

Teaching Design and Mode of Courses with Ideological and Political Elements in the Course of Principle of Environmental Engineering

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Abstract: Principle of Environmental Engineering is an important foundational and core course at higher education institutions. While teaching students the basic knowledge of the profession, ideological and political education concepts should also be incorporated into the teaching design to achieve the goal of educating students. Based on the course characteristics of the Principle of Environmental Engineering, a comprehensive and systematic exploration and summary of the ideological and political elements contained in each chapter of the course are conducted, from the perspectives of patriotism, craftsmanship, philosophical thinking, and responsibility. Finally, the ideas and strategies for integrating ideological and political education into professional teaching are proposed, with the aim of providing theoretical support for ideological and political teaching in related environmental engineering courses.

1. Introduction

The importance of ideological and political education in course construction is self-evident. Since the concept of “ideological and political theories teaching in all courses” was first proposed in 2016 [1], universities across the country have actively explored new teaching approaches to integrate ideological and political education into professional courses. To fully utilize the “main channel” of “classroom teaching”, efforts have been made to integrate ideological and political education into the entire process of classroom teaching [2]. However, due to the dull and complex nature of the course content, it is difficult to carry out in-depth reforms and explorations of ideological and political education in science and engineering courses [3-5]. Relevant research has been conducted on the ideological and political education reform in environmental engineering courses, and some teaching research results have been achieved [6-13]. Nevertheless, the implementation of ideological and political education in all course mostly remains at the level of summarizing experiences due to the lack of scientific theoretical guidance, resulting in phenomena such as “labeling” and “dual standards” [14,15]. Most studies still face practical problems such as inadequate understanding and exploration of ideological and political elements, the inability to integrate ideological and political elements into

the course, and evaluation issues.

In recent years, our university has been tightly focused on the fundamental task of cultivating students with high moral standards, and has achieved the organic integration of professional courses and ideological and political elements. This has resulted in the establishment of a “course-based ideological and political education” system, which is characterized by a rich variety of platforms and a circular approach to student development[16]. The Environmental Science and Engineering major in the College of Resources and Environmental Engineering has been declared as an application demonstration major in Sichuan Province, therefore, it is important and imperative to carry out the reform of the course-based ideological and political education teaching model, which has become the forefront of our university's course-based ideological and political education reform.

Based on the characteristics of the course of Principle of Environmental Engineering, this paper comprehensively and systematically explores and summarizes the ideological and political elements contained in each chapter, including patriotism, craftsmanship, philosophical thinking, and responsibility. Finally, ideas and strategies for integrating ideological and political education into professional teaching are proposed based on examples of the design of the Environmental Engineering ideological and political education course.

2. Course Introduction

“Principle of Environmental Engineering” is a core course of the Environmental Engineering major and serves as the theoretical foundation for subsequent professional courses. The basic chapters of the course include mass balance and energy conservation, fluid flow, and transport processes. The principle part of the separation process includes basic principles such as precipitation, filtration, absorption, and adsorption. [17] The key teaching focus is on the basic principles of the separation process, while the teaching difficulty lies in the balance equations and pipeline calculations of fluid flow. The knowledge objectives of this course are to master the basic principles of the three categories of pollution control technologies represented by “isolation technology”, “separation technology”, and “transformation technology”; and to master the process and calculation methods of the three major separation technologies. The quality and moral education goals are to develop professional qualities such as diligence, willingness, ability, skill, love of work, and dedication; to have a rigorous scientific attitude, good scientific literacy, and innovative thinking methods; to inspire pride in the responsibility of being a citizen of a great nation like China; and to cultivate a strong sense of patriotism and guide students to recycle, conserve resources, and enhance awareness of environmental protection.

This paper emphasizes that in the course of education, not only should we focus on students' mastery of basic knowledge and professional skills, but also shoulder the responsibility of cultivating students' professional ethics, scientific thinking, and ideal beliefs. Therefore, in teaching the course, teachers should reasonably combine the characteristics of the course and integrate ideological and political theories teaching into the plan, so as to cultivate students' ideal beliefs and enhance their environmental awareness while learning knowledge, fully reflecting the inherent role of ideological and political education in “moistening things silently”.

3. Thoughts on the Mining and Integration of Ideological and Political Elements in All Courses

The content of ideological and political theories teaching in all courses should closely revolve around strengthening students' ideals and beliefs, with the main theme being love for the country, and love for the people. Key areas such as patriotism, moral cultivation, and other aspects should be optimized to systematically provide education on patriotism, socialist core values, quality education, and traditional Chinese culture. In engineering-related courses, attention should be paid to

strengthening students' engineering ethics education, cultivating the spirit of striving for excellence as great craftsmen of the country, and stimulating students' sense of patriotism and mission to serve the country through science and technology (Table 1).

