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Research on the Integration of Linux Programming and Curriculum Ideology and Politics

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Abstract: *The new era of university curriculum teaching requires the introduction of ideological and political elements. In this paper, we integrate ideological and political education into computer science courses, using Linux programming as a case study. Linux programming is based on the distribution version of the Linux operating system. Firstly, the main ideas and content of ideological and political education in the curriculum were outlined. Then, the basic course content, job positions, and demands of Linux operating system and program design were analyzed. Finally, it is proposed to integrate ideological and political elements into Linux programming courses, in order to enhance students' political awareness and values while imparting knowledge.*

Keywords: *Linux OS, Ideology and Politics, Curriculum, Programming*

1. Introduction

Recently, significant decisions have been made to deepen the implementation of the strategy of rejuvenating the country through science and education, accelerate the modernization of education, and establish the goal of building an education powerhouse by 2035. The education power that China wants to build is a socialist education power with Chinese characteristics. It should have strong ideological and political leadership, talent competitiveness, scientific and technological support, livelihood security, social synergy, and international influence to provide strong support for comprehensively promoting the construction of a strong country and national rejuvenation with Chinese path to modernization [1]. The comprehensive development of students' morality, intelligence, physical fitness, aesthetics, and labor has achieved more significant results. The concept of "five educations simultaneously" has deeply rooted in people's hearts. The construction of ideological and political courses in schools has been comprehensively strengthened, and quality education has been solidly promoted. One after another, a group of new era people who listen to the Party and follow the Party have grown strong and thrived. In fact, a few years ago, the Ministry of Education has issued the "Guidelines for the Construction of Ideological and Political Education in Higher Education Curriculum" to comprehensively promote the construction of ideological and political education in higher education curriculum [2]. The outline proposes that the construction of ideological and political education in courses should be comprehensively promoted in all universities and disciplines, focusing on the core point of comprehensively improving talent cultivation ability, optimizing the supply of ideological and political content in courses around political identity, patriotism, cultural literacy, constitutional and legal awareness, moral cultivation, etc., enhancing teachers' awareness and ability to carry out ideological and political education in courses, systematically carrying out education on socialism with Chinese characteristics and the Chinese Dream, socialist core values, legal education, labor education, mental health education, and excellent traditional Chinese culture education, strengthening students' ideals and beliefs, and effectively improving the effectiveness of moral education.

Courses such as science, engineering, agriculture, and medicine should pay more attention to cultivating patriotism, professional ethics, scientific spirit, craftsmanship spirit, and model worker spirit. As a popular engineering major in universities, computer science major naturally require educational content in this area. Although ideological and political education courses have been studied in many courses of computer science and technology majors [3-6], there is not much research in the field of elective courses for senior students. Therefore, it is meaningful to integrate ideological and political education into more senior computer courses. The following sections will introduce the content of ideological and political courses, Linux operating system and programming, and the integration of the two.

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2. Curriculum Ideology and Politics

2.1 Ideological and political theory course

Genarally, curriculum ideology and politics is easily confused with ideological and political courses. In fact, there is a certain difference between the two concepts. The ideological and political theory course is an important component of China's education system, aimed at providing students with systematic education in Marxist theory and ideological and political education, cultivating socialist core values, enhancing students' national identity, social responsibility, and moral cultivation [7]. The main content of ideological and political courses includes many independent public courses. The basic principles of Marxism are the introduction of the fundamental theories of Marxist philosophy, political economy, and scientific socialism. The theoretical system of socialism with Chinese characteristics includes Mao Zedong Thought, Deng Xiaoping Theory, the Important Thought of the Three Represents, the Scientific Outlook on Development, and Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era. The Outline of Modern Chinese History narrates the historical development of China since modern times, emphasizing the process of the Communist Party of China leading the Chinese people in revolution, construction, and reform. The cultivation of ideological and moral cultivation and legal foundation cultivates students' moral concepts, legal awareness, and sense of social responsibility. Situation and policy are the analysis of national policies and social hot issues based on the current domestic and international situation. The goal of ideological and political courses is to guide students to establish a correct worldview, outlook on life, and values. Enhance students' confidence in the path, theory, system, and culture of socialism with Chinese characteristics. Cultivate students' patriotism and sense of social responsibility. Help students understand national policies and social development, and become socialist builders and successors with both moral integrity and talent. In summary, it is a series of independent courses.

