

Research on Experimental Teaching Mode of Electrical Measurement Technology

Weifeng Chen, Yong Luo

School of Automation, NUIST, Nanjing 210044, China

Keywords: Electrical measurement; technology; teaching mode

Abstract: "Electrical measurement technology" is a basic course of electrical engineering and automation. With strong theoretical and practical, it is a knowledge and skill course for electrical professionals and electricians. At present, the State advocates strengthening the cultivation of engineering students' innovative practice ability and engineering practice ability. "Electrical measurement technology" is a professional course of electrical engineering and automation. Since this part of the content is also very easy to understand for senior science and engineering students, we need to find appropriate experimental teaching methods to change students' boring learning habits, fully stimulating students' interest in learning. Through theoretical teaching, multimedia teaching and experiments, students can skillfully use multimeter, DC regulated power supply, signal source, oscilloscope and other common instruments and meters. Because this course will directly serve the production practice, we should not blindly follow the previous teaching mode, but should fully embody the practicality and professional pertinence of the course, combine theory with practice, and pay equal attention to knowledge and ability. In this paper, the teaching ideas and concrete implementation steps of the discussion experiment are discussed, and the teaching practice of the proposed method is carried out by taking the current detection experiment as an example.

1. Introduction

"Electrical measurement technology" is a basic course of electrical engineering and automation [1]. With strong theoretical and practical, it is a knowledge and skill course for electrical professionals and electricians. Its core is the reform of teaching methods, paying more attention to the integration of students' inside and outside classes, and the combination of results and process, which greatly improves students' practical ability, independent thinking ability and problem-solving ability [2]. At present, the State advocates strengthening the cultivation of engineering students' innovative practice ability and engineering practice ability. "Electrical measurement technology" is a professional course of electrical engineering and automation [3]. At the same time, the course also includes some measurement methods of specific physical quantities, such as the measurement theories and methods of current, voltage, speed, noise, force, temperature, flow rate, etc. This part is also very easy to understand for senior science and engineering students, which requires finding suitable experimental teaching methods, changing students' boring study habits and fully stimulating students' interest in learning [4]. Experimental teaching is best implemented by theoretical teachers and experimental teaching staff, which is beneficial for students to ask and answer questions during the experiment, truly integrating theory with practice [5].

With the development of science and technology, test and measurement technology has developed into a complete technical discipline. The course mainly includes 4 parts: DC circuit module, AC circuit module, dynamic circuit module and magnetic circuit module [6]. Through theoretical lectures, multimedia teaching, experiments, etc, students can master the use of common instruments such as multimeter, DC stable power supply, signal source, oscilloscope etc [7]. Curriculum experiment and classroom teaching have the same important status, and they complement each other to achieve the teaching goal of letting students master knowledge and have the ability to apply knowledge [8]. As the course will directly serve the actual production, it can not blindly follow the previous teaching mode and should fully reflect the practicality and professional pertinence of the course, so as to combine theory with practice, and pay equal attention to

knowledge and ability [9]. On the basis of summing up the past experience and lessons, we reformed the classroom and practical teaching methods, which especially strengthened the experimental teaching link, and proposed to add open experiment based on independent design. Let students choose experimental topics according to their own interests and abilities, in order to mobilize the enthusiasm of students and achieve more obvious teaching effects [10].

2. Self-made experimental device

2.1. Reform of experimental model

For technicians engaged in measurement and control, only those with good comprehensive practical ability and innovative awareness can be competent for future work. Make. The content of the previous courses that are not well-targeted in majors will only be briefly introduced to reduce their class hours, highlight the professional characteristics, and focus on the parts of the courses that are in close contact with the electrical engineering major. Figure 1 shows the principle and block diagram of electrical measurement.

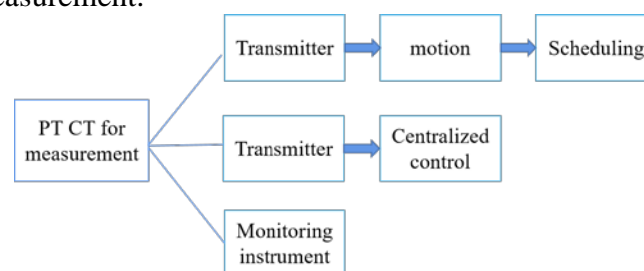


Fig. 1 Principle and block diagram of electrical measurement

During the experiment, students use their spare time to conduct experiments in the open laboratory with a deadline for completion without a specific time. The hardware part of the experimental platform completes the collection of measured physical quantities, and the collected data can be flexibly processed by virtual instrument technology. Based on this, we should choose representative experiments as the content of experiment. In addition, common analog electrical measuring instruments, analog voltage and current measuring principles, analog frequency period measuring methods, and analog power and energy measuring methods are also introduced. In the next class, let the students give lectures in groups on the platform, point out their strengths and weaknesses, and then naturally transform to the content of the new class. This requires teachers to be good at fully mobilizing students' enthusiasm and initiative, consciously cultivating students' participation, and strengthening students' sense of innovation and ability.

