



Research and Practice of Case Teaching in Network Engineering Course Teaching Under OBE Concept

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Abstract. In view of the traditional teaching methods of network engineering major core courses are difficult to tap students' potential motivation and learning enthusiasm, in order to further improve the teaching quality of network engineering major courses, mobilize students' enthusiasm and initiative in learning, and improve the teaching effect of professional core courses, based on the OBE education concept, this paper proposes to introduce case teaching method into the teaching process from the aspects of teaching method, teaching content and teaching mode, further consolidate the concept of "student-centered, output-oriented and continuous improvement", and finally realize the goal of cultivating application-oriented talents for the country and society. Case teaching method is an open and shared teaching mode with students as the main body and teachers as the leading part through "teaching and learning". Case teaching method is introduced in the teaching process of professional courses, and appropriate cases are selected to blend into knowledge points combined with the course content. According to the steps of case explanation, question raising, group discussion, summary and promotion, effect evaluation, and problem solving, relying on the industry-education integration platform of school-enterprise cooperation, the case library is formed, and the application of cases in professional courses is analyzed and discussed.

Keywords: OBE · Case teaching · Network engineering · Teaching method · Cultivation of talents

1 Introduction

Outcome Based education (OBE for short, also known as ability-oriented education, goal-oriented education or demand-oriented education) is an educational concept that is oriented by students' learning outcomes [1]. As an advanced educational idea, Spady et al. put forward it in 1981, and soon gained people's attention and recognition. Now it has become the mainstream idea of educational reform in the United States, Britain, Canada and other countries. A-BET fully accepts the concept of OBE and applies it throughout the engineering education certification standard. In June 2013, China was accepted as a signatory member of The Washington Agreement, which marked that the curtain of engineering education certification with international substantial equivalent

has been opened in China. It is of practical significance to guide engineering education reform with the results-oriented education concept [2].

OBE refers to that the goal of teaching design and implementation is Learning Outcomes achieved by students at the end of the education process. OBE emphasizes the following four questions: What Learning outcomes do we want students to achieve? Why should students achieve such learning outcomes? How can students be effectively helped to achieve these learning outcomes? How do you know if a student has achieved these learning outcomes? OBE requires that schools and teachers should first define learning outcomes, coordinate with diversified and flexible personalized learning requirements, and allow students to complete the challenge of self-realization through the learning process, and then feedback the results to improve the original curriculum design and teaching [3].

The network engineering major of University of Jinan began to recruit students in 2003. In 2012, it was approved by Shandong Provincial Department of Education as the “Construction Point of Featured Majors of Colleges and Universities in Shandong Province”, and passed the National Engineering Education certification in 2020. As the first network engineering major in Shandong Province, it implements the core concepts of student-centered, output-oriented and continuous improvement. Adhere to the foundation of moral education, follow the “new engineering” talent training mode of knowledge, ability and quality, innovation and entrepreneurship, establish a curriculum system that can fully support the graduation requirements, the credit system, tutorial system, school-enterprise cooperation and other teaching modes throughout the whole process of talent training. It is committed to cultivating network engineering application-oriented talents with good humanistic quality and scientific literacy, solid theoretical foundation of computer science and technology, systematic professional knowledge of network engineering, and good engineering consciousness, engineering ability and innovation consciousness. In order to adapt to the requirements of the Ministry of Education for talents training in colleges and universities, the network engineering major of University of Jinan actively explores teaching modes, fully relies on network engineering-related enterprises and industry organizations, and constantly meets the social demand for network engineering talents. In order to further improve and continuously improve the teaching quality of network engineering courses, various teaching methods are actively introduced in the teaching process, including case teaching method, task-driven method, demonstration method, heuristic method and so on. This paper aims to illustrate the feasibility and implementation of case teaching method in course routing and switching of network engineering specialty.

2 Overview of Case Teaching Method

The case teaching method was put forward by Harvard Law School in 1870 and formally implemented by Harvard Business School in 1921. It was introduced into China in 1979 and gradually promoted from management to other disciplines [4]. The so-called “case teaching” is a teaching method that introduces real cases to help students understand and master knowledge. The specific operation steps are for the teacher to introduce real event scenes or imitate real scenes according to the course objectives and content, and let

students become one of them. Based on classroom theoretical knowledge, students are guided to combine theoretical knowledge with case content. Through group discussion, analysis, summary and report, let the students put forward the method to solve the actual complex problems, in order to develop the ability to analyze and solve problems. According to the students' feedback, the teacher answers the questions in order to consolidate the knowledge points taught. The case teaching method is characterized by student-led and teacher-led teaching mode of "open + sharing" and focuses on cultivating students' independent inquiry ability and innovation consciousness, which not only strengthens the two-way communication between teachers and students, but also cultivates students' sense of teamwork [5].

