Journal of Computer Science and Electrical Engineering
ISSN: 2959-9911
DOI: https://doi.org/10.61784/jcsee3026

EXPLORATION OF THE NETWORK SECURITY CRYPTOGRAPHY TEACHING REFORM BASED ON THE NEW ENGINEERING BACKGROUND

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Abstract: In the context of the construction of new engineering disciplines, the reform and innovation of engineering course teaching is one of the key tasks. This paper takes the construction of new engineering disciplines as a leader, adopts OBE result-oriented teaching theory, carries out the reform exploration of the teaching system structure and teaching mode of network security cryptography course, focuses on ability cultivation as an orientation, and aims to stimulate the students' independent learning power and learning enthusiasm, and cultivate the students' engineering awareness and application ability, and innovation and practice ability.
Keywords: New engineering disciplines construction; Network security; Cryptography; OBE concept; Teaching reform

1 INTRODUCTION

Since February 2017, the Ministry of Education of the People's Republic of China has issued national strategies such as the Notice on the Research and Practice of New Engineering Science and the Notice on the Promotion of the Research and Practice Program of New Engineering Science, which calls for the comprehensive implementation of the construction of "New Engineering Disciplines" and is committed to promoting the development plan of a strong higher education country[1]. Under the background of the construction of "new engineering", the reform and innovation of engineering course teaching is one of the key tasks. In the wave of higher education teaching reform, how to break the traditional engineering talent cultivation mode, how to cultivate compound and high-level talents with independent learning, engineering awareness and application ability, and innovation ability is the common concern of the education sector, which has far-reaching practical significance.

In the context of the rapid development of computer network technology, artificial intelligence, big data, cloud computing applications are becoming more and more widespread, and the ensuing network security situation is becoming increasingly serious. Without network security, there is no national security[2]. China is also paying more and more attention to the legal and regulatory safeguards and underlying pillars of network security, and has successively introduced a series of important laws and regulations, such as the Network Security Law, the Data Security Law and the Personal Information Protection Law[3]. In 2015, the Academic Degrees Committee of the State Council and the Ministry of Education of the People's Republic of China issued the Circular on the Addition of the First-Level Discipline of Cyberspace Security, which called for the strengthening of the disciplinary construction of cyberspace security, and raised the demand for the cultivation of cyberspace security talents to a new height[4]. In September 2020, the Ministry of Education issued the Guidelines for National Security Education in Universities, Middle Schools and Primary Schools, incorporating 16 areas such as cybersecurity into national security education[5].

Cybersecurity has become an important part of national security, and to enhance the overall strength of national security, it is actually necessary to promote and popularise the education and teaching level of cybersecurity professional direction courses, and the construction of cyberspace security discipline should be strengthened to guarantee and improve the quality of cultivation of cyberspace security professionals[6]. Cyber security cryptography is the core foundation of cyberspace security, involving discrete mathematics, number theory, probability theory and algebra and other mathematical specialities, while focusing on the knowledge of information security, computer programming, etc. The content covers the basic theory of cryptography, standard algorithms, security authentication protocols, as well as cryptographic applications and other knowledge points. The practical requirements of cryptography courses are very high, and the traditional teaching mode is commonly used, with problems such as insufficient cutting-edge teaching design and content, outdated teaching methods, and single teaching evaluation methods. The traditional indoctrination teaching mode limits the improvement of teaching effect and teaching quality to a greater extent, and cannot adapt to the new requirements based on the cultivation of students' ability literacy during the development of new engineering disciplines, so it is urgent to carry out teaching reform practice.

2 PLATFORMS FOR CURRICULUM TEACHING REFORM AND CYBERSPACE SECURITY KNOWLEDGE SYSTEM STRUCTURE

2.1 Platform for Teaching Reform of Cybersecurity Specialised Direction Courses

Our university built a 360 network security training room in May 2019, which focuses on offensive and defensive exercises, with an area of about 110.40 square metres, including six Huawei servers and several cabinets, network security virtual simulation systems and software modules. With advanced experimental equipment and complete functions, the training platform mainly contains three main parts: network security teaching, experimental training and CTF competition, and can provide rich learning resources (including professional modular learning courseware, handouts, lecture videos, experimental guidebooks, experimental projects, CTF training projects and CTF competition resources, etc.), and can concurrently accommodate 140 students for synchronous online practice. The platform will be upgraded and optimised in stages according to the demand for learning resources, and is maintained and managed by professional technicians, providing a good platform for the practical teaching reform of network security cryptography course. The 360 network security training room is used to build a hybrid online and offline teaching platform for network security cryptography, which guides students to learn independently, openly and inquisitively, and enhances students' learning initiative and enthusiasm.

