

Application of Case Method Teaching in the Master of Control Engineering

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Abstract

Professional degree Master is a form of postgraduate education in China, which focuses on the cultivation of practical and application abilities. In order to train the practical ability, the case method is introduced into the classroom of the master of control engineering. First the necessity of the case method is analyzed, and explores the basic ideas of case teaching. And then, Taking "smart grid control technology" as an example, the paper explores the production and application of the case. The cases need to simplify the actual project, so as to highlight the relevant knowledge points. Before the teacher guides the students to discuss the case, they are required to explain the background knowledge in advance. Practice has proved that the application of the case method is of great help to improve students' practical ability, understanding and solving practical engineering problems.

Keywords

Case method; Practical ability; Master of control engineering teaching.

1. Introduction

Professional degree Master is a form of graduate education in China. Compared with academic degree Master students, the cultivation of professional degree Master students is oriented by professional practice and pays more attention to the cultivation of practice and application ability [1]. The training goal of professional degree master students is to cultivate applied high-level professionals with solid theoretical foundation and adapt to the needs of industry and occupation, such as engineers, lawyers, accountants, teachers and other senior technical personnel with obvious professional background [2]. The cultivation of practical ability is the core of professional degree graduate education [3-4]. For the cultivation of professional master students, we should not only pay attention to the study of basic theory, but also strengthen the cultivation of practical ability, especially the ability of solving practical engineering problems. The case method is based on the actual case, through the discussion and analysis of specific cases, to train students' ability to analyze and solve practical problems. A case is a narrative of an actual or realistic problem. Teachers play the role of designers and motivators in teaching, encouraging students to actively participate in the discussion [5]. For the master of control engineering, the cultivation of practical ability and innovation ability is very important. The introduction of engineering cases can enhance students' ability to solve practical problems and improve their interest in learning.

2. Necessity of the Case Method in Training of Professional Master

2.1. Professional Degree Master of Control Engineering

Professional degree postgraduates need to study major courses for one year. These major courses generally have strong practicality. For major courses with strong practicality, the case teaching can make students contact with engineering problems as soon as possible and improve their ability to analyze and solve practical engineering problems [5]. After experiencing university education, postgraduates have learned a lot of theoretical courses and formed their own knowledge system [6]. Entering graduate stage of learning, if you still only explain professional knowledge, it is difficult to arouse students' interest, and the learning effect is not good. For major courses with strong practicality, the case method teaching is adopted to make students the knowledge they have learned and learn new knowledge in the process of solving problems, so as to arouse the interest of students.

The main goal of professional degree postgraduates is to train senior technicians. Compared with academic Master, the cultivation of practical ability is more important. For a qualified engineering and technical personnel, engineering scientific knowledge and the ability to deal with problems is the basic ability. Therefore, it is necessary to train each student's engineering ability, so as to have a certain practical and comprehensive ability of multi-disciplinary knowledge and experience. In the classroom teaching, the introduction of engineering cases can enable students to analyze and solve engineering problems from the perspective of an engineering technician. In this link, teachers need more guidance, not only to analyze and explain the engineering background, but also to simplify the engineering problems, so as to highlight the relevant knowledge points.

2.2. Students' Foundation

The major of Master degree graduate students in the undergraduate stage are not nearly the same, so the understanding and mastery of some professional knowledge are different. Students from electronic information, communication engineering, electrical engineering, automation, measurement and control, computer and other different undergraduate. Students of different majors have different bases for their specialized courses. Some technical terms are also understood differently. For example, for the concept of reactive power in the course of intelligent grid control technology, students of electrical major have a good understanding, and students of electronic major may be difficult to understand. Therefore, the explanation of major courses needs to take into account all aspects, and the difficulty of teaching is relatively large. Using case teaching method, students analyze and explore the points they are interested in, so as to take care of students with different foundation.

2.3. Teaching Cases

Most actual cases need to involve technical problems such as technical development, product development, engineering design, and etc. The scope of the major involved is very wide. The case connects theory to practice. For the construction and application of the cases, attention should be paid to the explanation of the project background, and the engineering questions will be simplified as necessary to highlight the knowledge points. After the case discussion is completed, it is necessary to explain and supplement the extension of the engineering problem and the current situation of the problem.

