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Ideological and Political Education through the Demonstration Course of "Data Structures and Algorithms" for the Internet-of-Things Engineering Programme

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Abstract

Data structure and algorithm are new engineering of Internet of Things As the cornerstone of engineering education, core courses serve as crucial platforms for implementing ideological and political education. Grounded in the principle of moral cultivation, this study systematically examines the educational value of exemplary ideological courses in three dimensions: strengthening professional foundations, enhancing social responsibility, and fostering lifelong learning with ethical awareness. It identifies current challenges including misaligned ideological elements, rigid integration, and monolithic evaluation systems. The paper proposes four strategic approaches: a "technology-scenario-value" tripartite design framework, digital technology empowerment, collaborative teaching-research integration, and diversified assessment mechanisms to achieve synchronized knowledge transmission and value guidance. This research establishes replicable models for ideological education in core engineering courses, offering practical implications for cultivating IoT professionals with both technical expertise and ethical competence.

Keywords

Data structures and algorithms; Curriculum-based ideological and political education; Internet-of-Things engineering.

1. Introduction

In an era of deepening new engineering education initiatives and rapid societal digital transformation, the significance of Internet of Things (IoT) Engineering has become increasingly prominent. Serving as a vital bridge between the physical and digital realms, this discipline plays a pivotal role in smart cities, industrial internet, and smart home ecosystems, driving a surge in demand for specialized professionals. As a core curriculum in the Internet of Things (IoT) Engineering program, Data Structures and Algorithms serves as the cornerstone for students to build professional knowledge systems and enhance technical competencies [1]. The course requires students to not only master solid knowledge in core areas such as sensor technology, network communication, programming and algorithms, as well as system integration and development, but also emphasizes comprehensive quality improvement, including logical thinking, innovative practice, and teamwork spirit.Furthermore, the Ministry of Education stresses the synergy between ideological and political education in courses and theoretical political courses to achieve holistic education [2]. In this context, integrating ideological and political education into Data Structures and Algorithms becomes particularly necessary and urgent.By deeply exploring ideological elements in the curriculum—such as rigorous scientific attitudes, innovative exploration spirit, and social responsibility—students can be guided to establish correct values, cultivate social responsibility and innovative spirit. This holds profound significance for improving the quality of IoT Engineering talent cultivation

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and promoting students' all-round development. It represents a crucial measure to meet the demands of the times and fulfill the fundamental task of moral education and talent cultivation.

2. Talent-Development Value of the IPE-Enhanced Demonstrative Course

2.1. Consolidating Professional Foundations and Overall Quality

The course constructs a systematic knowledge system of data organisation, storage, processing and optimisation indispensable to IoT engineering. Embedding stories of Chinese scientists' algorithmic breakthroughs stimulates national pride and professional identity [3]. Real-life projects train logical thinking and hands-on ability, laying a solid, sustainable foundation for career development.

2.2. Realising Universities' Talent-Cultivation Mission

Universities aim to produce professionals with social responsibility, innovativeness and practical competence [2]. The demonstrative course converts this mission into daily teaching [4]. For instance, when teaching queues, a bank-service scenario is analysed: how can algorithmic optimisation of waiting time avoid disadvantaging vulnerable groups who suffer digital divide? Designing priority queues plus "care windows" cultivates the "technology for social good" mindset, synchronising professional and value education.

2.3. Lifelong Learning and Ethical Literacy

Using a double-helix model [5], the course builds a closed loop of "frontier cognition–task-driven–self-directed inquiry" on the technical strand, while the value strand nurtures digital-era ethics. Students are guided to internalise moral norms for lifelong practice as responsible IoT engineers [6].

3. Challenges in Constructing the IPE-Enhanced Demonstrative Course

In the process of promoting the construction of demonstration courses of ideological and political education in data structure and algorithm courses, although the educational value of the courses has formed a broad consensus, the exploration of practical paths still faces multiple structural challenges, which directly restrict the organic integration of ideological and political elements and professional knowledge, which is embodied in the following aspects:

3.1. The Excavation of Ideological and Political Elements in Courses Is Not Accurate

The exploration of ideological and political elements in courses is the foundation for building exemplary courses with ideological and political education. However, in practice, some teachers tend to have a superficial understanding of the connotations of ideological and political education or lack an in-depth perspective on the professional content of data structures and algorithms. This often leads to directional deviations and omissions in the exploration of ideological and political elements. Such imprecise exploration directly produces two negative effects: first, the educational value of technical cases is weakened, such as ideological and political elements like the integrity mechanism of blockchain traceability systems and ethical constraints in graph theory algorithm optimization not being effectively activated; second, students develop knowledge cognitive biases, making it difficult for them to establish correct technical values when facing practical issues such as data privacy protection.

3.2. The Integration of Ideological and Political Elements with Professional Knowledge Lacks Sufficient Depth and Naturalness

In the current construction of the ideological and political demonstration course for Data Structures and Algorithms, there exists a structural disconnect between ideological elements

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and professional knowledge. The core contradiction lies in the fact that knowledge transmission and value guidance have not yet formed an organic unity. Specifically, the explanation of technical principles and the introduction of ideological and political cases appear as 'two separate layers.' Teachers mostly adopt a superimposed model of 'knowledge points and moral labels,' which leads to students having difficulty simultaneously understanding the systemic thinking and ethical constraints embedded within core principles such as tree structures and graph algorithms, preventing them from establishing an intrinsic connection between the logic of knowledge and the logic of values.

