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Construction and Practice of the Ideological and Political Teaching System for the Course of Optoelectronic Detection Technology in the Context of New Engineering Education

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Abstract: Under the coordinated advancement of the fundamental mission of higher education to foster virtue through education and the development of New Engineering Education, ideological and political education embedded in professional courses has become a crucial vehicle for the deep integration of knowledge instruction and value guidance. As a core course in the major of Optoelectronic Information Science and Engineering, Optoelectronic Detection Technology features strong theoretical depth, practical relevance, and frontier characteristics, providing abundant scenarios for the effective implementation of ideological and political education. Aiming at the existing problems in current course-based ideological and political teaching, such as the lack of systematic instructional design, rigid integration of ideological elements, and imperfect evaluation mechanisms, this study combines practical teaching experience and constructs a comprehensive ideological and political teaching system from four dimensions: clarification of ideological and political objectives, reconstruction of teaching content, innovation of teaching methods, and optimization of the evaluation system. The feasibility and effectiveness of the proposed system are further verified through teaching practice. The research outcomes provide a practical reference for ideological and political teaching reform in engineering courses and contribute to the cultivation of high-quality engineering professionals with both moral integrity and technical competence.

Keywords: Optoelectronic Detection Technology; Ideological and Political Education in Courses; New Engineering Education; Teaching System; Collaborative Education

1. Introduction

Since the invention of the laser in the 1960s, optoelectronic detection technology, characterized by non-contact measurement, high sensitivity, and high precision, has been extensively applied in key fields such as industrial manufacturing, aerospace, national defense and security, and biomedicine. It has become one of the core technologies supporting the development of China's strategic emerging industries.

As a compulsory core course for the major of Optoelectronic Information Science and Engineering, Optoelectronic Detection Technology not only undertakes the task of imparting professional knowledge, including detection principles, device characteristics, and system design, but also shoulders the educational responsibility of cultivating students' scientific spirit, engineering ethics, and a sense of social responsibility and national commitment.

The Guidelines for Ideological and Political Construction of Courses in Higher Education issued by the Ministry of Education explicitly require that ideological and political education be integrated throughout the entire teaching and learning process, so as to realize the organic unity of knowledge acquisition, ability cultivation, and value shaping. However, in the current teaching practice of Optoelectronic Detection Technology, the construction of course-based ideological and political education still faces several practical challenges.

First, the exploration of ideological and political elements lacks systematic design and is often attached to isolated knowledge points, resulting in insufficient alignment with the overall instructional objectives of the course. Second, the integration approaches are relatively monotonous and mainly rely on case-based explanations, with limited in-depth connections

to cutting-edge scientific and technological advances and engineering practice, which weakens student engagement. Third, teaching evaluation remains predominantly focused on professional knowledge and technical skills, while the effectiveness of ideological and political education lacks robust assessment indicators and feedback mechanisms. Consequently, how to construct an ideological and political teaching system that aligns with the characteristics of the course and the needs of the discipline, and how to achieve resonance between value education and professional instruction, have become critical issues in the teaching reform of Optoelectronic Detection Technology.

2. Current Status and Significance of Ideological and Political Teaching in the Course Optoelectronic Detection Technology

2.1 Analysis of the Current Teaching Status

Insufficient systematic design of the ideological and political teaching framework.In current teaching practice, the identification of ideological and political elements is largely knowledge-point oriented, lacking top-level design based on the overall course structure and talent cultivation objectives. For instance, when introducing optoelectronic detection devices, references to scientists' achievements are often fragmented and sporadic, failing to form a progressive educational chain of scientific spirit–engineering ethics–national commitment. As a result, ideological and political education appears fragmented and discontinuous.

Monotonous presentation of ideological and political elements. Ideological and political elements are predominantly presented through traditional case explanations, with insufficient integration of cutting-edge developments in optoelectronic technology, major national engineering projects, and industry hotspots. For example, when discussing laser detection technologies, China's indigenous innovation achievements in the laser field are not adequately incorporated, which limits the stimulation of students' national pride and innovative motivation.

Imperfect evaluation and feedback mechanisms. Course assessment still mainly relies on traditional formats such as final examinations and laboratory reports, emphasizing students' mastery of professional knowledge and practical skills. Quantitative indicators and effective methods for evaluating students' ideological and political development are lacking, making it difficult to accurately assess the educational outcomes and to establish a continuous improvement feedback loop.

2.2 Significance of Ideological and Political Construction in the Course

Alignment with talent cultivation requirements of New Engineering Education.

New Engineering Education emphasizes the cultivation of interdisciplinary talents with innovative capacity, engineering competence, and a strong sense of social responsibility. By embedding value education into the entire process of professional teaching, course-based ideological and political education helps address the deficiencies of traditional engineering education and fosters high-quality engineering professionals who possess both technical expertise and a strong sense of responsibility.