3 The Necessity of Using Case Teaching in Network Engineering Courses

Through engineering education accreditation since 2020, when the network engineering, institute of the teaching and research section closely around OBE's education idea, pay more attention to cultivating the regional economic construction and social development need, good humanity quality and scientific literacy, to use solid and system network engineering professional knowledge to solve complex engineering problems of high-level talents. Therefore, in the teaching process of network engineering courses, in addition to enabling students to master the necessary basic knowledge of mathematics and physics, basic knowledge of engineering and professional knowledge in the field of network, it is more important to guide students to use theoretical knowledge to propose systematic solutions to complex network engineering problems in life.

Basic Programming, Discrete Mathematics, Circuit and Digital Logic, Data Structure, Computer Network Principle, Routing and Switching are the core courses of network engineering major, which are characterized by a wide range of curriculum knowledge, complex knowledge system, abstract and boring content of individual courses and high difficulty. As a few courses have no obvious relationship with students' real life, it is more difficult for students to understand and master knowledge. Therefore, adopting the OBE idea, take the student as the center, adhere to the theory with practice, in the teaching course learning outcomes as output oriented, continuous improvement teaching method, at the same time in the process of teaching the appropriate introduction of real case in life, can not only stimulate students' interest in learning, and can deepen students' understanding of course content. So as to enhance the advanced, innovative and challenging degree of the course.

The introduction of case teaching method into the teaching of network engineering courses is one of the main teaching organization and implementation measures to implement THE OBE concept. It makes teachers become storytellers and designers of cases, encourages students to think independently and guides them to change their focus from knowledge to ability. Through two-way communication and learning, students are trained to propose solutions to complex network engineering problems by applying knowledge concepts, professional theories and standard rules of engineering technology.

4 Analysis of Existing Problems in Case Teaching of Network Engineering Courses

Network engineering courses mainly include program language courses, network engineering practice courses and network principle courses. Problems existing in case teaching of these three types of professional courses are analyzed and summarized as follows:

The teaching cases of program language and network principle courses are relatively simple, with a single teaching and explanation, and there is a certain gap between them and real cases in real life. Case teaching mainly uses language explanation, step demonstration, and does not fundamentally change the teaching mode. It is still stuck in the stage of “teachers speak and students listen”, without really clarifying the nature of case teaching method and the tasks that both teachers and students need to complete in the process of case teaching. As a result, students’ interest in the case is not high, their participation is low, and their initiative is weak, thus affecting the teaching effect is not ideal.

Network engineering practice courses have achieved good teaching effects in case teaching, the key lies in the collection and integration of excellent cases to match the knowledge points of the course. At present, most young teachers are unable to collect classic cases due to lack of engineering practical experience, so they will continue to use some old cases, leading to uneven quality of cases and failing to meet students’ needs for knowledge update at the present stage. In addition, if the teaching case involves interdisciplinary, it will not be conducive to students’ independent analysis and discussion, but will lead to students losing interest in learning.

Network engineering professional practice courses have high requirements on the engineering practice ability of teachers, so case teaching method is adopted to organize teaching. In addition to years of teaching experience, teachers should also have rich experience in engineering practice, so as to clarify the matching and integration of cases and course knowledge points in the process of case collection, sorting, analysis, teaching, discussion and evaluation. This requires teachers to invest more time and energy in lesson preparation, compile cases suitable for their own teaching content and teaching objectives, effectively guide students to participate in case discussion, and achieve the corresponding teaching objectives.

5 Design and Application of Case Teaching of Network Engineering Courses

This section is the core network engineering required course “routing and switching”, for example, using case teaching method to organize the implementation, in the professional course teaching content of blended in selected cases, to deepen students’ understanding of curriculum knowledge and master, mobilize the students’ interest in learning, enhance the teaching effect, improve the students’ ability to solve complex engineering problems in life.

5.1 The Implementation of Case Teaching

The teacher should first clarify the teaching objectives, that is, the ability level that students should achieve through case study as well as the evaluation methods and standards adopted [6]. According to the teaching objectives can be decomposed step by step, the teacher should be clear through the case to solve the problem at what level, but also clearly reflect the ability level of students to solve the problem. At the same time, we should also consider the change of students' learning attitude and ability.

Second, lecturers are able to anticipate the course of teaching and prepare case studies by asking themselves questions such as: What is the likely effect of the case? What questions were raised? What problems are to be solved? How to solve this problem? What questions are the students likely to ask? And so on. The instructor also needs to plan when and how concepts will be presented.

