ISSN: 1813-4890

Analysis on Case Teaching Method in the Training of Practical Ability for Professional Graduate Students

Guozheng Han [1, a], Xia Dong [1, b] and Zhongquan Wang [2, c]

[1]School of Information and Automation Engineering, Qilu University of Technology (Shandong Academy of Sciences), Jinan 250353, China;

[2]Shandong Ankong Information Technology Co., LTD, Jinan 250101, China.

[a]han_guozheng@163.com, [b]dongxia6078@163.com, [c]wangzhongquan1976@163.com

Abstract

Aiming at the lack of practical ability of professional graduate students, this paper explores the method to improving students' practical ability through case teaching method. Firstly, the basic idea of case teaching was introduced, followed by an introduction to the selection and production process of engineering cases. Finally, taking the course of "Smart Grid Technology" as an example, the selection, production, and application process of the cases method used in the course were specifically introduced. Practice has proven that the application of engineering cases is of great help in improving students' practical abilities, understanding, and problem-solving skills in practical engineering.

Keywords

Case teaching method; Practical ability training; Professional graduate students.

1. Introduction

Professional degree graduate are a form of graduate education in China and the main channel for cultivating high-level applied talents. Compared to academic degrees, the purpose of professional degrees is to cultivate applied high-level specialized talents with solid theoretical foundations and to adapt to the practical work needs of specific industries or professions [1]. Professional degree graduate students are guided by professional practice and place greater emphasis on cultivating practical and applied abilities. Compared to applied talents at the undergraduate level, professional degree students place more emphasis on cultivating applied research abilities [2]. The cultivation of practical ability is the core of professional master's degree education.

Case teaching method is an effective approach for cultivating practical abilities [3]. Taking the Master's degree in Control Engineering as an example, the cultivation of practical and innovative abilities is an important part of professional master's research and training. Select appropriate engineering cases, introduce them into classroom teaching, and encourage students to actively participate by acting as designers and motivators. Teachers are responsible for explaining the background knowledge and required professional knowledge of engineering cases, guiding students to solve engineering problems, which is very helpful for improving students' ability to analyze and solve practical problems [4-5].

ISSN: 1813-4890

2. The basic idea of case teaching

2.1. Selection of Cases

Most engineering cases involve a wide range of professional fields, including technical development, product research and development, engineering design and other technical issues, as well as engineering background. These all need to be supplemented and introduced before the production process of the case. In the process of case application, teachers need to first introduce relevant background knowledge to students, so that they can understand the required background knowledge and the technical background at that time. Moreover, practical engineering problems are often very complex. The production of engineering cases requires the integration of relevant knowledge and necessary simplification. This enables students to analyze and solve relevant technical problems within the scope of their knowledge. At this stage, teachers should be good helpers for students and provide sufficient explanations of necessary background knowledge and engineering background.

A typical engineering project usually involves numerous knowledge fields and is not suitable for direct application in classroom teaching. So for the selection of cases, it is necessary to highlight their engineering characteristics while also paying attention to their compatibility with textbook knowledge, highlighting key points, in order to facilitate students' mastery of knowledge. When selecting engineering cases, multiple aspects need to be considered to ensure that the selected cases are representative and meet the requirements of classroom teaching.

Firstly, a case should consist of multiple components, each with its specific functions and roles. This makes it easier to understand and analyze these components. By reasonable combination between components, a complete system can be formed. In addition, the case should be able to be easily expanded to adapt to constantly changing needs and technological developments.

In addition, the selection of cases should be in line with the current level of technology and have practical application value. Choosing cases that are too complex or too simple is not conducive to learning and practice. We should choose cases that match our own technical level, which can better enhance students' practical abilities. We should choose cases with practical application value, which can help students better understand the issues that need to be paid attention to in practical applications, and also help them develop the ability to solve practical problems.

2.2. Simplification of engineering problems

Most engineering cases are quite complex. We need to consider both the engineering and technical background at that time, as well as the economic costs and social benefits. For the production of cases, it is necessary to explain these background issues clearly. Taking the intelligent distribution terminal used in the smart grid as an example, it is necessary to ensure the accuracy of data measurement, consider the installation environment, temperature, and the convenience of product installation and construction in the later stage. Controlling the cost of products is also an important aspect of engineering design. These are all issues that need to be considered and addressed in engineering. In the process of case design, it is necessary to provide necessary explanations of the engineering background.