Enhancement of the connotation and quality of course teaching. The course Optoelectronic Detection Technology contains abundant ideological and political elements, including the spirit of scientific exploration in the historical development of optoelectronic technologies, craftsmanship in detection system design, and social responsibility in technological applications. Systematic excavation and integration of these elements can enrich the ideological depth of course instruction and promote a fundamental shift from mere knowledge transmission to holistic talent cultivation.

Serving national strategic demands for talent development. As a strategic emerging industry in China, the optoelectronic sector urgently requires technical professionals with a strong sense of national mission and industry responsibility. Through course-based ideological and political education, students can be guided to align their personal career development with national strategic needs, thereby strengthening their commitment to contributing to the optoelectronic industry and advancing technological self-reliance.

3. Construction of the Ideological and Political Teaching System for the Course Optoelectronic Detection Technology

Guided by the Guidelines for Ideological and Political Construction of Courses in Higher

Education issued by the Ministry of Education, and in alignment with the training objectives of the major in Optoelectronic Information Science and Engineering, a four-in-one ideological and political teaching system integrating objectives–content–methods–evaluation is constructed, aiming to achieve deep integration between value education and professional instruction.

3.1 Establishment of a Four-Dimensional Ideological and Political Education Objective System

In accordance with the course objectives and graduation requirements, ideological and political education objectives consistent with the professional training orientation are formulated, forming four core course objectives:

Value-oriented objective (Course Objective 1). Students are expected to apply fundamental principles of natural science and engineering science to identify and analyze the working principles of optoelectronic detection instruments. By understanding domestic and international frontiers in the development of optoelectronic detection instruments, students' national pride is strengthened. Through learning about the life stories of scientists, students are guided to appreciate the scientific spirit of truth-seeking and perseverance, establish correct outlooks on life and values, and adhere to the worldview and methodology of dialectical materialism.

Knowledge application objective (Course Objective 2). Students are expected to proficiently use common light-emitting devices and typical photoelectric conversion devices, explain their basic structures, working principles, characteristic parameters, and application methods, and make rational device selections according to specific measurement targets.

Practical innovation objective (Course Objective 3). Students are expected to master the use of general optical and electronic testing instruments, conduct testing and analysis of photoelectric conversion components and systems, and apply optoelectronic detection principles and methods to solve comprehensive parameter testing problems in practical engineering applications.

Lifelong learning objective (Course Objective 4). Students are expected to acquire independent learning methods, develop the ability to expand knowledge according to personal or professional development needs, and adapt to continuous social and technological advancement.

3.2 Reconstruction of Teaching Content Based on "Knowledge Modules + Value Modules"

Construction of a multidimensional repository of ideological and political elements. Centered on the core content of the course, ideological and political elements are systematically explored from four dimensions: scientific spirit, national commitment, engineering ethics, and craftsmanship. For example, in the chapter on Fundamentals of Optoelectronic Detection, the exploratory spirit of scientists overcoming challenges in the historical development of optoelectronic technologies is incorporated. In the chapter on Laser Detection Technology, China's transition from following to leading in laser technology innovation is introduced to strengthen national commitment education. In the Detection System Design chapter, engineering ethics such as reliability and safety are emphasized through practical engineering cases. When explaining topics such as the photoelectric effect and device principles, the historical evolution of theories is traced to highlight the arduous journey from experimental exploration to theoretical establishment, guiding students to develop a truth-seeking and perseverant scientific attitude. By analyzing typical design pitfalls and solutions in engineering cases, students' rigorous engineering thinking and pursuit of excellence are cultivated.

Organic integration of ideological elements and professional knowledge. The traditional additive model of "knowledge points + ideological cases" is replaced with a deeply integrated teaching content system combining value modules and knowledge modules. Ideological elements are embedded into modules such as optoelectronic detection devices, signal conditioning circuits, detection system integration, and frontier technology applications, forming a comprehensive educational framework characterized by "point-based breakthroughs, linear extensions, and holistic coverage." For instance, when introducing photodiodes, China's indigenous innovations in semiconductor materials are incorporated, enabling simultaneous instruction of device principles and cultivation of innovation awareness and cultural confidence.

Integration of technological frontiers and

engineering practice. In line with the latest trends in optoelectronic technology, emerging applications in fields such as 5G communications, intelligent manufacturing, and space exploration are incorporated into teaching content. For example, applications of optoelectronic detection technology in the Chang'e lunar exploration program and the Tianwen-1 Mars mission are introduced to help students intuitively perceive the societal value of technology and enhance their professional identity and sense of mission.

3.3 Innovation of Diversified Teaching Methods

Blended online–offline teaching approach. Relying on intelligent teaching platforms such as Chaoxing Learning Pass, an online–offline collaborative education model is established. Online resources including ideological cases, frontier literature, and industry developments are provided to guide students' autonomous learning, while offline teaching adopts case-based instruction, situational teaching, and group discussions to deepen understanding of ideological elements. For example, students are assigned an online research task on "the current development status of China's optoelectronic industry," followed by offline thematic discussions to analyze opportunities and challenges, thereby strengthening their sense of responsibility.

