Exploring the Integration of Ideological and Political Elements into Computer Network Courses

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Abstract: Computer Networks is one of the core required courses offered in the second semester of the sophomore year for computer science and related majors. The course features rigorous theory, strong engineering orientation, and close ties to industry development, plays a bridging role in professional talent education. This course is not only a crucial foundational subject for students to enhance their professional competence, but also an effective vehicle for universities to fulfill the fundamental mission of cultivating virtue and talent, implementing the overall national security concept, and nurturing a new generation of network technology professionals. By systematically analyzing the necessity and feasibility of integrating moral and ideological education into computer network courses, this study proposes a holistic teaching model and implementation strategy that organically integrates ideological and political education through the four-in-one approach: value guidance, theoretical instruction, practical application, and quality development. Practical teaching experience has shown that naturally embedding ideological and political education into every class effectively enhances students' overall competence and sense of social responsibility.

Keywords: Ideological and Political Education in Courses; Computer Networks; Cultivating Virtue and Nurturing Talent; Teaching Practice; National Security

1. Introduction

As a key approach for universities in the new era to fulfill the fundamental mission of fostering virtue and talent, ideological and political education in courses aims to break down the barriers between professional course instructors and ideological and political educators in education [1,2]. It seeks to organically integrate value guidance, knowledge transmission, and ability development, ensuring that all professional courses move in the same direction as ideological and political theory courses. This creates an educational framework in which the entire university community participates comprehensively and throughout the entire process. Today, with the deepening implementation of the strategy to build a cyber power and "Digital China," cyberspace has become a critical domain affecting national security and development. As a fundamental technological foundation for digital information transmission, network architecture construction, and data exchange and sharing, computer networking directly influences the effectiveness of national cybersecurity. Therefore, computer networking is an essential foundational course in cultivating talent for the digital era.

After one year of foundational academic study upon entering university, undergraduate students begin in their second-year spring semester to develop a deeper understanding of their major and to form their worldviews, life perspectives, and values. Students at this stage have already gained learning experiences in courses such as programming, data structures, and computer organization, and have acquired a preliminary grasp of relevant logical theories and basic practical skills. However, their knowledge remains fragmented, lacking a systematic, interconnected understanding, and they exhibit insufficient engineering practice capabilities and limited ability to solve complex problems [3]. At the same time, having long been immersed in online environments, students do not fully recognize the "double-edged sword" nature of internet technology. They often lack awareness of legal boundaries, professional ethics, patriotic sentiment, and social responsibility, making them vulnerable to negative online influences and misinformation. Therefore, there is an urgent need for targeted and systematic value guidance and ideological education [4].

As a required major course, Computer Networks is offered in the second semester of the sophomore year and serves as an ideal platform for cultivating students' professional skills in networking and shaping their proper career outlook. However, current teaching practices at some universities still face significant shortcomings, such as overemphasizing technical knowledge while neglecting ideological education, and a disconnect between political education content and specialized instruction—making it difficult to achieve the comprehensive educational goal. Therefore, based on the cognitive development patterns of sophomore students and the characteristics of course instruction, this study deeply explores the ideological and political educational resources embedded within the Computer Networks curriculum, and designs a practical model for integrating ideological education into the course. This approach promotes the organic integration of professional instruction with ideological and political education, effectively enhancing the quality of talent development in network-related fields.

2. The Necessity of Incorporating Ideological and Political Elements into Computer Network Courses

Computer networks are a typical core engineering course characterized by rigorous theoretical frameworks, strong engineering orientation, broad application areas, and close relevance to national development. The main content of this course includes network architecture, principles of network protocols, use of network devices, network construction, troubleshooting, and network security. Teaching methods primarily involve lectures, experimental simulations, packet capture analysis, and project development. Throughout the course, abundant ideological and political educational resources are embedded, making it an excellent vehicle for implementing ideological and political education in curriculum. Therefore, integrating ideological and political elements into the teaching process is particularly necessary and urgent, especially considering the cognitive characteristics and developmental needs of second-year students.