2.2 Deepen analysis of curriculum ideology and politics

The head of the Higher Education Department of the Ministry of Education of the People's Republic of China stated that the ideological and political content of the curriculum clearly defines five main aspects: Promote the integration of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era into textbooks, classrooms, and minds, continuously strengthen Marxist theoretical education, focus on promoting innovative theoretical education of the Party, enhance students' political, ideological, and emotional identification with the Party's innovative theories, and strengthen the "four confidences". Cultivate and practice the core socialist values. Strengthen the education of excellent traditional Chinese culture, vigorously promote the national spirit centered on patriotism and the spirit of the times centered on reform and innovation, Deepen the education on constitutional rule of law. Deepen education on professional ideals and professional ethics.

Curriculum ideology and politics is not a specific course or category, but an educational and teaching philosophy. Its basic meaning is that all courses in universities have the dual functions of imparting knowledge, cultivating abilities, and ideological and political education, carrying the role of cultivating college students' worldview, outlook on life, and values [8]. According to the survey, it is found that most of the knowledge obtained by college students comes from professional courses. In other words, college students spend most of their time with professional course teachers. This is also easy to understand why ideological and political elements should be integrated into professional courses. Although many courses in science and engineering majors are not related to ideological and political knowledge, this is exactly what university professional course teachers need to explore. Afterwards, integrate the elements into the knowledge teaching of professional courses.

3. Linux Promgramming Course

3.1 Linux course teaching content setting

Due to the different focuses of the courses, the Linux course settings vary among different disciplines and majors [9]. Table 1 shows the differences in Linux knowledge among different majors, especially the course content and application scenarios. In fact, a common feature among them is that professional knowledge and skills require an open-source and customizable operating system (OS). Compared to closed source, memory consuming and graphical interfaces in Windows OS, Linux is an excellent choice.

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Table 1: Differences in Linux knowledge among different majors.

Majors	Course content and application scenarios
Computer Science and Technology	Course content: Linux system management, Shell programming, kernel principles, system calls, etc. Application scenarios: software development, system architecture design, operating system research.
Software Engineering	Course content: Linux environment development tools (GCC/GDB), version control (Git), server deployment. Application scenarios: Enterprise level software development DevOps, Cloud computing platform development.
Network Engineering/Information Security	Course content: Linux network configuration (iptables/firewall), penetration testing (Kali Linux), server security reinforcement. Application scenarios: Network security defense, vulnerability analysis, red/blue team exercises.
Data Science and Big Data Technology	Course content: Big Data Processing in Linux Environment (Hadoop/Spark), Python/R Programming. Application scenarios: distributed computing, data cleaning and analysis.
Artificial Intelligence/Machine Learning	Course content: Linux server environment setup, GPU acceleration (CUDA), deep learning frameworks (TensorFlow/PyTorch). Application scenarios: model training, high-performance computing.
Electronic Information Engineering/Internet of Things	Course content: Embedded Linux development (Raspberry Pi/ARM), driver development. Application scenarios: Development of intelligent hardware and IoT devices.
Cloud computing and distributed systems	Course content: Linux containers (Docker/Kubernetes), cloud platforms (OpenStack/AWS). Application scenarios: Cloud service deployment, microservice architecture.
Automation/Robotics Engineering	Course content: Real time Linux system (ROS robot operating system), control script writing. Application scenarios: industrial automation, robot control.

Our previous research has described the main teaching content of Linux courses [10]. Recently, with the rapid development of big language models, artificial intelligence generated content (AIGC) tools have been widely applied in curriculum teaching [11]. In fact, due to the limited knowledge reserves of each individual teacher, the large language model (LLM) is equivalent to a union of numerous knowledge.In other words, the large language model can help teachers to consider more in the teaching of Linux courses, including courses related to courses, course content modules, and how to apply course knowledge to jobs or software businesses of Internet companies.

3.2 Teaching content aimed at employment positions

There is a problem that needs to be noted, with the global economic downturn and the increasing number of college graduates, the employment situation is severe [12]. For top tier universities, the pressure of employment issues is not significant due to the superiority of the platform and the high quality of student sources. However, this issue is very evident for universities in small local cities that are not well-known. Therefore, it is necessary to consider curriculum knowledge and skills teaching with employment as the goal. We search for Linux related job positions in recruitment site 51job, a well-known job search website for college students in China [13]. In fact, there are many job positions with Linux as the keyword,

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but unfortunately most of them are located in first tier cities such as Beijing, Shanghai, Shenzhen, and Hangzhou [14]. This is related to the distribution of high-tech enterprises in the country. Table 2 shows the relationship between job positions and knowledge and skill requirements related to Linux.