2.2 Cyberspace Security Knowledge Architecture

According to the development of professional frontier technology and practical application fields at home and abroad, the integration of cyberspace security knowledge structure mainly involves the theoretical knowledge including enterprise application-based and practical teaching content centred on CTF practice, covering the main structure of theoretical and practical knowledge content of cryptography. The theoretical knowledge structure of network security is shown in Figure 1, where each theoretical module is organized into offline classroom teaching in specialized courses.

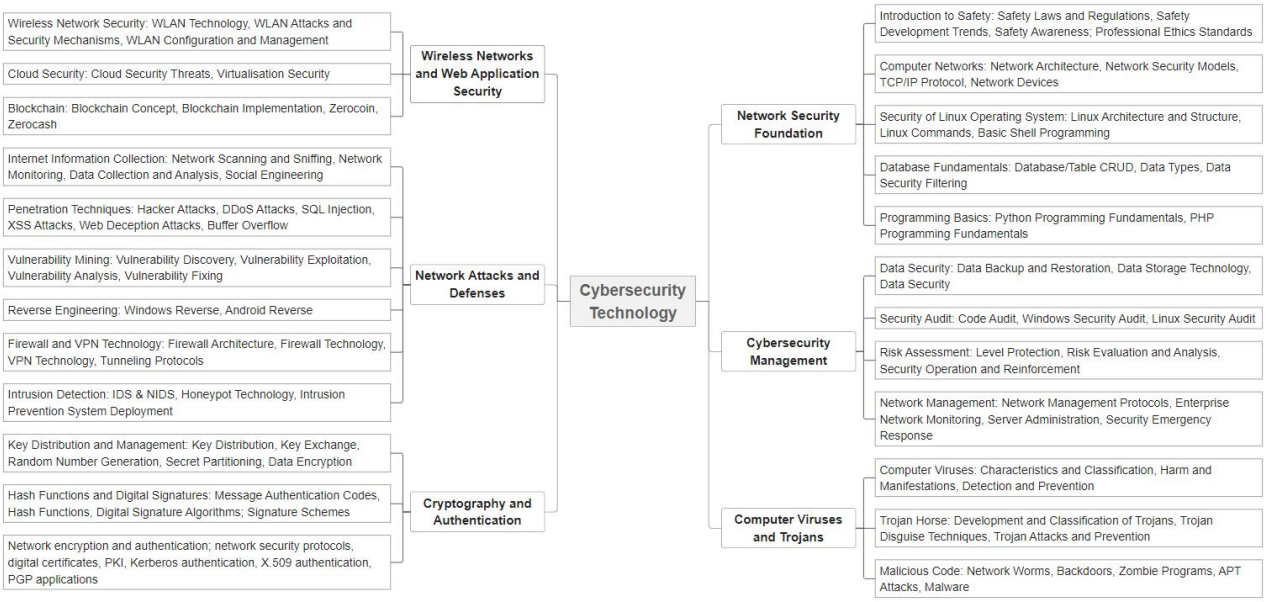

Figure 1 Network Security Teaching Content Structure with a Focus on Enterprise Engineering Applications

The structure of CTF practical content is shown in Figure 2, which organises online 360 platform practical hands-on training and CTF competition exercises.CTF questions are divided into basic mode and one-man mode according to type, and into beginner, intermediate and advanced levels according to difficulty. Students can carry out experimental practical training anytime and anywhere in the three main phases of pre-course, in-course and post-course.

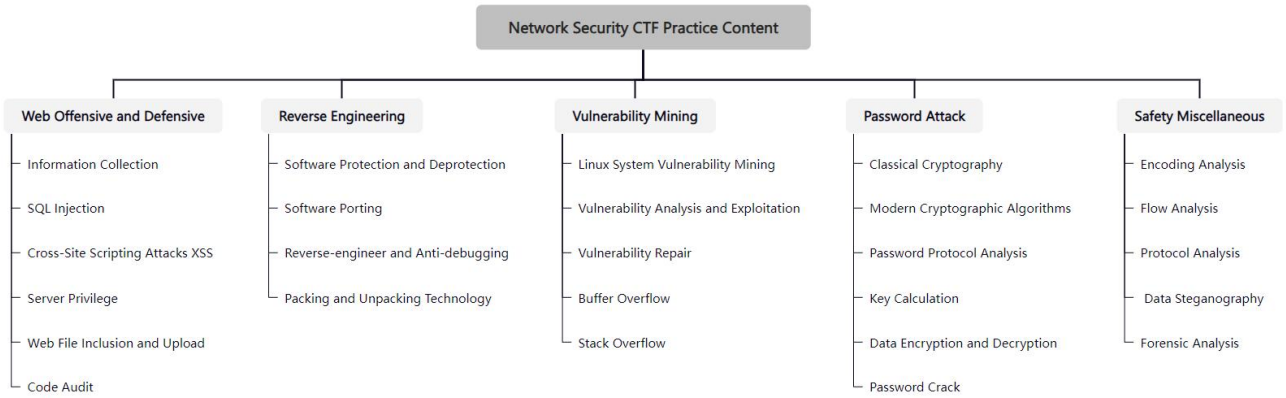

Figure 2 Network Security Practice Teaching Content Structure Centred on CTF Practice