Third, teachers should select teaching cases. Case selection is a necessary prerequisite for case teaching. On the basis of clear teaching objectives, it is particularly important to select appropriate and suitable teaching cases [7]. Cases should not only be consistent with the teaching objectives, but also adhere to the theory and practice. At the same time, it is the case that teachers can grasp by themselves, and students are easy to accept and recognize.

Fourth, create a good teaching atmosphere. The case materials will be sent to students one week in advance before each case teaching. Around the case materials, students will be assigned the learning task of consulting the designated materials and reading materials after class, so as to encourage students to think actively and preliminarily form the cause analysis and solution of the problems in the case.

Fifth, group discussion should be carefully organized to strengthen the two-way communication and interactive learning atmosphere between teachers and students. Teachers can divide students into groups consisting of 3–6 people according to their gender, interests and experience. One person in each group is chosen as the leader and responsible for the overall work of the whole group. Teachers should give full play to their leading role and lead students to analyze cases in the form of lectures, handouts and audio-visual teaching. Students should fully show their own main role, after entering the role, combined with knowledge points actively analyze cases, discuss and analyze the problems existing in cases. Students need to find solutions to complete the teaching tasks assigned by the teacher. In the process of communication and discussion, teachers can put forward several problems and treatment methods with relatively concentrated opinions, and let each group focus on these problems and treatment methods, so as to guide students' attention to a reasonable solution of the scheme.

Sixth, summarize and improve. After the discussion, time was set aside for students to think and summarize in written form. Then, each group sent representatives to present their analysis and solution opinions on the case, and teachers summarized the case according to the report content of each group. Teachers combine theoretical knowledge with cases to analyze and sort out key issues to consolidate course knowledge. At the same time, the teacher answers the questions and difficulties raised in the group, and can expand knowledge appropriately.

Finally, after completing a teaching task, teachers can establish a process evaluation and effective feedback mechanism to strengthen students' memory and understanding

of knowledge points. Through the new knowledge, the old knowledge points related to it can be awakened, and the two can be connected, so as to complete the learning process of understanding, analysis, application, evaluation and improvement, and apply it to the curriculum continuous improvement, improve the quality of teaching [8]. At the same time, students can turn the newly accepted knowledge into a storage unit in their own knowledge system, which can be integrated and applied to solve complex network engineering problems.

5.2 Teaching Case Design Related to National Security Concept

The rapid development and wide application of network technology has caused revolutionary changes in the field of national security, and network security has become the “invisible domain” of national security. Without network security, other areas of national security will not be effectively guaranteed. Therefore, network security occupies an extremely important strategic position in national security and has become the basic security of the country and society. The state has also formulated a series of laws and regulations to maintain cyber security. Since 2014, various departments of the state have jointly held the National Cyber Security Publicity Week. Let the concept of “network security for the people, network security by the people” deeply rooted in the hearts of the people, create a good atmosphere of network security, everyone’s responsibility, everyone’s participation, and constantly improve the national awareness of network security and protection skills.

The network security technologies involved in “Routing and Switching” include Access Control List (ACL), Network Address Translation (NAT), and Wireless Network Technology (WLAN). The teaching objective is to require students to master their basic configuration, working principle, deployment and troubleshooting methods, to train students to correctly understand the risk, safety and responsibility in the whole process of network project implementation, and improve their innovation ability. When telling this part of the teaching content, we can introduce the topic of “why the United States lists Huawei as a national security threat”. As a key private technology enterprise, some people may think that Huawei is just a company selling mobile phones to make money, and no one will associate it with the country and society. That is not the case, however, Huawei is a leading global information and communications technology (ICT) solutions provider, the telecom operators, businesses, and cloud computing terminal constructed end-to-end solutions in areas such as advantage, for the operator customers, enterprise customers and consumers to provide competitive ICT solutions, products and services. The U.S. government saw a Huawei growing up in recent years, began to crazy blocked it development abroad, slander Huawei company in the United States spying, restrict local supply Huawei technology company, enterprise and other countries want to fully defeated Huawei, however, as we are proud of private enterprises in Huawei Ren Zhengfei and his colleagues, Including the employees of all enterprises stand out, we can conduct independent research and development and technological innovation. The development of 5G business field has been in the world’s leading level, and it is the best 5G end-to-end solution with “minimal site, minimal architecture, minimal protocol, minimal operation and maintenance”. Huawei has launched corresponding products in access network, transmission network and core network. Among them, WTTx wireless broadband

provides home users with an efficient deployment and fiber-like experience. Huawei's 5G-Ready mobile bearer solution addresses capacity and O&M challenges by optimizing single-bit cost, improving configuration efficiency, and automating the full life cycle through a minimalist network architecture, SRv6 minimalist protocol, and NCE minimalist operation and maintenance. Huawei's fully integrated, intelligent and autonomous 5G minimalist core network solution, centered on micro services, helps operators quickly build networks and support business innovation. In recent years, Huawei's absolute R&D investment has gradually increased, and its R&D income has steadily ranked first among enterprises. It has not only generated significant economic benefits, but also far-reaching social benefits.