Engineering problems involve many technical aspects and are very complex. When construction engineering cases, it is necessary to simplify the engineering problems. So that students can grasp the essence of the problem, so as to highlight the knowledge points. Taking smart meter as an example, the intelligence of smart meter is reflected in communication. Smart meter needs to communicate with other devices. For the problem of communication, it is

necessary to simplify, so that students can understand the communication means used by smart meters, and avoid other interference.

For an engineering problem, the explanation and discussion of the case are very simple. After the students analyze and discuss the designed problems, teachers need to guide them further. The practical solutions of engineering problems are shared with the students, and the advantages and limitations of the solutions are analyzed. At the same time, we also need to explain the current development of the problem to improve students' interest in the problem. Avoid the idea that students have standard answers to engineering problems and deepen their understanding of engineering problems.

3. Case Method in Smart Grid Control Technology Course

3.1. Background of the Course

Since 2013, the author has taught the course name as "smart grid control technology" for the master of control engineering in Qilu University of technology. The content of the course is mainly about the theory and technology of smart grid construction in recent years at home and abroad. The practicality of the course is outstanding. In the course of teaching, we pay attention to the accumulation of cases, and combined with some scientific research projects we participated in, we appropriately simplified them, sorted them into cases that students can easily understand in class, analyzed and explained them, and achieved good results.

Based on physical power grid, smart grid is a new type of power grid, which integrates modern advanced sensor measurement technology, communication technology, information technology, computer technology and control technology with physical power grid. Ultra-high voltage (UHV) grid is the skeleton of China's smart grid. The construction and development of smart grid have always been a hot field. There are a lot of cases worthy of studying and learning. In recent years, a large number of research results and demonstration projects are emerging. Through case teaching, graduate students can better understand the frontier of the current subject, inspire and drive students to invest in scientific research practice as soon as possible. Smart grid construction at home and abroad provides good cases for our smart grid research and learning. Discussing and studying these cases can make graduate students better understand the connotation and research field of smart grid.

3.2. Constructing Teaching Case

The Case method aims at solving actual problems, and its essence is to stimulate students' innovative thinking. In order to cultivate the practical ability of master degree students majoring in control engineering, a series of teaching cases have been developed in cooperation with Shandong Kehui Electric Power Automation Co., Ltd. based on the teaching objectives of smart grid control technology and years of engineering practice.

(1) UHV alternating current transmission

Taking Shandong UHV alternating current transmission network as an example, the paper analyzes the technology, problems and research direction of UHV alternating current transmission network. At present, Shandong UHV alternating current power grid has been formed initially. It is connected with North China, northwest and Northeast China Grid respectively through 1000 kV alternating current lines, four 500 kV lines. During the period from the 12th Five Year Plan to the 13th five year plan, Shandong plans to build four 1000 kV high voltage communication projects. Shandong power grid is expected to receive about 37.5 million kilowatts from outside the province. Through the case study of UHV alternating current transmission, we can understand the development direction and trend of UHV in China, and the technical problems.

(2) Distributed energy generation

Taking the 5MW roof solar photovoltaic power generation project of Qilu University of technology as an example, we focuses on the control and protection technology in the process of solar power generation and grid connection. The project is divided into five installed areas, each with an installed capacity of about 1MW. Through the high-power inverter installed in No.1, No.2 and No.8 power distribution stations, library and liberal arts building, the direct current power is converted into alternating current power. Then, the voltage is increased from 380V to 10kV through the step-up transformer and connected to the 10kV switch station of the school. The generated energy is mainly used for the campus, and the excess power is transmitted to the State Grid. Under normal sunshine conditions, it can generate 23000 kWh of electricity in a whole day, and the effective utilization is about 12000-15000 kWh.

(3) Smart distribution network measurement and control system

Taking the project "research and development of new measurement, communication and protection technologies for intelligent distribution network" as an example, we focuses on the analysis of wide area measurement and control system for smart distribution network, centralized monitoring application based on master station and distributed intelligent control application based on intelligent terminal. Analysis of smart distribution network communication model, based on IEC61850 open communication system, automation equipment interconnection, plug and play; analysis of multi-functional intelligent terminal, advanced distribution automation master station. The distributed intelligent control technology based on peer-to-peer communication of intelligent terminal and the protection control technology based on distributed intelligence are analyzed. This paper analyzes the grid connected protection and control technology of distributed generation based on wide area measurement and control system. We also analyse the new single-phase grounding fault location technology of relay protection, feeder automation and neutral ineffective grounding system in active distribution network.