Table 2: Linux related job positions and skill requirements.

Employment positions	Responsibilities (Knowledge or skill requirements)
Linux system administrator	Responsible for server installation, configuration, monitoring, and troubleshooting, requiring proficiency in user permission management, backup and recovery, etc
Linux Operations Engineer	Emphasis on automated operations and maintenance, requiring proficiency in Shell/Python scripting and cluster management (such as Nginx/MySQL)
Server Operations Develop Engineer	Develop an operation and maintenance management platform, requiring Linux foundation and experience in open source software clusters
Cloud Computing Engineer	To manage AWS/Azure and other cloud platforms, familiarity with tools such as OpenStack/Kubernetes is required
DevOps Engineer	Integrate development and operation processes, requiring proficiency in Docker, CI/CD, and automated deployment
Embedded Development Engineer	Adapt Linux to smart hardware (such as routers, medical devices)
Linux Architect	Designing a highly available system architecture requires the ability to develop solutions
Network Security Expert	Using Linux tools for vulnerability analysis and intrusion detection

The Linux operating system and programming techniques can be applied in many industries or fields.The auto drive system needs to deal with complex tasks such as sensor data fusion, real-time decision-making, path planning, etc. Linux has become the mainstream choice due to its high reliability and real-time scalability. For example, Baidu Apollo autonomous driving platform based on Ubuntu Linux and ROS. Mobile robots cover warehousing and logistics, service robots, industrial AGVs (Automated Guided Vehicles), etc. Linux provides stable underlying support and flexible algorithm deployment capabilities. In the field of embedded systems, Linux can be applied to consumer electronics, smart homes, wearable devices, IoT systems, medical devices, and automotive electronics. Obviously, in embedded low-power and ground processing systems, the Linux operating system needs to be trimmed [15].

3.3 Online teaching system used for Linux teaching

In recent years, with the application of artificial intelligence technology in the field of education, there have been many new concepts and tools emerging in the education industry. The most well-known is the online course teaching system, such as the xuetangx.com, icourse163.org, study163.com, i.chaoxing.com, zhihuishu.com, edx.org, coursera.org, udacity.com, et. al [16]. Most of them gather high-quality video courses from multiple universities for students to learn online. Some of them provide functions such as online implementation of course teaching and uploading of course materials for university teachers.

Table 3 shows the main functional modules of the Chaoxing Learning Online Teaching System [17]. Compared to traditional blackboard writing or PPT presentation modes, online systems can provide rich functions and forms of material display. It is worth noting that homework assignment and grading are much more convenient compared to paper versions, especially when there are a large number of students. Similarly, the production, grading, and organization of final exams are also very convenient.

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Table 3: Course materials arrangement assisted by online teaching system.

Functional Module	Course materials
Class activities	Create a new virtual class Add, delete, search, and modify student information in a class Viewing operation logs
Courseware (Mainly PPT materials)	Add or delete courseware Local upload, select from cloud drive, teaching resource library Create a separate folder for the courseware
Teaching plan (Mainly Word documents)	Same as above, the content has been replaced with Word materials
Multimedia materials	Add or delete multimedia materials Local upload, select from cloud drive, website, online books, teaching resource library, notes and cross course import Create a separate folder for the courseware
Notice	Online broadcast notification information, for example, materials that need to be prepared temporarily for the course, course adjustment information, etc
Discussion	According to the topic or module settings, teachers and students can post comments and opinions below the post
Coursework/Assignment	Create a new single course assignment or choose from a pre built homework library Scores can be assigned to assignments The types of homework include multiple-choice questions, fill in the blank questions, true/false questions, short answer questions, calculation questions, and programming questions. Homework can be manually or automatically corrected by the system
Examination	Similar to homework and convenient than the paper-version examination Multiple online exam rules can be set up
Course information statistics	Basic data, classroom reports, learning situation statistics, student grades and learning monitoring
Knowledge graph	Establish various knowledge points and related knowledge content for the course
AI tools	Embedded large model question answering system Online Blackboard Online course recording and video playback system

4. Integrating Ideological and Political Education into Linux Course

4.1 Integrating into the Basic Content

According to the professional and curriculum development plan, we revise the curriculum teaching outline and add ideological and political education objectives on the basis of the old version curriculum outline that includes existing teaching objectives. It should be noted that the main content of the course is Linux professional knowledge, and ideological and political elements of the course should be introduced in appropriate lecture notes. Moreover, these elements won't take up too much time in the course.

Table 4 shows the teaching content modules and the related ideological and political elements. Basically, ensuring that each lecture section is covered to achieve full course coverage.

