

# *Exploration and Practice of Ideological and Political Demonstration Course in Mechanical Major: Taking Thermodynamics and Fluid Mechanics as an Example*

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**Keywords:** Ideological and political education, Mechanical Engineering, Thermodynamics and Fluid Mechanics, Teaching resource library

**Abstract:** The objective of ideological and political education in specialized courses is to combine knowledge impartation with value guidance, thus integrating the cultivation of ethical values throughout specialized courses. Thermodynamics and Fluid Mechanics is a core compulsory course for students majored in mechanical engineering, which mainly introduces the fundamental theories of the energy conversion and transfer, as well as the basic principles of fluid statics and dynamics. Taking Thermodynamics and Fluid Mechanics as an example, the present study explores the construction of ideological and political demonstration course from the following five perspectives: construction targets, teaching resource library, teaching team, teaching methods, evaluation and achievements of curriculum ideology and politics education. The curriculum ideology and politics education can help the students to reshape their core values, and significantly enhance the students' innovative awareness and creative abilities.

## 1. Introduction

Ideological and political education is a subject which has been taught as part of the country's Patriotic Education Campaign in higher education institutions of China since the early 1990s. In May 2020, the Ministry of Education issued a notice titled "Ideological and Political Construction of Higher Education Curriculum". It aims to thoroughly explore the ideological and political elements embedded in various curriculums, and implement ideological and political education through the whole education process. Specialized knowledge embedded in mechanical engineering curriculums has the potential to easily evoke the students' resonance with ideological and political education. In recent years, a variety of researches have been carried out to investigate the construction modes and

approaches of ideological and political education in mechanical engineering courses [1-5].

Mechanical Design, Manufacturing and Automation Major of Qilu University of Technology is a National First-Class Undergraduate Major and holds international engineering education accreditation. Thermodynamics and Fluid Mechanics is a core compulsory course within this program for sophomore undergraduate students, comprising 48 class hours and carrying 3 academic credits. Through the course study, students shall understand the fundamental concepts, laws, and theories of thermodynamics and fluid mechanics. It aims to cultivate students' ability to analyze and solve basic thermodynamics and fluid mechanics problems, and provide them with a solid theoretical foundation in this field. Building upon knowledge impartation and skill development, the curriculum teaching team have been making great efforts to achieve ideological and political education targets which can be effectively align with the professional training goals.

## **2. Construction targets of ideological and political demonstration course**

1) The course strictly adheres to the requirements outlined in the “Ideological and Political Construction of Higher Education Curriculum”, seamlessly integrating knowledge impartation with values instillation and skill development. Thermodynamics and Fluid Mechanics takes “Yellow River Culture and Core Socialist Values” as the main line of curriculum ideology and politics, which seeks to cultivate the patriotism, national spirit and craftsmanship of students, and shapes their core values of “confidence in political path - cultural confidence - mission and dedication”.

2) The course takes full advantages of “Science and Education Integration” of Qilu University of Technology, to achieve the high level of integration between theoretical research and practical exploration. The demonstration course aims to unearth the scientific inquiry and practical spirit embedded within Yellow River Culture, and foster the engineering competence of “engineering perspective - solving engineering problem”. Additionally, the demonstration course places a strong emphasis on engineering ethics related to Yellow River ecological conservation, thus promoting values of “energy conservation, environmental protection, and sustainable development” among students.

3) The teaching team organizes students to participate in technology-driven practical activities related to Yellow River Culture in order to cultivate students' innovative awareness and creative abilities as stipulated by the national first-class major. Various scientific and research topics have been involved, for example, “carbon-neutral-focused energy conservation and emissions reduction”, “water pollution control”, “water resource protection and utilization” and “renewable energy utilization system”. These activities can guide students to embrace the concept of sustainable development, and enhance their innovative qualities through a “research-oriented perspective - self-directed inquiry” approach.

