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Exploration and Practice of Practical Teaching System of Electricity Specialty by Stages and Continuities

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Abstract: *In this paper, starting from the whole process of higher education personnel training, aiming at cultivating students with engineering innovation ability required by enterprises, a comprehensive and systematic practice platform is constructed. The platform adopts the stages, continuity, practice mode, build mutual connection, the overall unity of practice teaching system, so that students in different learning stage to complete each independent unit of the circuit design, can blend in unit circuit in the system, and each stage of the unit can be design together, constitute a fully functional comprehensive experiments. At the same time, all kinds of pre-competition training will penetrate into all stages of undergraduate teaching to maximize the benefits of competitive learning mechanism.*

Keywords: *Periodic, Practical teaching, Teaching system*

1. Introduction

With the introduction of the new engineering concept, the focus of the construction of new engineering in applied undergraduate colleges should be based on the development needs of the regional local economy and industry, so as to meet the local economic and industrial development as the construction standard. Cultivating high-quality talents with strong analysis and problem-solving abilities, and certain innovative and practical abilities. Graduates can directly find employment in the front line of new industries. The goal of application-oriented talent training is to achieve a seamless connection from school to enterprise. Practical teaching is an important means of cultivating students with the design, operation, and maintenance capabilities required by the enterprise. Curriculum design and engineering training are the main ways to cultivate students' engineering practical capabilities. At present, most of the practical teaching in colleges and universities still focus on theoretical services. Students are not enough to learn independently, and the correlation between training courses is poor. The content of each experiment is independent, and it is difficult for students to have a complete sense of engineering. Various discipline competitions play a key role in improving students' engineering practice and innovation ability. However, due to the small coverage of the competition and the limited number of benefited students, it is difficult to comprehensively improve students' comprehensive practical ability. Therefore, constructing a relatively independent experimental teaching system with equal emphasis on knowledge and ability, organic combination of experimental teaching and theoretical teaching, and relatively independent experimental teaching is a prerequisite for improving the level and quality of experimental teaching.

2. Problems Faced by Electrical Practical Teaching under the Guidance of Traditional Courses

Traditional curriculum-oriented practice teaching focuses on teaching students the concept of knowledge. Students consider problems one-sidedly, and it is difficult to achieve comprehensive development of knowledge, ability, and quality. Moreover, the content of each practice course is relatively independent, and students cannot master the knowledge points thoroughly and it is difficult to form a complete with a practical teaching system, it is difficult to adapt to the enterprise's engineering-oriented work model immediately after graduation. Due to the implementation of the

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"3+1" talent training program, the graduation design time coincides with the corporate internship time. In the past few years, due to the impact of the epidemic, the graduation design of many colleges and universities can only be completed in the enterprise, so many designs only stay in the selection and simulation of the program Realization, looking at the above problems, the urgent problems to be solved are as follows:

The goal of training talents supported by practical teaching is inconsistent with the background of the new engineering era. The goal of talent cultivation is the key to talent cultivation. The goal of talent cultivation in traditional majors is relatively single and only emphasizes the mastery of theory.

The practical teaching system is imperfect, lacks a modern industrial practical teaching platform, lacks a way to cultivate innovative ability, practical teaching is independent of each other, emphasizes teaching and neglects practice, and the evaluation of practical teaching is not perfect.

The teaching team of practical teaching is weak. Teacher teaching emphasizes theory and ignores practice. Students do not have corresponding professional teacher guidance, and their autonomy is insufficient, which also leads to problems such as low utilization of laboratory resources.

3. Construction of a Phased and Continuous Practice Teaching System

3.1. Three-stage, Six-series Practical Teaching System Construction

Analyze the distribution of disciplines and professional structure of our school, learn from the successful experience of well-known universities at home and abroad, reform the existing experimental teaching system, adopt the basic idea of "leveling, modularization, interconnection, and overall unity", and select according to the training objectives of the stage As the carrier of the practice teaching system, 12 courses such as Circuit, Analog electronics, Digital electronics, and Single-chip microcomputer are used to construct a three-stage, six-series practice teaching model, as shown in Figure 1.

