Project Practice Teaching Process

3.4 Carry out School Enterprise Cooperation and Collaborative Education Model

Actively contact enterprises, introduce enterprise technical personnel to train students' professional skills, and carry out remote engineering training teaching; Combining industry trends and contacting enterprises to improve course teaching content and teaching models. Improve students' practical ability to independently solve problems, increase their new understanding of engineering consciousness, stimulate their innovative spirit based on professional knowledge, achieve the purpose of electronic process internship teaching, and meet the overall requirements of course teaching.

3.5 Combining Theory with Practice, Integrating Ideological and Political Education into the Classroom

Through the study of this course, students will establish a sense of safe operation and establish basic internship operation norms. By standardizing operations and reporting requirements, guide students to prioritize integrity. In the explanation of different internship contents and project implementation, based on current events and trends, combined with course characteristics and professional features, we introduce national craftsmen, character introductions, case analysis, etc., while imparting course knowledge to students and establishing correct values.

3.6 Actively Conducting Questionnaire Surveys

In the process of reforming, exploring, and implementing electronic technology practice teaching, to understand students' learning outcomes and related suggestions in a timely manner, we insist on conducting questionnaire surveys, student symposiums, and feedback meetings for each class of students to understand the impact of relevant teaching reforms on students' learning outcomes. The satisfaction survey results of students towards this course in the past three years are shown in Table 1.

Table 1 Student Satisfaction with this Course in the Past Three Years

Year	Very satisfied	Basically satisfied	commonly	dissatisfied
2021	93.3%	4.5%	2.2%	0
2022	95.5%	2%	2.5%	0
2023	96.2%	2.1%	1.7%	0

According to Table 1, it can be seen that the vast majority of students are satisfied with the setting of the practice program and the course content. Some students feel that the teaching effect of the course is average, and no student is dissatisfied with this course.

3.7 Statistical Analysis of Student Grades

The course grades are evaluated based on the completion status of students' practice projects at each stage, as well as their learning attitude and discipline, mastery of skills in daily teaching, completion of practice tasks, practice diaries, and summary of practice reports. The total score is synthesized according to different weights. Practice attitude and discipline (accounting for 20%), practical ability and level (accounting for 50%), practice diary and work summary (accounting for 30%), a total score is obtained, which is divided into five levels: excellent, good, medium, passing, and failing to give the overall score. Table 2 shows the distribution of course grades for two classes in the autumn semester of 2023.

Table 2 Distribution of electronic technology practice course grades for the autumn semester of 2023

Curriculum	Number s	Excellent/%	Good/%	Medium/%	Passing/%	Failed/%
Electronic Technology Practice A	34	6/17.6%	16/47.1%	9/26.5%	3/8.8%	0/0%
Electronic Technology Practice B	52	10/19.2%	16/30.8%	13/25%	13/25%	0/0%

From Table 2, it can be seen that the ratio of excellent to good is around 60%, indicating that during the practice process, the vast majority of students have a serious and upright attitude towards the practical course of electronic technology practice, which is mainly based on hands-on practice. They are particularly interested in the production of electronic small products during the practice, such as making radios, microcontrollers, PCBs, etc. During the practice, they not only learned relevant theoretical knowledge and process knowledge, but also cultivated good habits and innovative abilities of carefulness and patience, successfully completing the practice tasks at each stage and achieving the training objectives of electronic technology practice.

4 CONCLUSION

To meet the requirements of national engineering education certification and cultivate qualified engineering and technical talents, the Electronic Technology Practice course needs to continuously reform teaching content, improve teaching methods, closely follow the direction of technological development, combine with production reality, improve teaching methods, and strengthen the innovative elements of the Electronic Technology Practice course.

The teaching work of the Electronic Technology Practice undertaken by the Electrical and Electronic Experiment Center of our school's Experimental Training Teaching Management Department plays an enlightening and foundational role in cultivating students' hands-on operation, scientific research, new technology application, and innovative abilities. It also lays a solid foundation for the subsequent learning of related courses for our school's science and engineering students.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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