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Research on the Construction of a Case Library for Ideological and Political Education in Internet of Things Courses from the Perspective of New Engineering Disciplines

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Abstract

Under the background of the construction of new engineering disciplines, the education of Internet of Things (IoT) is confronted with the contemporary proposition of the coordinated development of professional knowledge imparting and value guidance. This study takes the IoT technology application course of Taishan University as the practical platform and constructed a case library of course ideological and political education covering three dimensions: technological innovation, social ethics, and professional responsibility. Through the systematic case development process and the teaching mode of "scenario embedding - conflict analysis - value elevation", the problem of "two separate skins" between professional courses and ideological and political education was effectively solved. The research results provide methodological support and practical paradigms for the reform of ideological and political education in engineering education courses.

Keywords

New Engineering Disciplines; Curriculum Ideological and Political Education; Internet of Things Education

1. Introduction

1.1 Research Background and Significance

With the in-depth advancement of the "New Engineering Research and Practice Project Guidelines", the Internet of Things (IoT) engineering major, as a core field of the new-generation information technology, its talent cultivation quality directly influences the process of Digital China construction. According to the special survey data of the Ministry of Education in 2023, the current IoT engineering major presents a "triple disconnection" phenomenon: the disconnection between technical teaching and social demands (accounting for 67.3%), the disconnection between knowledge imparting and value guidance (58.9%), and the disconnection between theoretical learning and practical innovation (72.1%) [1]. This structural contradiction was particularly prominent during the COVID-19 pandemic. Real-world issues such as data privacy leaks in smart epidemic prevention devices and controversies over the technical fairness of remote medical systems exposed the limitations of a purely technology-oriented talent cultivation model.

Course-based ideological and political education, as a strategic measure to fulfill the fundamental task of fostering virtue and nurturing talents, offers a new thinking path to address these predicaments. However, the traditional ideological and political education model in engineering majors has significant adaptation obstacles: Firstly, there is insufficient integration of ideological and political elements with professional technology, resulting in a "labeling" phenomenon. Secondly, the teaching carrier is single, lacking an ideological and political resource library with professional characteristics. Thirdly, the evaluation system lags behind, making it difficult to quantify the effectiveness of ideological and political education[2]. Therefore, constructing a course-based ideological and political case library with professional adaptability has become a key breakthrough for promoting the educational reform of new engineering.

1.2 Research Status and Challenges

Current related research at home and abroad mainly focuses on three directions: Firstly, the theoretical construction of course-based ideological and political education, such as Jones' "covert moral education" theory[3]. Secondly, the practical exploration of ideological and political education in professional courses, such as the "ethics embedded in engineering" teaching model of MIT[4]. Thirdly, the application of educational technology, such as the application of virtual simulation technology in ideological and political education[5]. Domestic scholars have achieved phased results in the construction of course-based ideological and political education in fields such as mechanical engineering[6] and computer science[7], but there is still an obvious research gap in the IoT major.

Through the investigation of universities, it was found that the construction of course-based ideological and political education in IoT courses faces three core challenges: Firstly, the structural imbalance of case resources. Among the existing cases, 68% focus on technical principles, while cases involving data ethics and technical responsibility only account for 12%. Secondly, the mechanical transplantation of teaching methods. 78% of teachers still adopt the traditional model of "case explanation + conclusion notification". Thirdly, the absence of a dynamic update mechanism. 91% of the case libraries have not updated their contents within three years[8]. The existence of these problems seriously restricts the improvement of the talent cultivation quality in the IoT major.

2. Development Model of IoT Course-Based Ideological and Political Case Library

An innovative "scene deconstruction - ethical analysis - value distillation" three-level development model is proposed, achieving an organic integration of professional technical knowledge and ideological and political education goals: Technical Scene Deconstruction: Select representative IoT application scenarios in the industry, such as smart home data collection and industrial IoT equipment operation and maintenance. Present the teaching points through the visualization of technical principles.

Ethical Conflict Analysis: Guide students to identify ethical dilemmas in technology applications, such as the privacy rights disputes in facial recognition technology and the responsibility for the authenticity of environmental monitoring data. Value Concept Distillation: Combine with the core socialist values and distill core value dimensions such as the spirit of technological innovation, engineers' social responsibility, and the sentiment of serving the country through science and technology.

3. Practical Path for the Construction of Ideological and Political Case Libraries

3.1 Case Screening and Classification System

This study constructs a "three-level and four-dimensional" classification system, forming a case classification framework with structural adaptability and teaching targeting through the matrix intersection of technical levels and value dimensions. In the technical level dimension, strictly following the characteristics of the Internet of Things (IoT) technology architecture, the cases are classified into three major categories: perception layer, network layer, and application layer. Perception layer cases focus on terminal devices and data collection. For example, in the "Biometric Sensor Accuracy Dispute" case, by analyzing a fingerprint misrecognition incident of a smart lock enterprise, it guides students to consider the direct impact of technical reliability on citizens' privacy rights. Network layer cases emphasize data transmission and protocol standards. A typical case is the "5G Industrial IoT Data Hijacking Incident", taking the tampering of production instructions in a manufacturing enterprise as the starting point to reveal the importance of communication security for national critical infrastructure. Application layer cases cover vertical fields such as smart cities and smart healthcare. For instance, in the "Community Elderly Care IoT System Misjudgment Incident", by simulating an ethical dispute caused by a false alarm of a monitoring device, it cultivates students' awareness of systemic risk prevention and control.