2.1 The Curriculum System Includes a Wealth of Ideological and Political Education Materials

Computer networking topics and teaching units inherently contain abundant ideological and political educational materials, aligning well with the educational goal of fostering moral development and nurturing talent. When teaching the brief history of network evolution, instructors can trace China's journey from catching up to running alongside—and in some areas even leading—global advancements in network technology, while sharing stories of dedicated researchers who overcame hardships and broke through technological monopolies, thereby strengthening students' national pride and confidence in technological achievements. For instance, when teaching the TCP/IP layered model, educators can incorporate dialectical perspectives on the relationship between the whole and its parts, collaboration, and step-by-step progression, cultivating students' systematic thinking; During hands-on exercises such as switch and router configuration, strict rules, regulations, and standards can foster a spirit of craftsmanship; In modules on cybersecurity and legal issues, real-world cyber incidents and relevant laws can be introduced to instill awareness of legal compliance and ethical boundaries; Through comprehensive network design projects, students can develop teamwork and a sense of responsibility. A well-developed system of ideological and political resources provides a solid foundation for the deep integration of professional education and value guidance.

2.2 College Sophomores Are In a Critical Stage of Development That Urgently Requires Value Guidance

The second semester of the sophomore year is a critical period for college students to develop professional awareness, stabilize their thinking patterns, establish initial career competencies, and continuously shape their values. During this stage, students' shortcomings urgently require ideological and political education to address them. In terms of knowledge, students' understanding is fragmented, with superficial grasp of fundamental network principles, network system composition and operation modes, as well as methods of applying network technologies. They lack the ability for dialectical analysis and exhibit a "pseudo-learning" phenomenon—knowing the outcome but not the underlying reasons. In practice, students have relatively low skill levels. Despite strong motivation to learn, they lack hands-on

experience and often exhibit carelessness and improper techniques during practical tasks. When encountering technical difficulties, they frequently show reluctance and over-rely on teachers, lacking the ability to independently explore and solve problems. In terms of mindset, students lack sufficient understanding of the dual social impacts of network technology. They often emphasize its convenience and practical value while overlooking underlying risks such as security threats, legal regulations, and ethical boundaries. Without clear career goals or a strong sense of professional ethics, they urgently need systematic political education to develop proper attitudes toward their profession and strengthen their sense of mission and responsibility.

2.3 Aligned With the Fundamental Mission of Fostering Virtue and Talent and the Direction of Cultivating Online Professionals

The goal of higher education is to cultivate well-rounded talents who excel in morality, intelligence, physical fitness, aesthetics, and labor, equipping them not only with solid professional skills but also with correct political orientation, noble professional ethics, and a strong sense of patriotism and dedication to the people [5,6]. In recent years, international competition in cyberspace has intensified, and online security threats have become increasingly complex, diverse, and ever-evolving. The nation urgently needs a group of high-caliber cyber technology professionals who possess strong political integrity, technical expertise, rigorous work ethics, and firm adherence to principles. Traditional computer network education has focused heavily on technical knowledge while neglecting value guidance and character development, resulting in some students who are technically proficient yet lack legal awareness, ethical standards, and national consciousness. Integrating ideological and political education into course instruction can effectively address the educational challenge of "emphasizing skills over character," guiding students to correctly understand the values and limitations of network technologies, strictly abide by laws and moral boundaries, foster a sense of responsibility toward building a strong cyber nation, and proactively align their professional growth with national strategic needs—thus achieving simultaneous advancement in both technical competence and personal character development.

2.4 Breaking the Limitations of Traditional Teaching to Promote Educational Reform and Quality Improvement

Currently, ideological and political education in computer network courses faces the following issues: First, the content of such education tends to be fragmented and superficially additive—for example, being delivered only at the end of class sessions, detached from the knowledge transmission process, thus failing to achieve effective educational outcomes. Second, the approach is predominantly one-way and didactic, relying solely on lectures without incorporating practical experiences, hands-on projects, or experiential learning, resulting in students' lack of initiative and engagement. Third, the depth of education falls short in terms of value guidance, with insufficient emphasis on cultivating students' professional ethics, legal awareness, and sense of responsibility, leading to a narrow scope of moral development. By systematically and purposefully integrating ideological and political elements into the curriculum, we can innovate teaching methods, enrich educational content, and strengthen the system for nurturing virtue and talent. This will bring ideological and political education closer to actual teaching practices, student realities, and industry needs, effectively addressing the disconnection between ideological education and specialized instruction in "course-based ideological education," and comprehensively enhancing both teaching quality and educational effectiveness.

3. Teaching Implementation Pathways for Integrating Ideological and Political Elements into Computer Network Courses

Based on students' cognitive levels and learning characteristics during their sophomore year, as well as the features of computer networking courses, and in alignment with national goals for building a strong cyber nation and cultivating engineering talent, we have developed an integrated teaching methodology that combines "value guidance, knowledge instruction, skill training, and quality development." This approach explores and implements six core values: patriotism and love for the people, law-abiding conduct, pursuit of truth and practicality, continuous improvement, teamwork, and dedication. It integrates ideological and value-based education throughout the entire teaching process—including theoretical lectures,

experiments, case studies, and course design—achieving a unified integration of knowledge transmission and value cultivation.