## **3. Establishment of ideology and politics teaching resource library**

### **3.1 Construction of ideology and politics theory resources**

The course teaching team deeply explores, collects and organizes course related ideology and politics theory resources. Such resources include: core socialist values, ecological protection and high-quality development in the Yellow River Basin, environmental protection and sustainable development, social ethics. This effort aims to help students comprehend the guiding significance of ideological and political theory in the field of mechanical engineering, fostering the development of a correct worldview, life philosophy, and value system.

### **3.2 Development of outstanding historical and cultural resources**

The course teaching team collects relevant historical and cultural resources, such as: milestone historical events in the application of thermal and fluid engineering technologies, biographies and remarkable contributions of renowned scientists, and notable water infrastructure projects in the Yellow River Basin. By studying and exploring exceptional historical and cultural aspects, this course can guide students in inheriting and promoting the Yellow River culture and professional traditions, while nurturing a sense of patriotism and unwavering cultural confidence.

### **3.3 Construction of professional knowledge and practical resources**

Such resources mainly include practical engineering cases, interdisciplinary research projects within the university, high-quality online education resources, pre- and post-course professional knowledge and practical resources. Internet + Cloud Computing, Tree of Knowledge, online and offline blended teaching, and flipped classrooms are extensively adopted during the course teaching, thus integrating ideological and political education throughout the entire teaching process.

### **3.4 Construction of technical innovation resources**

The course teaching team utilizes post-class time to conduct a series of lectures aimed at cultivating students' innovation capabilities. The objective is to guide and encourage capable students to apply the knowledge gained in the classroom and extracurricular knowledge to technological innovation and research activities. These activities revolve around subjects such as the “Dual Carbon Strategy - Carbon Peak and Carbon Neutrality Goals”, “Comprehensive Utilization of Renewable Energy Systems”, “Water Pollution Control and Remediation”, “Water Resource Protection and Treatment” and “Environmental Monitoring and Early Warning”. The teaching team introduces the latest domestic and international research developments, aiming to enhance students' scientific innovation thinking, innovative methods, hands-on practical skills, research literacy, and lifelong theoretical learning abilities. Until now, the students have designed various innovations, such as: an optical-fiber based hybrid lighting and power generation system, an intelligent bicycle power generator, a PV powered multifunctional smart bin, “Smart Flower” power generator, a defect identification device for oil and gas transport pipelines based on leakage magnetic detection, a portable seawater desalination device, a zero-energy intelligent marine garbage collector, wastewater purification system for the Yellow River Basin.

## **4. Construction of curriculum ideology and politics teaching team**

The construction of teaching team is a key factor to ensure the quality of ideological and political education. The success of curriculum ideology and politics education largely depends on the intellectual qualities, educational level, cultural background, and cohesion of the teaching team members. Furthermore, members of the teaching team actively participate in training seminars and forums related to ideological and political education, as well as workshops organized by teaching development center. Teaching team makes great efforts to improve their moral and ethical education skills, learn classroom design and implementation strategies for ideological and political education.

For Thermodynamics and Fluid Mechanics, the current teaching team consists of four associate professors and two lecturers with extensive teaching experiences, and three members have more than one year of overseas study experience. With strong support from the ideological and political education practical projects, the teaching team has been exploring the integration of ideological and political education into the course of Thermodynamics and Fluid Mechanics. Over the past five years,

the teaching team has undertaken three collaborative education projects with the Ministry of Education, over ten provincial and university-level educational research projects, published five textbooks and over thirty educational research papers, and received one provincial-level first prize for teaching achievements. Correspondingly, the teaching team has been awarded various honors, including outstanding teachers in ideological and political education, awards for teaching quality excellence, high-quality courses in national security education and top ten academic advisors. Furthermore, the teaching team has rich experiences in guiding students in scientific and technological innovation and competitions. Teaching team with above rich experiences provides strong support for the successful implementation of ideological and political demonstration courses.