Heuristic and inquiry-based teaching methods. The traditional lecture-centered approach is replaced with problem-oriented and project-driven methods to stimulate students' learning initiative. In experimental teaching, inquiry-based projects such as "optimization design of optoelectronic detection systems" are introduced, encouraging students to independently design experimental schemes, analyze data, and solve practical problems, thus cultivating scientific spirit and innovative capability. For instance, during optoelectronic sensor calibration experiments, students are guided to focus on data accuracy and experimental rigor to reinforce craftsmanship.

Whole-process integrated teaching approach. Ideological and political education is embedded throughout the entire teaching process, including course introduction, knowledge instruction, experimental practice, and assessment. During the introduction stage, the strategic significance of optoelectronic technology is highlighted to stimulate learning interest; during knowledge instruction, ideological connotations are explored alongside technical concepts; during experimental practice, teamwork and responsibility are emphasized; and during assessment, comprehensive evaluation of ideological literacy is incorporated.

3.4 Optimization of a Scientific and Comprehensive Evaluation System

Establishment of diversified evaluation indicators. To overcome the limitations of a single knowledge-oriented assessment model, a dual evaluation system integrating professional competence and ideological literacy is established. Professional competence indicators include knowledge mastery, experimental skills, and system design ability, while ideological literacy indicators cover scientific spirit, national commitment, engineering ethics, craftsmanship, and teamwork. These are further operationalized into quantifiable evaluation items such as classroom participation, experimental attitude, project reports, and performance in thematic discussions.

Combination of formative and summative evaluation. Formative assessment accounts for 60% of the total grade, including classroom interaction (10%), experimental practice (20%), group projects (20%), and ideological-themed reports (10%). Summative assessment accounts for 40% and combines a course paper with a final examination. Ideological and political elements are integrated into the final examination through questions such as ethical issues in optoelectronic technology applications and analyses of opportunities and challenges facing China's optoelectronic industry.

Establishment of a multi-stakeholder feedback mechanism. A comprehensive evaluation approach combining student self-assessment, peer assessment, and teacher assessment is adopted to ensure objectivity and completeness. Teaching feedback is regularly collected through questionnaires and teacher–student interviews, enabling timely identification of problems and adjustment of teaching content and methods. This forms a closed-loop mechanism of "evaluation–feedback–improvement."

Course Objective 1 requires students to apply fundamental principles of natural science and engineering science to identify and analyze the working principles of optoelectronic detection instruments, understand domestic and

international development frontiers, strengthen national pride, learn from scientists' life stories, appreciate the truth-seeking and perseverant scientific spirit, establish correct outlooks on life and values, and adhere to the worldview and methodology of dialectical materialism.Figure 1 presents the evaluation results of course objective attainment for the course Optoelectronic Detection Technology offered to the 2020 cohort of the Optoelectronic Information Science and Engineering major at Zhoukou Normal University.

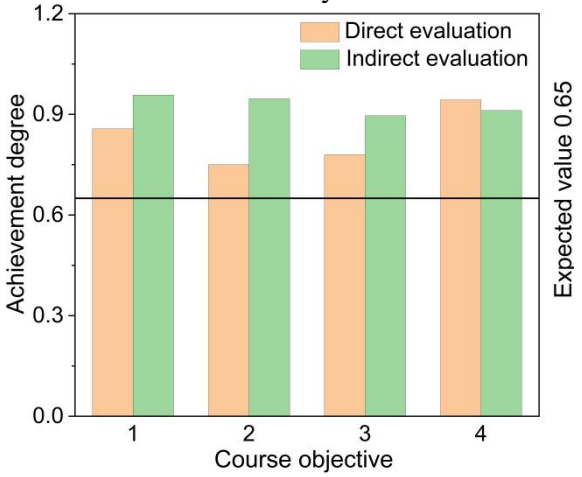

Figure 1. Evaluation Results of Course Objective Attainment

4. Conclusion

The construction and implementation of an ideological and political teaching system for the course Optoelectronic Detection Technology represent a meaningful exploration of fulfilling the fundamental mission of fostering virtue through education under the background of New Engineering Education. By clarifying integrated teaching objectives, reconstructing teaching content through the combination of knowledge modules and value modules, innovating diversified teaching methods, and optimizing a scientific and comprehensive evaluation system, the proposed approach effectively addresses the prominent challenges in current course-based ideological and political teaching and realizes deep integration between value education and professional instruction.

Looking ahead, with the continuous advancement of optoelectronic technologies and the ongoing evolution of educational philosophies, the ideological and political teaching system of this course still requires further refinement. First, the repository of ideological and political elements should be continuously enriched through strengthened collaboration with industry and enterprises to explore more vivid and authentic engineering cases. Second, the application of intelligent teaching approaches should be deepened by leveraging technologies such as big data and artificial intelligence to enhance the precision and effectiveness of ideological and political education. Third, the scope of practical implementation should be expanded by extending the teaching outcomes to a wider range of engineering disciplines, thereby providing stronger support for the cultivation of high-quality talents in New Engineering Education.

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