3.3. Application Case

In the process of case building, it is closely combined with the current engineering practice of smart grid construction, and it is necessary to simplify and highlight the relevant knowledge points. A smart grid project often involves universities, manufacturers, user units (power enterprises) and other units, and uses more and more new technologies. In order to facilitate students' understanding, the production of the case first need to explain the background of the project clearly. In addition, the production of the case also needs to simplify the project and highlight the knowledge points, so as to facilitate students' understanding.

Taking the case of UHV alternating current transmission as an example. UHV alternating current transmission refers to the alternating current transmission above 1000kV. UHV transmission technology involves many kinds of technologies and fields, such as power grid stability, energy transmission, insulation technology and so on. It is more complex, which requires the necessary simplification, focusing on one or several knowledge points.

First of all, students should understand the technical background of UHV transmission. Due to the long-distance and reverse distribution of energy resources and power demand in China, it is necessary to develop and apply long-distance, large capacity and high-efficiency UHV transmission technology. Since the end of 2004, we have carried out large-scale research and technical research, mastered the key technologies of overvoltage suppression, external insulation configuration, electromagnetic environment control, developed a series of core equipment, and established a complete UHV transmission technology system. UHV transmission technology is one of the leading technologies in the world in China. At the same time, UHV alternating current / direct-current transmission is also an important feature of China's smart grid construction, with UHV power grid as the backbone grid, which is also a significant difference between China's smart grid construction and other countries in the world.

Through the explanation of UHV technology background, students' national pride will be enhanced.

The remarkable advantage of UHV transmission is to improve the power transmission capacity. According to the data given by State Grid Corporation, the transmission capacity of 1000 kV alternating current UHV transmission line is more than 5 million kilowatts, which is close to 5 times of 500 kV UHV alternating current transmission line. For this knowledge point, the homework after class is arranged. Let the students review the knowledge points of natural power learned by undergraduate first, and then consult the relevant literature for discussion, focusing on understanding why the relationship is five times. Through the discussion, we can deepen the students' understanding of natural transmission power and other knowledge points, and deeply understand the necessity and superiority of UHV construction.

After the course discussion, the next step is the extension of relevant knowledge. This part of the work is mainly completed by the lecturer. The UHV transmission is a system engineering, involving all aspects. Through the explanation of engineering background, students can understand the difficulty of engineering construction. In 2009, the first UHV transmission line in China, Jindongnan Nanyang Jingmen, was completed, making China is the first country in the world to put UHV technology into commercial operation. In 2013, "key technology, complete equipment and engineering application of UHV alternating current transmission" won the special prize of national science and technology progress award. At present, 26 UHV lines have been built in China, covering seven regional power grids. Through the explanation of these background knowledge, students can have an understanding of the difficulty and development status of UHV technology, stimulate students' interest, and lay a foundation for future research.

3.4. Result

In 2020, 22 students took the smart grid control technology course. The undergraduate majors include electronic information engineering, communication engineering, automation, electrical engineering and automation, measurement and control technology and instruments, computer science and technology, and etc. The students have different bases of power system. Facing such complex learning situation, classroom teaching is more challenging. Therefore, the case method is used to teach. In the process of teaching, we should pay more attention to the simplification of relevant problems and explain the background knowledge more, so that students have a preliminary understanding of electrical engineering, and then discuss it on this basis, and stimulate students' interest and exploration of knowledge from multi-disciplinary fields.

The case method not only takes into account the students with poor basic knowledge, but also takes care of the students with certain electrical engineering foundation, which makes everyone gain and achieves the training goal.

4. Conclusion

In the classroom teaching of master of control engineering, the case method should not only select the main relevant cases, but also simplify the engineering cases, so as to highlight the relevant knowledge points. In the process of guiding students to discuss the case, teachers need to explain the background knowledge in advance, so that students can have a general understanding of the case. After the students' discussion, the teacher needs to expand and extend the case, explain the advanced methods of the project at home and abroad, stimulate students' interest and thirst for knowledge, and guide students to gradually learn to analyze and solve problems with the knowledge they have mastered.

Similarly, built cases can also be used in the teaching process of senior undergraduates to cultivate and exercise undergraduates' awareness of participating in scientific research activities and their ability to solve complex engineering problems.

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