3.1 Deepen Education on Patriotism and Technological Confidence in Alignment with the Strategy of Building a Strong Cyber Nation

Cybersecurity and technological autonomy are crucial foundations for national security and cyber sovereignty, as well as one of the key prerequisites for building a strong cyber nation. In teaching, we must closely align with national strategic needs, incorporate achievements in China's cyber technology development and stories of its scientists, continuously inspire students' patriotism, and strengthen their confidence and determination toward self-reliance and self-strengthening in science and technology.

Briefly outline the development process of China's internet, summarize key aspects such as network equipment and protocol standards, and then introduce successful cases including large-scale commercial deployment of IPv6, global leadership in 5G, successful independent R&D of controllable network equipment, and effective protection of critical infrastructure. Elaborate on China's independent innovation practices—leading the formulation of international IPv6 standards and building the world's largest IPv6 commercial network—and explain how domestic companies like Huawei and ZTE have overcome overseas technological barriers to achieve localization and replacement of core network equipment such as switches and routers. This enables students to deeply appreciate the leapfrog progress in national networking technology, thereby strengthening their sense of national pride and technological confidence.

In addition, teaching should incorporate inspiring stories of Chinese experts, scholars, and frontline engineering professionals in the field of network technology who have overcome difficulties and made silent contributions, highlighting the noble qualities of researchers—patriotism, dedication, perseverance, and innovation. By linking these narratives to national initiatives such as new infrastructure development, the Digital China strategy, and the protection of critical information infrastructure, students should be guided to deeply understand that network technology is the core pillar of national digital advancement, and that network talent forms the backbone of building a strong cyber nation. This approach helps students fully appreciate the significance of their academic pursuits for the country and society, eliminates short-sighted thinking, and fosters a sense of responsibility toward loving and contributing to the nation.

3.2 Strengthen Legal and Ethical Education to Reinforce the Baseline Thinking In Technology Application

Cyberspace is not beyond the reach of law; technological applications must be governed by laws and guided by ethics. Students in their second year are about to enter a phase of in-depth professional study and pre-internship training. During this period, students' awareness of the rule of law and professional ethics will determine their future conduct in the workplace, making it a crucial stage for ideological and political education through curriculum.

In the teaching process, integrate knowledge of relevant laws and regulations with cybersecurity course content by incorporating provisions from the Cybersecurity Law, Data Security Law, Personal Information Protection Law, and Criminal Law concerning online activities to define the boundaries of internet usage. Emphasize the harms and corresponding legal liabilities associated with illegal acts such as unauthorized access to computer information systems, unlawful collection and sale of personal privacy data, cyberattacks, fabrication and dissemination of false network packets, and disruption of the online environment, thereby clarifying the fundamental difference between "compliance-based security research" and "criminal activities related to online gray and black industries." Guide students to accurately understand the authorization procedures and operational standards required for legitimate penetration testing and vulnerability discovery, thus strengthening their awareness of rules and compliance.

At the same time, using real-life cases—such as college students illegally accessing school systems, employees selling customer data, and unauthorized intrusions causing network outages — as negative examples, students are guided to analyze, discuss, and summarize these incidents. Through this process, they gradually come to understand that "hackers are not inherently good or bad; only their actions determine legality,"

helping them avoid the temptation of taking shortcuts and fostering a sense of respect for laws and regulations.

3.3 Deepen the Content of Theoretical and Experimental Teaching to Foster a Scientific Attitude Grounded In Fact-Based Inquiry

Computer network architecture is highly structured, logically rigorous, and has very little room for error; even minor configuration mistakes or logical flaws can lead to widespread network failures. This makes it an ideal platform for cultivating students' scientific mindset. To address common issues among second-year students—such as carelessness and fear of difficulty—the course combines theoretical instruction with hands-on experiments, aiming to develop students' meticulousness, precision, and perseverance in scientific practice.

Theoretical instruction should not merely follow textbooks verbatim, but instead focus on key concepts such as network layering, TCP reliable transmission protocol, error control methods, and routing and switching. This approach aims to inspire students to understand the fundamental principles and interrelationships behind these technologies, thereby fostering their dialectical thinking and holistic perspectives. In teaching the network layer model, the idea of division of labor and collaborative coordination is introduced; when explaining cyclic redundancy check and retransmission mechanisms, emphasis is placed on the precision and rigor of network protocols, cultivating in students a pragmatic and meticulous attitude toward learning.