In the value dimension, a four-category classification standard is established: Technological innovation cases focus on solving "bottleneck" technical problems. For instance, in the "Domestication of Industrial IoT Platform" case, it retraces the efforts of a domestic team to break through the real-time operating system (RTOS) kernel technology, fostering students' awareness of technological self-reliance. Ethical responsibility cases closely align with core ethical issues in the digital age. The "Smart Meter Data Security Incident" case comprehensively presents a data leakage event of user electricity consumption behavior in a power grid company. Through the analysis of the original logs after data desensitization processing, it trains students' ability to construct a data lifecycle governance model. Cases of patriotism deeply connect with national strategic needs. The "Agricultural IoT Facilitating Precision Poverty Alleviation" case restores the practical path of a county in the west to increase the yield of characteristic crops through a soil moisture monitoring system. By comparing technical solutions, it strengthens students' sense of mission to serve rural revitalization. Professional ethics cases focus on the cultivation of professional behavior norms. For example, in the "Industrial IoT Operation and Maintenance Team Collaboration Conflict" case, based on the multi-department collaboration record of a smart manufacturing project, it enhances engineers' awareness of professional ethics through role-playing exercises.

This classification system achieves precise retrieval through a multi-dimensional tag system. Each case is labeled with four types of tags: "technical level + value dimension + applicable chapter + teaching form". For example, the "Smart Meter Data Security Incident" is labeled as (perception layer/ethical responsibility/Chapter 3/debate-based teaching). Teachers can quickly filter out suitable cases based on the combination of conditions such as "RFID technology principle + ethical responsibility + group discussion". The classification system has a dynamic optimization mechanism, adjusting the proportion of each level and the weight of each dimension every semester based on teaching feedback to ensure that the classification standards keep pace with industry development and policy guidance.

3.2 Case Library Architecture Design

This study proposes a teaching closed-loop system architecture, which, through the two-way interaction of teaching implementation and dynamic updates, builds a sustainable optimization mechanism for the case library operation. The teaching closed-loop covers the entire process of "lesson preparation system → classroom implementation → effect evaluation → case optimization": Teachers obtain case resource packages (including teaching design templates, ethical decision trees, etc.) through the intelligent lesson preparation system, conduct teaching in the classroom using multiple forms such as role-playing and virtual simulation, collect teaching effect data through cognitive diagnostic tests and emotional scales, and finally optimize the cases based on students' knowledge mastery and value internalization.

This architecture has three innovative features: Firstly, the modular design supports flexible configuration for various scenarios such as "basic teaching + special topic discussion + project practice". For example, the "Smart Home Privacy Protection" case is decomposed into a technical principle module (sensor data flow analysis), an ethical analysis module (user profile compliance discussion), and a practical extension module (security solution prototype design). Secondly, the intelligent recommendation engine based on machine learning can automatically push suitable cases based on students' knowledge graphs (error distribution, emotional tendency). Thirdly, the version control mechanism comprehensively records the 17 revision trajectories of the cases (including updates of technical parameters, adjustments of legal provisions, and optimizations of teaching strategies), ensuring the continuity of teaching across different academic years. Teachers can intuitively grasp the evolution logic of the cases through the "version comparison" function.

3.3 Implementation Guarantee Mechanism

In terms of the construction of the teacher training system, this study has established a "three-dimensional linkage" training mechanism. Firstly, it conducts "technology + ideological and political education" dual-capability modular training, setting up special sections such as "Internet of Things Security Attack and Defense Experiment", and regularly invites enterprise lecturers and professors from the School of Marxism to give joint lectures. Secondly, it establishes a long-term mechanism for teachers' enterprise practice, utilizing the practice bases jointly built with enterprises to participate in projects such as smart home and industrial Internet of Things platform construction. The quality monitoring system precisely controls through the formulation of seven core entry standards: technical accuracy must be reviewed by both university and enterprise experts, ideological and political alignment must be certified by the School of Marxism, teaching applicability must be optimized through three rounds of trial teaching, and four additional indicators are attached: timeliness (case years $\leq$ 3 years), typicality (covering 80% of professional knowledge points), interactivity (including more than two teaching forms), and extensibility (supporting cross-course combinations). In terms of innovation in the school-enterprise collaboration mechanism, a case research and development center is jointly established with enterprises, forming a "quarterly joint consultation + annual case incubation" collaboration model. Through a three-stage process of enterprises providing original engineering documents (with sensitive information removed), the university conducting teaching transformation, and third-party institutions conducting ethical reviews, it ensures that the proportion of new cases added each year reaches 30%.

4. Conclusion and Outlook

The IoT course-based ideological and political education case library constructed in this study provides certain guidance and suggestions for the integration of professional education and value guidance. By establishing a theoretical model, innovating practical paths, and improving the evaluation system, a replicable and scalable course-based ideological and political education construction plan has been formed. However, the research still has limitations such as an unbalanced geographical distribution of cases and the need to improve the long-term tracking mechanism, which require further in-depth study.

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