3 EXPLORATION OF TEACHING REFORM PATH OF NETWORK SECURITY CRYPTOGRAPHY

The reform of this course is mainly led by the construction of new engineering disciplines, adopting the advanced theory of OBE results orientation, and promoting the reform of teaching system structure and teaching mode around the guiding ideology of 'student-centred', 'learning results-oriented education', 'feedback and continuous improvement', and so on. It mainly includes four parts: reconstruction of teaching objectives, updating of teaching design and content, optimisation of teaching methods, and reform of teaching feedback and evaluation. The deep integration of the actual engineering application of the discipline teaching reform exploration and practice, focusing on the ability to cultivate oriented, stimulate students' independent learning power and learning enthusiasm, cultivate students' engineering awareness and application ability, innovation and practice ability.

3.1 Clarify Learning Outcome Orientated Multi-stage Teaching and Learning Objectives

In-depth understanding of the latest technology and industry development trends at the forefront of the profession, and mastering the latest talent capacity needs and training objectives of the industry. From the perspective of enterprise talent demand, regularly visit network security enterprises and conduct research on enterprise talent demand. Carry out more in-depth school-enterprise cooperation with enterprises, school-enterprise joint training and coeducation, invite enterprise technical backbone, industry experts and professional teachers to discuss together, analyse, re-plan and construct the teaching objectives and curriculum system, and make clear the multi-order teaching objectives oriented to enterprise-level learning outcomes. Under the requirements of personality-based learning based on diversity and flexibility, the differences of individual students are included as important influences on the setting of learning outcomes. Taking students' own professional training and development, learning ability quality cultivation, enterprise talent demand and industry-specific application as comprehensive considerations, we determine the maximum learning objectives and outcomes that students should achieve in each major learning stage, so as to reconstruct the multi-step and progressive teaching objectives of the courses. Emphasis is placed on the internalisation of knowledge and the importance of students' independent learning ability, engineering application ability, research design and innovative practice ability, so as to realise the in-depth mapping between the ability structure and the structure of the course objective system.

3.2 Update the Teaching Content and Practice Content in Line with the Actual Engineering Application

On the basis of network security knowledge structure, reflecting the development of cutting-edge technology in the industry, linking each knowledge module, continuously updating and optimising the teaching content, eliminating obsolete and impractical theoretical knowledge points, and increasing the content of modern cryptography's new technology, new concepts and new applications, so as to optimise the cryptography knowledge structure which is mainly practical. According to the development of cutting-edge technology and practical application fields of cryptography at home and abroad, in the theoretical teaching content, emphasis is placed on conforming to the actual engineering application, updating the dimension of knowledge and information, and ensuring that the content is practical and useful. In the practical content module, the actual project cases of enterprises are the main focus, and task-driven throughout the whole practical teaching process. In the design of experimental content, reduce the proportion of verification and demonstrative experiments, and increase the weight of independent design, innovation and research and exploration experiments. Using the school's 360 network security training, attack and defence and competition platform, according to the actual engineering application and project case requirements, students are guided to explore and develop independently to complete comprehensive practical training and summary improvement. Through a variety of professional competitions, training, ability development, all-round cultivation of students' comprehensive application and innovation ability.

3.3 Optimize the Student-Centered Research-Oriented Teaching Strategies and Methods

Cybersecurity cryptography occupies a very important position in cyberspace security, and the practical content is relatively complex, traditional teaching emphasizes indoctrination-type education, focusing on the output of the teacher's teaching process rather than the internalisation and input of knowledge. In the reform of teaching methods, online and offline hybrid teaching methods can be used to build teaching activities, as shown in Figure 3, to guide students' independent, open-ended and inquiry-based learning, to enhance students' learning initiative and enthusiasm, and to emphasise the importance of the demand for the development of independent learning power and competence literacy. Adopting OBE outcome-oriented education theory, carrying out research-based teaching mode, taking students as the centre of the main body of education, taking group collaboration as the dominant form, teacher-guided teaching rather than teacher-dominated teaching, and promoting the personalized teaching of students' independent learning. According to the needs of enterprises and students' actuality, the group teaching mode is organised by creating scenarios and task-driven method, so that students can be integrated into the case scenarios to stimulate students' interest and initiative in learning. In the teaching method, we highlight the 'integration of science and practice', and adopt the virtual simulation technology of 360 network platform to organise online and offline mixed teaching. Simulate the real work scene of enterprises, save hardware and software teaching resources, reduce the expenditure of experimental consumables, improve the practical teaching conditions, solve the time and space constraints of

experiments, which is conducive to significantly improve the students' engineering application ability and innovation and practice ability.