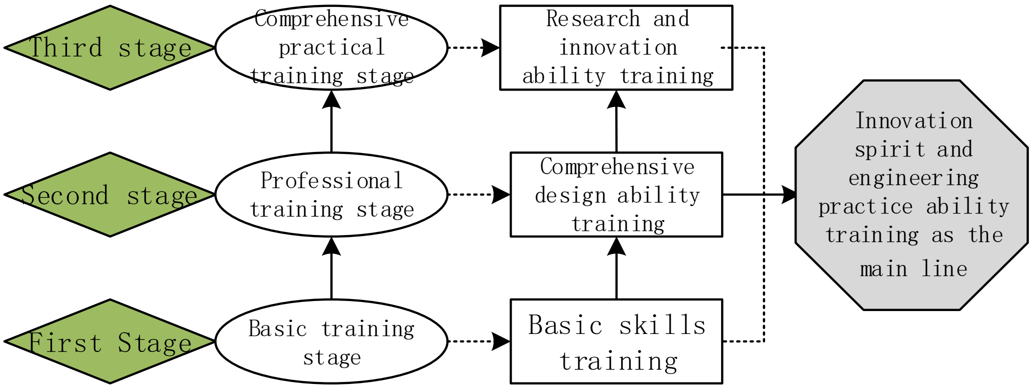

Figure 1: The mixed teaching mode.

The third stage includes the basic training phase based on circuits, Analog electronics, and Digital electronics, the professional training phase based on embedded, Single-chip, and PLC, and the comprehensive training phase with college students' innovation and entrepreneurship projects and subject competitions as the core. The six series include basic circuit series, Single-chip series, PLC series, embedded series and college students' innovative practice series and subject competition series. Class teachers condense the practical training goals of the courses and refine the knowledge context, and find the knowledge connection points between the courses.

3.2. Basic Training Stage

The basic training stage includes the basic circuit series. This stage focuses on basic circuit design and welding debugging, focusing on the cultivation of students' basic skills, and cultivating students' basic engineering qualities, basic experimental skills, analysis and problem-solving abilities, and innovative thinking. Students are required to integrate theory with practice and carry out rigorous electrical and electronic experimental skills training. This level increases the proportion of design and comprehensive experiments, which is conducive to cultivating students' ability to analyze and solve problems and innovative capabilities, and lay a solid theoretical and practical foundation for the subsequent expansion of experimental teaching. In the electronic technology experiment, the "portable

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e-learning machine" independently developed and designed by the experimental center was distributed to students, creating an all-weather open experimental teaching environment and forming an experimental teaching mode that combines both inside and outside classes.

3.3. Professional Training Stage

The professional training stage mainly focuses on printed circuit board design, computer simulation and electronic process assembly, focusing on the cultivation of students' comprehensive design ability. The basic requirements of the extension layer are to master solid professional experimental skills, with the ability of systematic analysis, design and application, especially the ability of comprehensive use of knowledge and innovation, emphasizing students to carry out independent learning and independent experimental design.

The core layer of this phase is the student experiment, students are required to complete the strict professional courses experimental skills training, with comprehensive and design type of experiment is given priority to, also can organic combination, meet the experimental classes increasing and the proportion of type design, comprehensive experiments, the main contents include: automatic control series experiment, communications, electronic system, computer, microcomputer control series experiments Application series experiment.

3.4. Comprehensive Training Stage

Comprehensive training takes college students' innovative training projects and subject competition projects as the entry point. Students choose topics independently, and use the independent unit circuits completed in the first two stages to build a fully functional training system.

This level mainly includes curriculum design, production practice, experimental research conducted by graduation practice, and also includes students' extracurricular scientific and technological activities, training of various competitions, and experimental research of participating scientific and technological production. The basic requirements are independent development, independent research, cultivating students' innovative spirit and innovative ability, enhancing students' engineering design and comprehensive application quality, and promoting outstanding talents to stand out.

This level is a high-level experimental teaching link for students to comprehensively use the knowledge they have learned for scientific and technological development and new technology application research. It emphasizes students' independent development and independent research, and aims to cultivate students' innovative spirit and scientific research ability. Focusing on research and innovative experiments, students are required to put forward experimental topics and design experiment content by themselves in combination with the knowledge they have learned, so as to cultivate students' independent work ability and innovative spirit.