In professional classes, naturally introducing classic cases closely related to our lives can not only enhance students' interest in learning and sense of national crisis, but also actively guide students to truly feel all kinds of hidden network security events that occur around them every day, so that they can be aware of the hidden dangers of network security faced by the country, and then work hard and innovate key technologies to prevent and resist foreign aggression.

5.3 Case Design Related to Classical Philosophical Theory

Dialectical materialism epistemology is an important part of the basic principles of Marxism, which includes practice, cognition and truth. Among them, practice is the only criterion to test the truth, and cognition is a process of pursuing the truth, which requires us to keep pace with the times, develop and innovate, recognize and discover the truth in practice, and test and develop the truth in practice. In the classroom teaching, we will introduce the extraordinary history of the Party in the 100th anniversary of the founding of the Party, experience how the Chinesization of Marxism has profoundly changed China, realize the truth and practical power of Marxism, deeply learn and understand the major initiatives of the Party in the opening year of the 14th Five-Year Plan, persistently arm our minds with the Party's innovative theories and latest achievements, and guide our practice. Actively promote all kinds of work.

In the parts of switching basis, network redundancy and DHCP technology in "Routing and Switching", the selection of teaching cases should combine the process of human cognition of objective truth with the epistemology of dialectical materialism. The teaching objective of basic switching is to enable students to know and understand simple network structure through learning single-route network interconnection, and to have simple troubleshooting ability through obstacle removal practice. The teaching goal of network redundancy and DHCP technology is to be able to plan, design, analyze and eliminate faults of the park network by learning EtherChannel, FHRP, DHCP and other technologies, and to train students' scientific spirit and guide them to think in multiple dimensions. The gradual cultivation of network interconnection scheme and obstacle removal ability in the park is a dialectical process of "cognition-practice-recognition-re-practice", so is scientific research. Students should be taught to deepen their understanding of the materialistic world. The design and explanation of relevant teaching cases are beneficial to the cultivation of students' outlook on life and values. Classical theory should not be abandoned, but should be combined with modern civilization, with theory to guide practice, and in turn to enrich and develop theory. Classical

philosophical theory should be the leader and the guide of students on the way to success, promote students to master knowledge at the same time, but also train the builders and successors of socialist cause for the society and the country.

5.4 Case Design Related to the Inheritance of Craftsman Spirit

“Craftsman spirit” is an attitude of striving for perfection, as well as a professional spirit of loving work. We should not only have lofty ideals, morality and art, but also carry skills to make China strong and shoulder the inheritance and innovation of national culture. Teachers are the backbone of the education work, make good use of the three-foot platform, impart professional knowledge, for the country and society to train more socialist builders and successors is the initial aspiration and mission of every teacher. A rich and pleasant teaching needs to use case teaching method to combine professional knowledge with practical life, so as to naturally infiltrate into the course’s ideology and politics. While advocating the value of professionalism, students can intuitively feel the freshness and vitality of the content taught in class, and silently integrate it into the craftsman spirit.

In the large network interconnection part of “Routing and Switching”, the teaching content is to learn multiplexed network interconnection, and the teaching goal is to train students to be able to analyze, configure and troubleshoot more complex network systems. The design of network architectures of different scales and the deployment of security policies adopted by each layer are the difficulties and emphases of the teaching content. We can demonstrate and explain to students the development history of the campus network architecture, including the overall architecture, IP address, VLAN division, device selection, data center deployment, security strategy and so on. This is the network implementation plan after repeated verification and improvement, the next step will continue to adjust with the continuous expansion of the campus network scale. As a professional network engineer, you should have professional craftsman spirit, scientific and rigorous working attitude and good professional ethics.

6 Conclusion

Based on the OBE education concept, case teaching method is introduced into the teaching of network engineering courses. It not only stimulates students’ learning initiative, but also encourages students to experience real examples related to professional spirit, classic Marxist philosophy theory and national security concept in the learning process, thus arouses students’ love for the major and thinking about its application. At the same time, case teaching can better practice the teaching concept of “student-centered, output-oriented and continuous improvement”, improve students’ professional knowledge, skills and accomplishment, improve teaching effects and achieve teaching objectives.

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