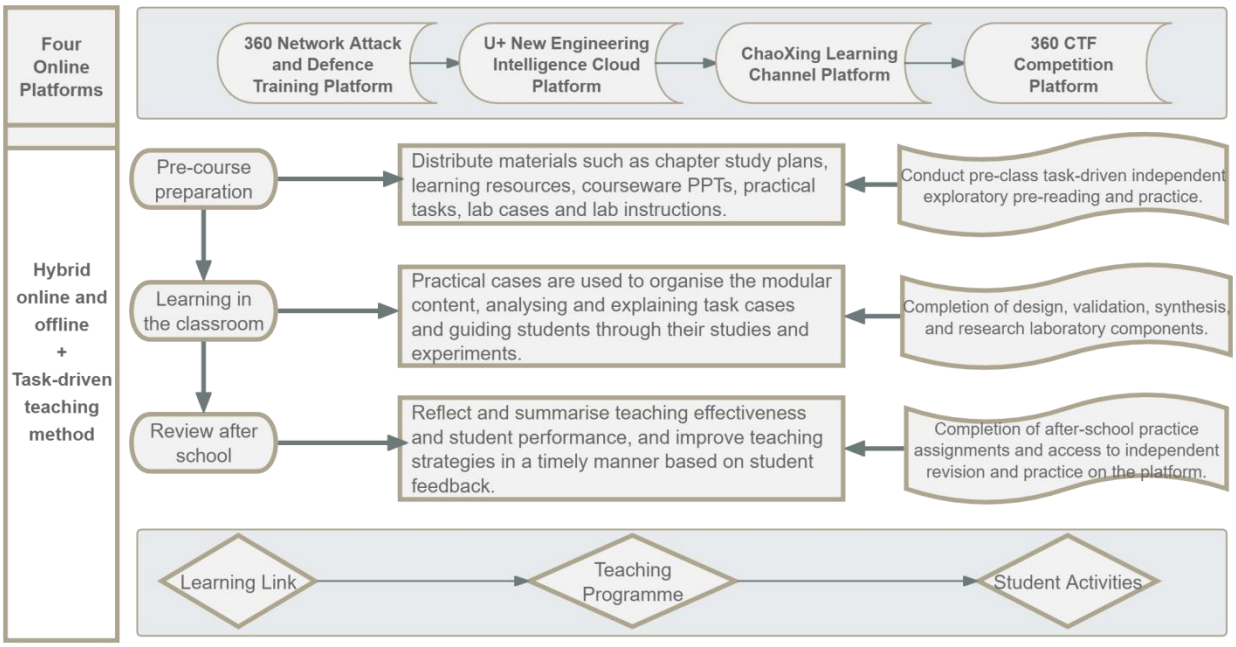

Figure 3 Design of Cybersecurity Cryptography Teaching Activities Based on Online-Offline Hybrid and Task-Driven Approach

3.4 Construct a Teaching Evaluation System Based on Process Assessment

Reform the traditional assessment method based on examination results, implement process-based competency assessment for students, and build a quality monitoring system for scientific assessment and evaluation. Focusing on the cycle of continuous improvement and optimisation of teaching design and curriculum teaching to achieve diversified and flexible personalised learning needs by student autonomy, and to complete autonomous challenges to learning milestones and goals. The feedback and oriented education of learning outcomes with students' self-reference will then be used by teachers to continuously improve and optimise the curriculum design and course teaching according to the learning outcomes. The assessment of milestones continues to drive the students' subsequent professional learning, with an emphasis on achieving the core content of the learning outcomes and realising the individual student's learning progress. In such an internal feedback and cyclic evaluation system of the curriculum, each core element promotes, improves and optimises each other, and works together to improve and develop the teaching evaluation system.

4 CONCLUSION

The exploration of network security cryptography teaching reform based on the new engineering background is a long way to go, and in the process of practice, it is necessary to continue to optimise and improve the reform objectives and content, and to apply and promote them in the teaching of the course, in order to achieve better teaching reform results and teaching quality.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

FUNDING

The project was supported by 2021 Provincial Quality Engineering Construction Project of Guangdong Provincial Department of Education, ‘Research on the Reform of Practical Teaching Methods of Network Security Technology - Based on the Upgraded Version of 360 Network Security Platform’ (Project No. Guangdong Higher Education Letter [2021]No. 29); 2022 Ministry of Education Industry-University Co-operation Collaborative Education Project ‘Research on Teaching Reform of Modern Cryptography Curriculum Based on OBE Concept in the Context of New Engineering Construction’ (Project No. 220605211102737); 2021 Guangdong General Colleges and Universities Young Innovative Talents Project (Project No. 2021KQNCX126).

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