4. Training Project Development

Table 1: PLC training project level and teaching goals

Item level	Implementation of the requirements	Target	Improvement of practical ability
primary	Assign questions on site and complete them independently in class.	Understanding of PLC basic structure and programming environment	Build students' interest and confidence in practice.
Medium	Assign questions on the spot, teachers give appropriate guidance, complete independently.	Able to design simple PLC electrical control system independently.	Develop students' ability to independently design a slightly complex electrical control system
Difficult	After class design, on-site debugging. It can be completed independently or according to the division of labor of members according to the degree of difficulty, and teachers will give appropriate guidance.	Master the more complex PLC electrical control system structural design ideas, complete some module design.	To cultivate students' modular design ability and teamwork spirit in complex electrical control systems.

According to the training objectives of the stage, build a training project library, and develop basic

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training projects such as DC stabilized power supply, multi-signal generator, and multi-person answering machine based on professional basic courses such as analog electronics and digital electronics as the carrier; Professional training projects are divided into single-chip series, PLC series and embedded series according to the training series. There are several projects in each series, and the teaching is carried out at different levels according to the students.

Table 1 shows the PLC training project levels and teaching objectives; comprehensive training includes the series of undergraduate innovation projects and subject competitions, including major innovation projects and subject competition questions over the years, students can further innovate on this basis.

4.1. Development and Implementation of Primary Training Projects

4.1.1. Familiarity with Programming Environment and Basic Training Steps

There are two stages to complete this training. The first stage is after-school practice. Before the training, teachers should provide information related to the PLC programming environment and language. Students install programming software and master the PLC programming environment and programming language proficiently after class; the second stage is practice in class. Teachers should introduce to students the composition of the PLC training platform, PLC input and output units, program download methods, etc. Students should complete the writing, downloading and running of the program code.

4.1.2. LED Light Control, Relay Control

Provide extended breadboards, LED lights, relays, wires, soldering irons, multimeters, etc. required for training. Topics and tasks are given in class and designed on site. 3 ~ 5 people can use one training platform according to the number of training devices. In order to ensure the effective implementation of the training, the better students should carry out the training firstly, other members can choose to write program code and design extension modules on the exercise paper. In order to prevent students from copying each other and inspire students with innovative ideas, teachers can give different requirements on the allocation of IO ports, extension modules and programming language design. This kind of project is the link that the student must complete, in the process of practice the teacher should pay attention to observe each student, and can correctly guide the student, make the student can better complete the transition from PLC theory study to PLC practice study, master a simple PLC control system design method.

4.1.3. Medium Difficulty Training Project Development and Implementation

After the investigation of relevant majors in some colleges and universities, the medium difficulty practical training project can be set up into four practical training exercises: 1. Neon control; 2. Fountain simulation control; 3. Design of combination lock; 4. Traffic light control, etc. The above training project involves more PLC language code writing, as well as more complex logical relationship processing. In this link, students will further understand the application of PLC in electrical control system, and how to design PLC control system have a clearer understanding.

Site layout and control requirements, 3 ~ 5 people using a training device, site design. According to the requirements of personal ability and time, students can complete part of the control function, take the control of neon lights as an example, the control requirement is to choose a variety of flashing modes, not less than 4 modes, among which water ripple, rotation two modes must be completed.

4.2. Development and Implementation of Highly Difficult Comprehensive Training Projects

The complex communication protocol, PID digital control algorithm, digital filter and other major categories are involved in the highly difficult comprehensive training project. Therefore, five training exercises can be set up in the training project: 1. Temperature detection and control; 2. Motor speed control; 3. Elevator control; 4. Network communication; 5. Digital filter design, etc.

The above part of the training needs more training materials, such as motor speed control and elevator control, but the training platform has been provided for this part of the training basically. In order to save the training cost, students can directly use it instead of designing it separately.

This kind of project involves the comprehensive application of multi-disciplinary fields, and the design is complicated, so most students cannot finish it in limited class time. Teachers can assign the

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questions and requirements to students in advance, and divide the students into groups. Usually, the project is composed of multiple modules, and each group is divided according to different modules. Take elevator control as an example, one person can be assigned to take charge of elevator car control, one person is responsible for elevator door control, and one person is responsible for the design of PID control algorithm. Each group of members and members of different groups can communicate with each other in the design process, for good design ideas can be used for reference.

5. Evaluation System

The assessment is divided into two parts, one is the practice part, and the other is the report writing part. The evaluation of the practical link should consider the four aspects of content conception, design, implementation and operation. The traditional practice link performance evaluation basically only considers the results of the practice and the amount of time it takes to complete the practice, which brings some drawbacks. In order to quickly complete the practice training, most students copy more and think less. Good students, the whole training process is also kept in a tense state.