3.3. Single Course Evaluation

Course evaluation serves as the core benchmark for assessing the effectiveness of exemplary ideological and political education courses. The current evaluation framework for the Data Structures and Algorithms course demonstrates structural flaws: while overemphasizing explicit assessments of technical expertise such as algorithm complexity and coding standards, it neglects in-depth evaluations of political literacy including technical ethics awareness and team collaboration responsibilities. Therefore, establishing a diversified and comprehensive evaluation system that incorporates political literacy and holistic competencies into assessment criteria is crucial for ensuring continuous improvement and development of exemplary ideological and political education courses [7].

4. Countermeasures for the Construction of Demonstration Courses of Ideological and Political Education in Data Structure and Algorithm

4.1. Deepen Curriculum Design and Promote Organic Integration

To address the superficial integration of ideological elements with professional knowledge, we need to reconstruct the teaching logic from the source of curriculum design. It is recommended to establish a three-dimensional integration model of "Technical Principles-Life Scenarios-Value Guidance," transforming abstract concepts into perceptible teaching cases. For example, when teaching tree data structures, we can abandon the traditional analogy of "family genealogical charts" and instead use relatable real-life examples like networks as entry points: First, guide students to observe the tree-like logic of file categorization, then extend this to the grid-based management system in social governance. By comparing the data organization differences between personal digital lives and urban epidemic prevention grids, students can better understand the characteristics and relationships of tree structures. This approach not only reinforces students' grasp of the recursive logic of "root node-child node" in tree structures but also subtly instills systems thinking and a sense of responsibility, achieving a gradual elevation from technical cognition to value recognition.

4.2. Use Modern Technology to Enhance the Effect of Integration

Modern technology has become highly advanced and convenient. The widespread use of online learning platforms and virtual technologies can enhance the integration of ideological and political elements with professional knowledge. The resource sharing capabilities of online platforms break geographical learning barriers, enabling anytime, anywhere learning. Teachers can upload course-related videos, case studies, and literature for students' self-directed learning. Online platforms also facilitate interactive discussions where students can express opinions, ask questions, and resolve doubts. Teachers can regularly participate in discussions to guide students in exploring the integration of ideological elements with professional knowledge, helping them master scientific learning methods [8]. During teaching, simulating real-world scenarios allows students to experience the charm of ideological elements through immersive learning, boosting their interest and engagement. When explaining data structures in IoT applications, virtual reality technology can simulate IoT environments, enabling students

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to experience the importance of data structures in practice while guiding them to consider ethical issues like data security and privacy protection [9].

4.3. Carry Out Teaching Seminars To Improve and Explore Skills

To deepen the construction of exemplary ideological and political education courses in Data Structures and Algorithms, it is necessary to regularly carry out high-quality teaching seminars. These activities are conducted in an orderly manner according to semesters or teaching stages, with broad participation from both ideological and political education experts and specialized course teachers. Ideological and political education experts provide macro-level guidance from theoretical perspectives and the overall educational context, while specialized course teachers accurately grasp professional knowledge and explore points of integration between ideological elements and professional content. During collective lesson preparation, teachers jointly discuss teaching plans and uncover ideological elements in the course, such as the fairness of algorithm design and the integrity principles of data storage. Classroom observation allows teachers to intuitively learn from exemplary cases and adopt effective methods for integrating ideological elements [10]. At the same time, teachers are encouraged to pay attention to current events and industry trends such as the Internet of Things and artificial intelligence, integrating the latest ideological elements such as data security and algorithm ethics into teaching. This ensures that course content keeps pace with the times, combining professional advancement with profound ideological significance, thereby achieving an organic unity of knowledge dissemination and value guidance.

4.4. Improve the Evaluation System and Pay Attention To Multiple Evaluation

In the era where IoT engineering is rapidly integrating into various social sectors and data algorithms are driving industrial intelligent upgrades, the development of ideological and political education demonstration courses in data structures and algorithms urgently requires establishing a diversified and comprehensive evaluation system. This system must transcend traditional single-dimensional assessment frameworks by deeply embedding ideological-political literacy and comprehensive qualities into evaluation dimensions, forming a three-dimensional assessment mechanism that holistically evaluates professional knowledge, technical ethics, and practical capabilities. As IoT engineering involves massive data collection, transmission, and intelligent processing, data structures and algorithms as its core technological foundation not only require students to master professional skills such as algorithm efficiency optimization and data model construction, but also emphasize strengthening technical ethics awareness and team collaboration responsibilities. Meanwhile, adopting a combination of student self-assessment, peer evaluation, and instructor feedback, the growth trajectory of students is recorded from multiple dimensions including algorithmic logic derivation, team collaboration contributions, and ethical decision-making capabilities [11]. Establishing a dynamic feedback mechanism, we regularly collect opinions from teachers and students regarding the alignment between the course and IoT industry demands, as well as the timeliness of ideological-political case studies in data algorithms. This allows timely adjustments to the technical ethics evaluation indicators in the assessment system, continuously optimizing the development path of ideological and political education demonstration courses. Ultimately, this approach aims to cultivate interdisciplinary talents in IoT engineering who possess both technical expertise and ethical competence.

5. Conclusion

Amid new engineering initiatives and societal intelligence, IoT engineering is vital to smart cities and beyond, and demand for talent is soaring. “Data Structures and Algorithms”, the core course, must not only transmit knowledge but also cultivate virtue. Through systematic

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seminars, co-planning and demonstration classes, we have built a bridge between IPE experts and disciplinary teachers, integrated real-time issues and industry trends, and achieved deep fusion of professional and value education, equipping students with sound values and social responsibility. We will continue to deepen IPE reform with innovative measures, shedding ideological light on students' growth and cultivating more pillars of the digital era.

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