2.2. Design of experiment circuit

Using the circuit board designed and manufactured independently can make the experimental circuit completely correspond to the teaching content, meet the needs of students' ability training, be close to the industrial reality and keep up with the technological development. Students can build different measurement systems on this platform according to their own interests and abilities. At the same time, we also start from several aspects such as data services and environment construction, to create a learning, practice and innovation environment that is conducive to students' independent learning, free from time and space constraints. Through the study and practical operation of the course, combining the professional characteristics with the training and certification of "Special Operation Certificate" for electrical work can reduce the pressure of students to participate in electrician training certification, and make some contents familiar and rehearsed in advance. Figure 2 shows the structure diagram of the innovative experimental platform.

In the process of explaining electrical measurement technology, temperature measurement schemes are generally explained. At present, there are many experimental schemes with relatively low measurement cost, which can be realized by thermistor or special temperature measurement chip provided by professional manufacturer. In the choice of the specific structure of the

experimental circuit, we need to pay attention to the practical application and keep up with the development of technology. Finally, the experimental results will be included in the total score of the theoretical course to strengthen the role of experimental teaching.

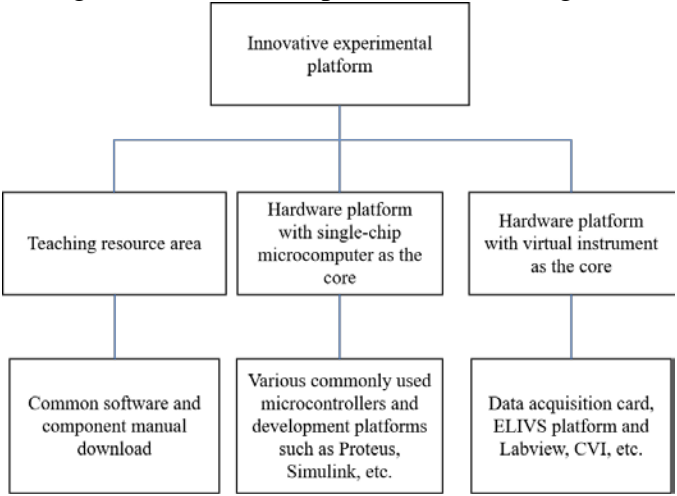


Fig. 2 The structure of innovation experiment platform

3. Experimental guidance and evaluation methods

3.1. Implementation of seminar-style experimental teaching

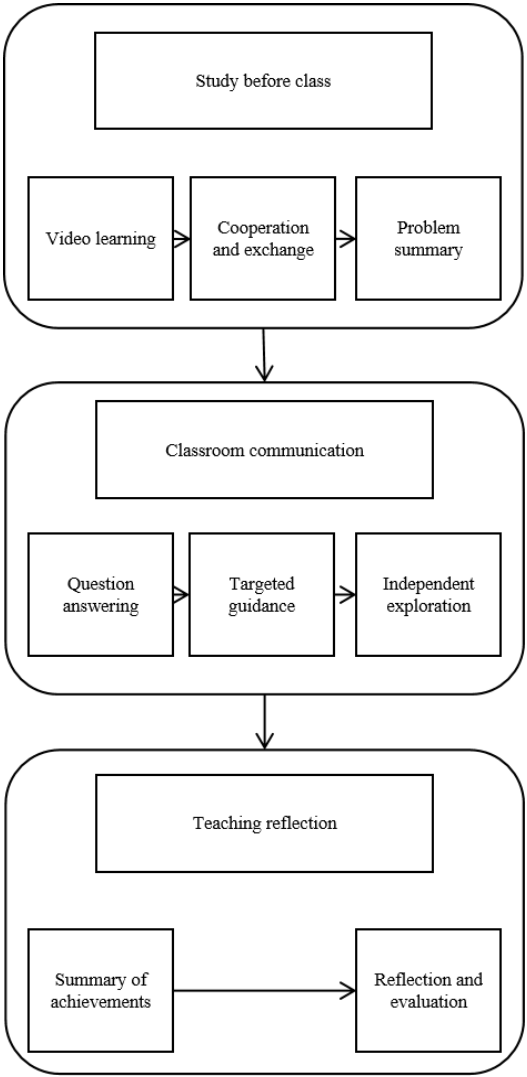


Fig. 3 Specific teaching workflow

In this experiment course, the discussion link will be put in the experiment design and experiment process. When the students are very interested in the experiment, we launch a question discussion so that students do not float on the surface, but think deeply and respond positively. In classroom teaching, teachers take the design of strain detection system and intelligent watt hour meter as typical application objects, introducing the detection principle, dynamic and static characteristics, conditioning circuit design, data acquisition and error handling, electromagnetic compatibility and other issues. Experiments are mainly carried out in the form of homework assignments, allowing students to independently design experimental schemes, complete experimental design tasks, and clarify the teaching workflow based on the existing equipment and materials provided by the laboratory, as shown in fig. 3.