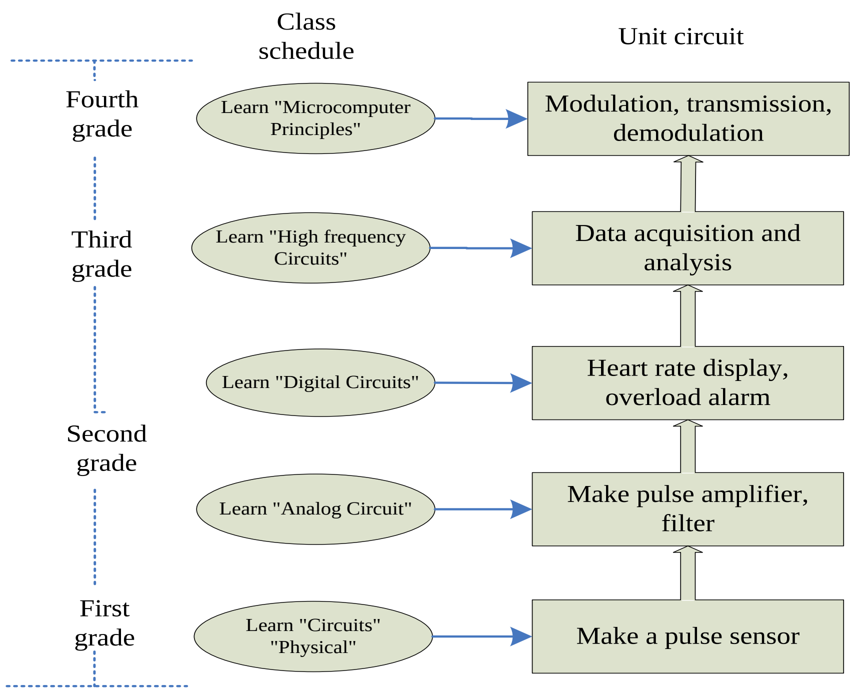

Figure 2: Pulse signal acquisition system

This traditional practice method does not give students the opportunity to innovate, and does not allow students to deeply experience the joy of practice, which also leads to the poor effect of traditional practice. Therefore, from the assessment link, we should pay attention to, not too much emphasis on the results, but pay attention to the whole process of practice, give students more relaxed, more space for thinking, in order to cultivate students' courage to practice, willing to practice psychology, from the essence of improving students' practical ability.Figure 2 takes the collection and analysis of pulse signal as an example to construct a relational block diagram of phased continuous practice system.

6. Conclusions

The proposed phased continuous experimental teaching system effectively integrates the training of four years in university, enabling students to apply what they have learned and make use of what they have learned. It is committed to cultivating first-line application-oriented engineers who meet the job requirements of relevant enterprises, have innovative thinking and adapt to the rapid development of the industry. Therefore, according to the characteristics of most private undergraduate colleges, this paper puts forward some restrictive factors and solutions to the talent cultivation mode, in order to provide some help for the reform and development of relevant colleges.

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References

[1] ZHANG Hongtao, TAN Lian, LIU Peng, et al. Under the background of new engineering, electronic information specialty "Learning, Practice, Research and Creation" four-in-one Practical Education reform [J]. Southern Agricultural Machinery, 2019, 50(10):2.

[2] Yu Shuaizhen, Yang Jiagui. Exploration and Research on the Practical Teaching Mode combining "Learning, Practice, Research and Innovation" in the New Engineering Background [J]. Public Science and Technology, 2021, 23(5):3.

[3] Zheng Chunlong, SHAO Hongyan. The Construction and Implementation of College Practice Teaching System aiming at Cultivating Innovative Practice Ability [J]. China Higher Education Research, 2007(4):2.

[4] Li Jinchang, Lin Jialian. The Combination of Practice Teaching and discipline Competition to promote the cultivation of innovative talents [J]. Experimental Technology and Management, 2011.

[5] Yuan Xun, GUO Hui, Qin Changming. Exploration and Practice on the Construction of Application-oriented Talents Training and Practical Teaching System in Local Universities [J]. Experimental Technology and Management, 2011, 28(8):5.

[6] Zhou Dejian, Li Chuangdi, Liu Zhaoming. Construction and Practice of Practical Teaching System for Application-oriented Undergraduate Talent Cultivation in Local Universities [J]. Heilongjiang Higher Education Research, 2011(3):3.