In the laboratory course, standardized procedures are strictly followed, requiring students to prepare thoroughly before experiments and conduct them according to specified guidelines, while ensuring the authenticity of experimental results and preventing carelessness, perfunctory behavior, or plagiarism and fabrication. For common student issues—such as incorrect routing configurations, VLAN division conflicts, or failure to capture and analyze data frames—the teaching approach incorporates diagnostic analysis combined with self-repair exercises. Without providing correct answers in advance, students are guided to use tools like the ping command, Tracert for route tracing, and Route Print to examine routing tables, enabling them to identify problems independently and complete troubleshooting on their own. This method fosters proactive thinking and a willingness to tackle challenges, helping to shift students' tendency to avoid difficulties.

3.4 Employ Diverse Teaching Methods to Cultivate a Meticulous Craftsmanship Spirit

Computer network practice courses involve diverse application scenarios, often without fixed answers, posing certain challenges to students' overall planning awareness, attention to detail, and creativity. Given that sophomore students are prone to rigid thinking, lack of creativity, and insufficient dedication to in-depth study, the course incorporates discussions on multiple solutions to cultivate students' meticulousness and proactive, innovative work attitudes.

In the practical teaching phase, instructors systematically introduce multiple technical implementation approaches around the same topic [7], guiding students to compare and select solutions from various dimensions. For instance, during IP address planning, they explain differences among equal-length subnetting, variable-length subnetting, and demand-based allocation in terms of IP address utilization and engineering feasibility. Regarding interconnection methods for local area networks, they discuss distinctions between static routing, RIP protocol, and OSPF protocol with respect to network convergence time, resource consumption, and ease of maintenance. This comparative analysis encourages students to move beyond rote memorization of command-line instructions, enabling them to choose and optimize technical solutions based on real-world engineering requirements, thereby cultivating a professional competence characterized by continuous improvement and precision.

At the same time, practical projects such as small company networking, campus network upgrades, and campus LAN security construction are incorporated into the curriculum, allowing students to fully participate in all stages—including project research, planning and design, equipment installation and testing, network security configuration, testing and acceptance, and technical report writing. Students are encouraged to carefully refine, revise, and improve their work throughout the implementation process, consciously adhere to industry technical standards and procedures, abandon short-term profit-seeking mindsets, and

cultivate a focused, meticulous, and dedicated professional attitude—preparing them to smoothly adapt to engineering roles in future workplace environments.

3.5 Cultivate Teamwork Qualities Such As Collaboration and Responsibility through Group Project Practice

The construction, operation, and optimization of network engineering are systematic tasks that cannot be accomplished independently by individuals. Teamwork, shared responsibility, and effective communication are essential qualities that professionals in the networking industry must possess. To address issues among sophomore students—such as weak team awareness, lack of accountability, and poor communication skills—the course adopts a project-driven, collaborative learning model to comprehensively cultivate students' teamwork and sense of responsibility [8].

During the teaching process, teams of 3 to 5 students will be formed for comprehensive project work, assigned practical tasks such as small business network planning and deployment, campus network VLAN optimization, LAN fault diagnosis and troubleshooting, and wireless LAN security enhancement. A clear division of labor with individual accountability will be implemented. Team members will take on distinct roles including overall project coordination, topology design, device configuration, security testing, documentation, and reporting, requiring each student to fulfill their responsibilities while collaborating effectively. Throughout project execution, students will be guided to hold regular team discussions to exchange technical challenges, track progress, and resolve disagreements collaboratively. Through continuous teamwork and coordination, students will enhance their communication skills, project management abilities, and technical problem-solving capabilities.

At the same time, establish a task evaluation mechanism that assesses students' participation, project outcomes, and communication and collaboration skills throughout the process, thereby preventing shirking responsibilities or passive responses. Through continuous group project practice, students experience the collaborative environment of large-scale network engineering projects, reduce self-centered attitudes, and enhance their sense of collective pride and responsibility, thus transitioning from mere knowledge acquisition to the development of comprehensive teamwork and project coordination capabilities.

3.6 Strengthen Professional Mission Education to Cultivate Cyber Guardians for the New Era

In the internet era, network technicians are not only technical professionals but also defenders of national cybersecurity and social digital order [9,10]. Given that students begin to form clearer ideas about their future careers in their sophomore year, it is essential to strengthen education on mission and responsibility, guide them toward establishing correct professional values, and help integrate their personal growth goals into the great endeavor of national rejuvenation.