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Table 4: Teaching content modules and ideological and political elements.

Lecture Notes	Ideological and Political Conent
Fundamentals of Operating System	Patriotism and National Security Values and Social Responsibility Professional ethics and scientific spirit
Basic Concept of Linux	Open source spirit and sharing concept Craftsmanship and Innovation Consciousness Legal awareness and copyright concept
Basic Commands of Linux	Rule awareness: The allocation of permissions embodies the principle of "minimum authority", analogous to social rules.
Text Edition of Linux	Linux and its text editors (such as Vim, Emacs, Nano) are representatives of open source culture, embodying the concept of co-construction and sharing.
Operation of Files and Directories	The strict permission system of Linux (rwx, chmod, chown) embodies rule awareness and data security The Linux directory tree (such as/etc,/home,/var) embodies standardization and orderliness and global perspective The root directory is the cornerstone of the system, reflecting the core consciousness and integrity
User and Usergroup	The separation of permissions between root and regular users reflects the concept of power constraint
Process and Remote Login	Process scheduling (nice, renice commands) reflects the balance between efficiency and fairness Guardian processes (such as sshd and nginx) silently serve in the background, reflecting sticking to their posts and selfless dedication Process parent-child relationship (pstree command) reflects system integrity and team collaboration The independent development of remote control technology reflects the national network security strategy
Shell Script Programming	Automated scripting and the strategy of building a technological powerhouse Script standards and the spirit of craftsmanship
C/C++ Programming in Linux	The flexibility and danger of pointers reflect the double-edged sword characteristics of technology Multi threaded programming and collaborative spirit
Make and Makefile Rules	The automated construction of Makefile reflects technology empowering productivity and echoes the national Intelligent Manufacturing 2025 strategy. The dependency relationship of Makefile (target: prerequisites) embodies the engineering philosophy of global planning and problem decomposition
Cmake and CMakeLists Rules	By modularizing the writing of CMakeLists.txt (such as add_Subdirectory() to manage multi team projects), similar to social division of labor and collaboration, it emphasizes the responsibility of individuals in the collective

Although many high-tech innovations in the field of electronic computers mainly originated from European and American countries, China's pursuit has not stopped either. In the field of operating systems,some domestically produced operating systems based on Linux improvements are also widely used in multiple fields. Some representative operating systems include Deepin OS, UOS, NeoKylin, Kylin and Red-Flag Linux[18]. The domestic Linux operating system has developed rapidly in recent years,mainly targeting fields such as government affairs, enterprises, and education, emphasizing autonomy, controllability, and information security.

4.2 Extension of Project Practice

Although incorporating ideological and political elements or driving Linux course teaching based on job skills requirements has some advantages, students still have difficulty accessing some practical projects outside of school during their time in school. Therefore, exploring teaching based on practical projects is very meaningful, especially interdisciplinary integration projects with other disciplines and

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majors in universities [19]. Table 5 shows some potential interdisciplinary collaboration projects. In fact, there are many computer algorithms and models that need to run on the Linux operating system.

Table 5: Potential interdisciplinary collaboration projects.

Interdisciplinary collaboration in colleges or disciplines	Project Cases	Details of technology integration
School of physical education	Traditional Chinese Martial Arts Events such as Tai Chi, Baduanjin, boxing, Fitness Qigong and aerobics.	Computer vision based action recognition requires the use of Linux operating system and deep learning models.
School of foreign languages	Machine translation, Emotion analysis, Speech technology.	Developing or optimizing translation models. Cross language social media public opinion monitoring (such as comparing the differences in public opinion between Chinese and English). Tool chain: Python (NLTK, spaCy), Hugging Face, Linux server deployment
School of music and dance	AI composition and arrangement Dance and Movement Calculation	Using machine learning (such as Magenta, OpenAI Jukebox) to generate music or assist in composition, and optimize algorithms based on music theory Capturing dance movements through Kinect/inertial sensors to generate 3D animations or AI choreography suggestions

5. Conclusion

The application of ideological and political elements in the teaching of professional courses in universities is crucial. This paper introduces the basic content of ideological and political education courses and the basic situation of Linux engineering design courses. Afterwards, the employment oriented Linux technology related job positions and technical requirements are analyzed in detail. Subsequently, the functional modules of the Linux course online teaching system were introduced. Finally, the ideological and political elements of the Linux course module content were proposed. In addition, the possible intersection of knowledge between different colleges within the same school has been proposed to enhance the effectiveness of curriculum teaching.

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