## **5. Teaching methods for curriculum ideology and politics**

The integration of ideological and political elements into the course teaching process primarily adopts project-driven teaching method, case-based teaching method, storytelling method, theoretical deduction method, and classroom discussion method. Didactic and coercive educational methods shall be avoided to achieve the organic integration of ideological and political education with professional knowledge. Taking project-driven teaching method as an example, the students are encouraged to design a renewable energy utilization system to improve the energy efficiency and reduce environmental pollution. Based on the research project “National Key Research and Development Program of China” undertaken by the teaching team members, an optical fiber based hybrid solar lighting system for illumination of interior spaces is designed and fabricated. The system combines the features of optical fiber daylighting technology and photovoltaic power generation technology, saving 316.82 kWh and reducing 251.24 kg carbon dioxide emissions every year in the studied case. At present, this work has received multiple awards in academic competitions and honors, such as funding from the national university student innovation and entrepreneurship training program. These achievements have enhanced students’ awareness of engineering ethics related to energy conservation and environmental protection, as well as their capabilities in technological innovation for sustainable development.

## **6. Evaluation and achievements of curriculum ideology and politics**

The course has established a “2+N” multi-dimensional assessment and evaluation system. “2” represents the fixed assessment of the students’ basic proficiency in course knowledge, including the final exam paper score and post-class assignments. “N” represents flexible assessment methods such as pre-class preparation, participation in class discussions, in-class quizzes, ideological and political interaction and technological innovation abilities. All above elements combine to form a comprehensive evaluation approach aimed at objectively and fairly assessing each student’s learning process. Within this framework, 10% of the “N” assessment is allocated to classroom ideological and political interaction and technological innovation abilities. Additionally, the subjective ideological and political questions are included in the final exam paper, accounting for about 6% of the final exam paper score.

The preliminary ideological and political education of the course has already shown positive results. The followings are some real-time feedback provided by the students: “After learning about the remarkable achievements in the field of thermal engineering and fluid mechanics engineering in our country, I have come to realize the importance of a prosperous nation. This has strengthened my confidence in the socialist system, confidence in my major and confidence in future life”; “After course learning, I have a sense of contributing to the nation’s development through my knowledge and skills. I will uphold engineering ethics and professional morals at all times and dedicate my youthful energy to the development of the mechanical engineering industry”; “I have come to

understand that striving for success is the most beautiful state of life. When faced with challenges, I should be as adaptable as a fluid, never giving up, never admitting defeat, and never blindly pursuing unrealistic ideals". Obviously, the ideological and political elements introduced in this course have been integrated into various aspects of students' learning and life. This has achieved an organic integration of knowledge transmission in professional education, skill development in quality education, and value guidance in ideological and political education. Furthermore, over the past five years, based on the knowledge embedded in the course, the students have won more than 20 national-level innovation competitions and more than 60 provincial-level competitions. During this process, scientific innovation thinking, innovative methods, hands-on practical skills, research competence, lifelong theoretical learning abilities, and teamwork capabilities of the involved students have been significantly improved.

## 7. Conclusions

The practice of ideological and political demonstration course based on Thermodynamics and Fluid Mechanics shows that, the integration of ideological and political elements into professional knowledge is an effective approach to achieve the organic unity of knowledge dissemination, skill development and value guidance. The students not only enhance their professional competence by learning theoretical knowledge, but also improve their innovative thinking, engineering ethical and sense of social responsibility. The demonstration course encourages students to become outstanding engineers and responsible citizens with a strong ethical foundation.

## Acknowledgements

This research was carried out with the financial support of Teaching Research Project from Qilu University of Technology (Research on the Construction of Ideological and Political Demonstration Course of "Thermodynamics and Fluid Mechanics" Targeting National First-Class Major, 2022zd03; Construction of Engineering Training Teaching Model Combining Virtual and Real Way, 2021yb34; Research on Cultivating Innovation and Entrepreneurship Abilities of Students in Mechanical Engineering via Second Classroom, 2022yb06), Undergraduate College Teaching Reform Research Project of Shandong Province (Reform and Practice of Full-Cycle Project-Based Talent Training Model for Mechanical Majors in Industry-Specific Universities), Teaching Research Project Research Project on Course Ideological and Political Teaching Reform in Shandong Province (Exploration on Integrating Core Principles of the 20th National Congress of the Communist Party of China into the Ideological and Political Construction of "Thermodynamics and Fluid Mechanics" Course), for which due acknowledgement is given.

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