However, in the traditional course teaching, the measurement environment is rarely mentioned, let alone the installation process requirements of the measurement process, which directly leads to the problems of measurement methods and measurement accuracy. The rational use of integrated teaching is conducive to the organic connection between theoretical teaching and practical teaching, and avoids the separation between them. Cultivate awareness of quality, technology and technical standards. Cultivate the ability of self-study and knowledge acquisition. Cultivate innovative consciousness. Teachers should develop teaching democracy and become organizers, guides and collaborators of students' learning professional knowledge. The purpose of discussion-based experimental teaching is not only to impart knowledge, but also to cultivate students' ability to acquire knowledge by themselves.

3.2. Experiment report design

The traditional experimental report, including the experimental purpose, experimental equipment, experimental steps and experimental results, can be copied directly in the teaching materials. The evaluation standard of experimental examination should also be changed from the correctness of experimental results to the comprehensive evaluation of whether students have innovation and ability. At present, the teaching content of a training project is assessed when it is completed. Only after passing the assessment, can we participate in the next training project. Moreover, the results of the previous training project are regarded as the qualification of participating in the next training project. The process of writing an experiment report is a process of thinking, refining, and improving. It is also a process of sorting out ideas and identifying missing parts. Introduce large-scale homework in the chapter of "Electric Energy Measurement" of this course. Students are required to complete the design of campus centralized automatic meter reading system in group form, including the development history, present situation and trend of centralized meter reading system, the composition and architecture of centralized meter reading system, the investigation of campus power distribution, centralized reading scheme and system cost estimation. According to the differences of students' learning abilities and interests, we divide the experimental contents into different levels for them to choose. General students only need to complete basic experiments, and potential students have the opportunity to choose the experimental contents and methods that interest them. Whether the experiment succeeds or fails, it can be truthfully explained and analyzed in the experimental report. Encourage students to write experimental reports in the form of scientific papers, and submit articles to relevant magazines or apply for patents.

4. Conclusions

“As a basic course of electrical engineering and automation, electrical measurement technology has strong engineering practice. These practical links are connected from front to back, progressive in turn, which improves students' innovative consciousness and practical ability, and makes students gradually change from passive learning to active learning for the purpose of ability cultivation. Under the teacher's discussion guidance, the students can basically complete the experimental task. Through the setting of experiment content, students can truly understand the core content of the problem, and independently complete the design of comprehensive experiment under the guidance of the instructor. Strengthen international exchanges and cooperation through various channels such

as joint training, student exchange, mutual visits of scholars and international conferences, narrowing the gap with foreign countries. Encourage students to use part of their extracurricular time to do experiments, so as to alleviate the shortage of class hours. There is still a long way to go to strengthen the cultivation of students' innovative practical ability and build a corresponding talent training system, which requires our constant exploration in practice.

References

- [1] Liu Hongda, Li Zhipeng, LIU, et al. Teaching example analysis of flipped classroom in electrical measurement experiment. *Laboratory research and exploration*, vol. 09, no. 259, pp. 193-197, 2017.
- [2] Shi Jingzhuo. The design of the course experiment "weak magnetic field measurement" in the teaching of "Electrical Testing Technology". *New curriculum research (mid-single)*, vol. 000, no. 002, pp. 113-115, 2018.
- [3] Zhou Yiheng, Yan Jiaming, Wu Xinzhong, et al. Discussion on comprehensive innovative experimental teaching integrating scientific research results. *Experimental technology and management*, vol. 37, no. 11, pp. 236-240, 2020.
- [4] Wei Yu, Shao Chen. Development of an experimental platform for detecting foreign matter on the surface of photovoltaic modules. *Laboratory research and exploration*, vol. 38, no. 01, pp. 42-45, 2019.
- [5] Wang Yan, Xu Jun, Chen Panfeng, et al. "Three-meter cross-phase measurement of reactive power in a three-phase circuit" experimental design. *Journal of Electrical and Electronic Education*, vol. 42, no. 03, pp. 162-165, 2020.
- [6] Yang Caixia, Yang Lei, Zheng Xue. Research on the experimental teaching reform of the course "Electrical Engineering Fundamentals" based on MATLAB Research. *Journal of Science and Education*, Vol. 000, Issue 003, Pages 115-116, 2019
- [7] Hu Jianjun, Zhu Qing, Wang Meida, et al. PIV Experimental Study of jet impingement on flat plate at close range 1). *Acta mechanica Sinica*, Vol. 52, No. 5, pp. 1350-1361, 2020
- [8] Shi jingzhuo. Design of current measurement experiment for electrical testing technology course. *China modern educational equipment*, Vol. 323, No. 19, pp. 47-49, 2019
- [9] Ping Xuwei, Li Li, Yin Xinghui, et al. Experimental teaching of impedance measurement using Smith chart. *Journal of electrical and electronic teaching*, Vol. 39, No. 002, pp. 124-126, 2017
- [10] Wang Yuanyuan. Research on Project-based Teaching of "electronic measurement technology" experimental course in Applied Technology University. *Wireless Internet technology*, Vol. 16, No. 07, pp. 81-82, 2019