Engineering problems involve various aspects and are very complex. When we solving engineering problems, it is necessary to simplify them so that students can grasp the essence of the problem and highlight the knowledge points. Taking intelligent distribution terminals as an example, they need to communicate with other intelligent devices to achieve certain intelligent functions. The issue of communication is a relatively complex problem in the construction of distribution automation, involving specific installation environments and engineering design requirements. Currently, effective communication methods include WiFi, power line carrier, fiber optic, 5G networks, and so on. And these require rich engineering experience, which is difficult for students to master. Here, necessary simplifications can be

ISSN: 1813-4890

made, assuming that our communication methods all use fiber optics. Encourage students to pay more attention to communication needs, consider reasonable communication performance indicators, and avoid excessive involvement in the design of specific communication networks. This is the necessary simplification for engineering cases. The purpose of simplification is to complement teaching and enable students to better grasp key issues.

2.3. Extension and Expansion of Engineering Problems

For an engineering problem, the explanation and discussion of a case study is just a glimpse. After students have analyzed and discussed the designed problems, teachers need to further guide them to restore the original state of the engineering problem as much as possible. This makes students realize the complexity of engineering problems. Share practical engineering problem solutions with classmates and analyze the advantages and limitations of the solutions. With the development of technology, there should now be better solutions for engineering problems. At the same time, it is necessary to explain the current development of this issue and enhance students' interest in it. Avoid students having the idea of having standard answers to engineering problems.

3. Application of Case Teaching method in "Smart Grid Technology" Course

3.1. Background of the course

The authors have been teaching the course of "Smart Grid Technology" for Master's degree in Control Engineering at Qilu University of Technology since 2013. The content taught in this course mainly covers some theories and technologies in the construction of smart grids both internationally and domestically in recent years. The course is closely integrated with reality. During the course teaching process, emphasis was placed on accumulating case studies and combining them with some of the research projects I participated in, simplifying them appropriately and organizing them into easily understandable cases for students to analyze and explain in class, achieving good results.

Smart grid is a new type of power grid formed by highly integrating advanced sensing and measurement technology, communication technology, information technology, computer technology, and control technology with the physical power grid, based on the physical power grid (a strong power grid with ultra-high voltage power grid as the backbone and coordinated development of various voltage levels). The smart grid aims to fully meet users' demand for electricity, optimize resource allocation, ensure the safety, reliability, and economy of power supply, meet environmental constraints, ensure power quality, and adapt to the development of the electricity market. The smart grid achieves reliable, economical, clean, and interactive power supply and value-added services for users. The construction and development of smart grids have always been a hot field, and there are numerous cases worth studying and learning from. In recent years, a large number of research results and demonstration projects have emerged continuously. Case teaching can help graduate students better understand the forefront of the current discipline, inspire and drive students to engage in scientific research practice early on.

The development of smart grids has provided us with many good cases. Analyzing and studying these cases can help graduate students better understand the connotation and research field of smart grids.

3.2. Selection of Cases

In the process of case production, it is closely integrated with the current engineering practice of smart grid. Necessary simplifications should also be made to highlight relevant knowledge

points. Aiming at the cultivation of practical abilities for master's degree students in control engineering, a series of teaching cases have been selected based on the teaching objectives of smart grid technology and years of engineering practice.

3.2.1. Case of distributed energy generation connection

The integration of a large number of distributed power sources into the utility power grid is a major change between the current smart grid and traditional power grid, completing the transition from centralized power generation to a combination of centralized and distributed power generation. Taking the 5MW rooftop solar photovoltaic power generation project at Qxxx University as an example, this paper focuses on analyzing the control and protection technologies during the process of solar power generation and grid connection. The project is divided into five installation areas, each with an installed capacity of approximately 1MW. By installing high-power inverters in power distribution stations 1, 2, and 8, as well as in the library and humanities buildings, direct current (DC) is converted into alternating current (AC). Then, the voltage is boosted from 380V to 10kV through a step-up transformer and connected to the school's 10kV switching station. The generated energy is mainly used for campus use, and excess electricity is transmitted to the national power grid. Under normal sunlight conditions, it can generate 23000 kilowatt hours of electricity throughout the day, with an effective utilization of approximately 12000 to 15000 kilowatt hours. Through the study of this case, students will have a comprehensive understanding of the application of distributed power sources.

3.2.2. Case of smart distribution grid measurement and control system

The construction of smart grids is also reflected in the improvement and upgrading of the facilities and automation devices of the distribution network, further enhancing the reliability of power supply. The smart distribution network wide area measurement and control system includes centralized monitoring applications based on the main station and distributed intelligent control applications based on intelligent terminals. Smart distribution network communication model, based on the open communication system of IEC61850, for the interconnection and plug and play of automation equipment. Multi-functional intelligent terminal, advanced distribution automation master station, forming the backbone of the measurement and control system. Distributed power grid connection protection and control technology based on wide area measurement and control system, with a large and flexible access of distributed power sources.

