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Research on the "Unity of Knowledge and Action" Teaching Mode for Information Security Technology Courses from the Perspective of Competition-Education Integration

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Abstract: With the rapid development of information technology, information security issues have become increasingly prominent, and the demand for information security talents has grown significantly. However, information security education in China lags relatively behind, with curriculum settings, teaching methods, and means struggling to meet societal needs. This paper focuses on the reform and practice of teaching modes for information security technology courses, proposing a "Unity of Knowledge and Action, Competition-Education Integration" teaching mode. By constructing a reasonable curriculum system, exploring a "point-plane combination, competition-education integration" teaching method, and researching comprehensive practical teaching approaches, this study aims to cultivate high-quality information security talents, promote the development of the information security field, and advance educational reform and innovation.

Keywords: Information Security Technology; Teaching Mode Reform; Practical Teaching; Unity of Knowledge and Action; Competition-Education Integration; CTF Competition.

1. Introduction

In today's digital era, information security has risen to the level of national security, and its importance cannot be overstated. China has successively introduced laws and regulations such as the Cybersecurity Law and Personal Information Protection Law, setting higher standards for the quantity and quality of information security talents. However, the lag in information security education still restricts talent cultivation. As a crucial base for talent development, universities bear the responsibility of cultivating high-quality information security professionals. Therefore, reforming the teaching mode of information security technology courses and exploring a "Unity of Knowledge and Action, Competition-Education Integration" teaching mode[1][2] is of great practical significance.

2. Analysis of the Current Teaching Status of Information Security Courses

With the acceleration of global digitalization, information security has become a core component of national security strategies. The implementation of China's Cybersecurity Law and Data Security Law has explicitly required information security talents to possess technical capabilities, particularly in applied skills such as practical attack-defense, vulnerability analysis, and data protection. However, current information security curriculum teaching in colleges and universities generally suffers from issues such as overemphasis on theory over practice and outdated course content:

(1) Outdated Curriculum System: Traditional teaching focuses on theoretical lectures, with practical sessions accounting for less than 30%. Experimental content often consists of verification-based operations (e.g., basic cryptographic algorithm demonstrations), lacking comprehensive project training close to real attack-defense scenarios.

(2) Disconnected Teaching Content: Teaching materials and cases have long update cycles, failing to promptly incorporate emerging technologies such as AI security, cloud security, and privacy computing, leading to a mismatch between students' knowledge structures and enterprise job requirements.

(3) Lack of Practical Platforms: Most universities rely on traditional laboratories, lacking attack-defense ranges that simulate real network environments and open-source project practice libraries, making it difficult for students to access practical scenarios such as CTF competitions and vulnerability mining.

3. Reform of the "Unity of Knowledge and Action, Competition - Education Integration" Teaching Mode

3.1. Teaching Reform Objectives

This study addresses key issues in information security curriculum teaching and practical training[3][4], exploring effective point-plane combined teaching methods and conducting practical teaching based on real-world applications of information security. It aims to research an integrated "competition-promoting-teaching, competition-promoting-learning, competition-education integration" teaching mode, achieving deep integration of college students' disciplinary competitions and curriculum teaching. This approach seeks to stimulate students' interest in learning, deepen their understanding of basic course theories, enhance their comprehensive practical ability to solve real-world problems using information security theories, cultivate innovative awareness and capabilities, realize the organic combination of information security theory and practice, and provide a reliable talent pool to alleviate increasingly

prominent information security issues. It also offers referenceable experience for teaching modes oriented toward applied talent cultivation.

3.2. Teaching Reform Ideas

The teaching reform ideas proposed in this study are as follows:

(1) Constructing a reasonable curriculum teaching system: Integrating competition content with textbook content, combining theory and practice, and forming a systematic and modular teaching content system.

(2) Exploring systematic theoretical teaching methods: Exploring teaching methods that integrate point-to-face instruction and competition-education integration.

(3) Studying comprehensive practical teaching methods: Based on the curriculum teaching system and syllabus, exploring practical teaching that uses open-source software and middleware of information security technology as practical platforms and object elements, as well as case-driven and competition-based teaching methods.

(4) Establishing a rational cognitive evaluation system: Combining the actual theoretical and practical teaching processes to establish a reasonable evaluation system for the basic cognitive content and cognitive level of information security technology.

4. Implementation Plan for Teaching Reform

The teaching reform plan of this study is as follows:

(1) Constructing a Reasonable Curriculum System

Current curriculum systems suffer from issues such as overemphasis on theory over practice, disconnection between course content and social needs, and arbitrary course content arrangement. To address these, this study establishes a practice-oriented teaching system by integrating information security technology courses with information security competitions such as CTF (Capture The Flag). First, based on training programs and syllabi, teaching content is adjusted according to the relationship between CTF assessment content and course content (as shown in Figure 1), strengthening the cultivation of students' engineering application and practical abilities while maintaining the basic quality and professional foundation of the curriculum. Additionally, a complete curriculum experiment platform and a CTF attack-defense training practice platform need to be established.

(2) Exploring "Point-Plane Combination, Competition-Education Integration" Teaching Methods

This study aims to implement point-plane combined teaching methods. To help students grasp the overall framework of the course's basic system, the "plane" (overall framework) of the course must be studied. For specific knowledge points and key technical theories, in-depth analysis of "points" (details) is required. After mastering points and planes, the focus should be on integrating them in curriculum teaching, enabling students to systematically master application technologies from "plane" to "point" and then deepen their understanding of the course's overall framework and rationality from "point" to "plane." Furthermore, instructors actively organize outstanding students to participate in information security competitions such as the Annual College Student Information Security Competition and Information Security and Technology Competition. Teachers also need to extensively study and analyze CTF problem writeups to smoothly integrate exam questions into corresponding knowledge points during lectures. Through the "competition-education integration" method, the teaching objectives of "promoting learning and teaching through competitions" are achieved.

(3) Researching Comprehensive Practical Teaching Methods

Based on teaching syllabi and training programs, teaching and practice units prioritizing skill or application cultivation are identified, and corresponding open-source software or middleware innovation practice libraries are developed, collected, and established. These libraries are continuously improved through curriculum teaching activities, incorporating prototype systems or practical applications from previous students' information security course designs and graduation projects, thus forming a relatively complete and open comprehensive experimental platform. Additionally, the Cybersecurity Range Platform developed by Beijing Knownsec Technology Co., Ltd., used for scientific research and information security teaching in our Henan Provincial Cyberspace Laboratory, can also be applied to experimental teaching and competition training for information security technology courses. Open platforms such as BUUCTF and Attack-Defense World serve as online platforms in the information security technology field, providing CTF competition and training services.

5. Conclusion

The teaching mode reform and practice of "Unity of Knowledge and Action, Competition-Education Integration" for information security technology courses are of great significance for cultivating high-quality information security talents, promoting the development of the information security field, and advancing educational reform and innovation. By constructing a reasonable curriculum system, exploring effective teaching methods, and researching comprehensive practical teaching approaches, students' practical abilities, teamwork skills, and innovative capabilities can be effectively enhanced, providing strong talent support for the development of the information security field. In the future, we will continue to improve this teaching mode, further enhance the teaching quality and effectiveness of information security technology courses, and strive to cultivate more outstanding information security talents.

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