In the teaching process, clarify the professional significance and social responsibilities of roles such as network engineers, cybersecurity operations personnel, and network architecture designers. Correct students' narrow understanding that network technology is limited to networking and operations, helping them recognize that network-related positions involve critical areas such as national security, public services, and industrial advancement. By introducing real-world cases—such as cybersecurity safeguards during major events, national cyber defense practices, and the operation and maintenance of critical information infrastructure—demonstrate the significant responsibilities borne by new-generation network professionals [11]. At the same time, highlight exemplary stories of young role models and technical experts in the industry, using their inspiring examples to encourage students to stay committed to the right path, focus on professional development, and steer clear of illegal and gray-market activities.

Continuing education students should establish a correct career outlook, abandon short-sighted and profit-driven mindsets, always uphold their original aspiration of serving the nation through science and technology, consciously take responsibility for building a strong cyber nation and fostering a clean online environment, and strive to become pioneers in the cyberspace industry who are politically sound, competent, skilled, and morally upright.

4. Teaching Effectiveness and Summary

Outlook

4.1 Teaching Implementation Effectiveness

Through teaching practice, integrating ideological and political education into computer networking courses has achieved remarkable educational outcomes, effectively combining professional instruction with ideological development. First, students' patriotism and confidence in science and technology have significantly strengthened; they now better recognize the achievements of China's network technology development, showing improved learning attitudes and a stronger sense of responsibility. Second, students' awareness of the rule of law and discipline has been effectively enhanced; they have gained a thorough understanding of cyber laws, regulations, and professional ethics, enabling them to regulate their technical practices and uphold ethical standards. Third, students are gradually developing a scientific mindset and a craftsman spirit of precision; during practical exercises, they work more systematically and meticulously, overcoming habits such as carelessness, impatience, avoidance, and perfunctory behavior, while their problem-solving abilities have noticeably improved. Fourth, students' teamwork and sense of responsibility have been effectively cultivated, leading to overall improvements in collective consciousness, communication, collaboration, and problem-solving skills, making their comprehensive engineering competencies more aligned with industry job requirements. Fifth, students' professional capabilities continue to grow, with more systematic knowledge and stronger technical proficiency.

4.2 Teaching Summary

Teaching practice has fully demonstrated that ideological and political education in courses is not simply an addition to professional instruction, but rather requires a deep integration with professional knowledge, achieving a subtle and organic unity.

Computer networking courses inherently possess advantages for ideological and political education. By closely aligning with the cognitive development characteristics and growth patterns of sophomore students, and by integrating the intrinsic logic of course instruction with industry demands for talent, these courses can weave in ideological and political elements—such as patriotism, rule of law awareness, scientific literacy, craftsmanship spirit, teamwork, and sense of responsibility—throughout the entire teaching process. This approach effectively addresses past issues such as overemphasizing skills at the expense of character development and the disconnection between ideological education and professional training, thereby establishing a comprehensive and practical collaborative nurturing talent mechanism. In short, only by teaching with the students' development in mind and nurturing their growth at every step, by identifying appropriate entry points for ideological and political education based on the inherent pedagogical principles of each course, actively exploring new pathways to integrate courses with such education, and innovating teaching methods can we truly fulfill our educational mission of cultivating virtue and talent, thereby achieving the unified goal of imparting knowledge, teaching skills, and resolving doubts.

4.3 Limitations and Future Perspectives

Although the teaching practice of ideological and political education in this course has achieved certain results, there are still some shortcomings: first, the timeliness of some ideological and political teaching cases needs improvement, as certain traditional cases do not align well with the current realities of the internet industry; second, the methods of integrating ideological and political education into teaching are not yet sufficiently vivid or engaging, and the integration approaches in some teaching segments lack novelty and uniqueness; third, the assessment mechanisms for evaluating students' moral and ideological qualities remain incomplete, requiring further development and refinement of process evaluation and comprehensive evaluation systems.

The next step will be to continuously deepen the reform of ideological and political education in courses, regularly update the online case database for ideological and political teaching, and incorporate the latest industry hotspots and typical safety accident cases. We will explore integrated approaches combining online and offline instruction, as well as virtual simulation laboratories, to enhance the effectiveness of ideological and political education. Additionally, we will improve the evaluation mechanism that integrates professional competence with moral

character, further clarifying specific assessment criteria for patriotism, legal awareness, craftsmanship spirit, and other aspects, while strengthening process-oriented and comprehensive educational evaluation.

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