3.2.3. Case of fault handling in distribution network

The distribution network is a network that distributes electrical energy to users. More than 80% of power outages for users are caused by issues with the distribution network. Studying fault handling in distribution networks is of great help in improving power supply reliability. In recent years, extensive research and renovation have been conducted on the distribution network. Fault handling in distribution networks is an important research topic in intelligent distribution networks. There are many cases to learn from.

(1) Short circuit faults quickly self-heal. The ring network section switch adopts a load switch. When a fault occurs, adjacent terminals exchange fault information to determine the fault section. After the outgoing line protection trips, the fault section is directly isolated and the contact switch is closed to restore system power supply. By using a universal short-circuit fault location algorithm based on distributed intelligence mode that does not rely on the main station/substation, fault isolation and power restoration algorithms can be achieved.

(2) Seamless self-healing of short circuit faults. The ring network adopts a closed-loop operation mode, and the section switches use circuit breakers. When a fault occurs, adjacent terminals exchange fault information to determine the fault section, and directly isolate the

fault section before the outgoing line protection trips. This will not affect the power supply of other healthy sections.

This case is a comprehensive case for fault handling in distribution networks, including the handling of three-phase faults, two-phase faults, and single-phase faults. Taking the application of X Power Company as an example, analyze the problems and solutions that arise in the actual application process.

3.3. Effectiveness of case teaching

From 2021, a total of 39 students have taken the course “Smart Grid Technology", about 13 persons per year. The undergraduate major of the students come from multiple majors such as electronic information engineering, communication engineering, automation, electrical engineering and automation, measurement and control technology and instruments, computer science and technology, etc. There is a significant difference in students' understanding of the power system. Many students have little understanding of the power grid. Faced with such a complex learning situation, classroom teaching is quite challenging. The number of students is not particularly large, so it is suitable to use case-based teaching method for teaching, which facilitates students' discussion. To this end, a case study method is adopted for teaching. During the teaching process, attention is paid to simplifying relevant issues and providing more background knowledge, so that students have a preliminary understanding of electrical engineering. Based on this, discussions can be conducted to stimulate students' interest and exploration of knowledge from multiple disciplinary fields.

Adopting the case study method for teaching not only caters to students with poor basic knowledge, but also takes care of students with a certain foundation in electrical engineering. This has benefited everyone, improved their practical abilities, and achieved the teaching objectives. Through 3 years of application, it has been found that case teaching has improved students' understanding of engineering problems and achieved good results.

4. Conclusion

Using case teaching in the classroom teaching of Master's degree in Control Engineering can improve students' practical abilities. During the process of guiding students to engage in case discussions, teachers need to provide necessary explanations of background knowledge in advance to give students a general understanding of the case. After the student discussion is completed, the teacher needs to expand and extend the case as necessary, stimulate students' interest and thirst for knowledge, and guide them to gradually learn how to analyze and solve problems with the knowledge they have mastered. Through 3 years of application, it has been found that case-based teaching has improved students' understanding of engineering problems and achieved good results.

Acknowledgements

This study is supported by 2023 Graduate Education Reform Project of Qilu University of Technology (YJG23YB009).

References

[1] Information on http://www.cdgdc.edu.cn/xwyyjsjyxx/gjjl/szfa/263317.shtml

[2] Zhang Xuemin, Hou Fogang: How far is it from theory to practice? ---A discussion on the knowledge transformation mechanism of case teaching for professional degree postgraduates, Modern university education, (2020) no.1, p.103-109. (In Chinese)

[3] Shi Zengmin, Dai Lei, Liu Wenjun, et al: Analysis of application of case teaching method in the professional degree postgraduate teaching, Education and teaching forum, (2018), no.48, p.126-127. (In Chinese)

[4] Shen Jin, Xing Xuening, Gao Mingliang, et al: Exploration on the cultivation of innovative practical ability for full-time graduate students majoring in electrical engineering, China Electric Power Education, (2018), no.07, p.71-73. (In Chinese)

[5] Zhang Damin, Zhang Qiang, Zeng Hanchao, et al: Exploration of Practical Ability Cultivation for Graduate Students majoring in Electrical Engineering, Education and Teaching Forum, (2020), no.35, p.85-86.(In Chinese)