Table 1: Integration of ideological and political elements in all courses

Patriotism (responsibility)	Patriotism, national spirit, traditional culture, three confidence (cultural confidence, road confidence and system confidence)
Moral quality (how to behave)	Moral sentiment: social morality, social ethics, professional ethics, correct outlook on life, etc. Sound personality: thought, emotion, attitude, heart, character, etc. Thinking ability: observation, imagination, independent thinking, judgment and reasoning, logical thinking, etc.
Scientific cognition (how to do)	Marxist epistemology and methodology, truth seeking and being pragmatic, innovative consciousness, patience and perseverance, critical summary, etc.

3.1. Patriotism

In the introduction section, global environmental issues can be used as a lead-in, with a focus on introducing China's response strategies to these global environmental issues. This will reflect the great responsibilities of the Chinese nation and inspire students' sense of national pride.

When discussing the development of China's environmental science and environmental protection, the depiction of the relationship between the economy and environmental protection reflects the continuous progress of environmental ethics in the new era. China's determined goals of "carbon peak" and "carbon neutrality" are also a solemn commitment to global efforts to address climate change. Starting with the ideological concept of achieving harmonious development between economic construction and environmental protection, the importance of ecological civilization construction should be highlighted, as it is fundamental to the sustainable development of the Chinese nation.

In chapter three, when discussing fluid flow, examples of China's great engineering achievements over the past 5,000 years, such as the flood control projects led by King Yu, the Dujiangyan Irrigation System, the Zhengguo Canal, and the Lingqu Canal, can be used to showcase the enormous accomplishments China has made in fluid mechanics, which will inspire students' cultural confidence and national pride. Additionally, modern Chinese hydraulic engineering, such as the Three Gorges Project, the South-to-North Water Diversion, the West-East Gas Pipeline, and the Xiangjiaba Hydropower Station, marks significant engineering applications of theoretical knowledge in fluid mechanics, such as open-channel flow and energy dissipation measures, and has achieved great success.

When discussing common physical quantities and unit conversions, the poem by Li Bai "My hair is white as frost, with sorrow beyond endurance" can be used to showcase the profound cultural heritage of China's long history, which will pique students' interest and enhance their cultural confidence.

In addition, when discussing fluid dynamics in Chapter 3, many poems related to the energy conversion principle of Bernoulli's equation can be used, such as Li Bai's famous poem Drinking Alone by Moonlight with the line "Have you not seen the Yellow River's waters coming from the sky, rushing to the sea and never returning?" or Looking at the Lushan Mountain Waterfall with the line "The falling stream descends three thousand feet, its spume resembles snowflakes floating down from heaven". Integrating ancient poetry and culture into the dry lecture process can not only enhance

classroom vitality but also increase students' cultural confidence.

3.2. Moral Quality

Newton's Law of Viscosity, Fourier's Law, and Fick's Law are all named after the scientists who discovered them. Therefore, in the course of studying these topics, it is possible to introduce the life experiences of these scientists, the problems they encountered during their scientific research, and the solutions they developed to set a good example for students and guide them to develop a persevering spirit of inquiry. The founder of theoretical fluid mechanics is Daniel Bernoulli, a Swiss scientist. By combining his life experiences, students can be inspired to develop an unwavering spirit of perseverance in the face of setbacks and challenges.

Qian Xuesen, Zhou Peiyuan, Qian Changwei, and Guo Yonghuai are the leading figures in applied mechanics in modern China. Through the life experiences of these scientists, students can be inspired to develop a love for their country and a spirit of dedication to scientific research throughout their lives.

By interpreting practical cases such as the "Beautiful China" construction project, the severe haze phenomenon in the Lop Nur area, and the Beijing-Tianjin-Hebei region, students can be motivated to fight against environmental destruction with unremitting spirit, and to achieve the sustainable development concept of "both the prosperity of the economy and the beauty of the environment are equally important" in production and construction.

3.3. Scientific Cognition and Philosophical Thinking

In the process of explaining environmental pollution control technology, adding practical case examples can visually help students understand the role of pollution control technology in environmental protection, and connect Marxist theory with reality, seeking truth from facts and integrating the thinking of testing and developing truth in practice.

The study of steady-state systems fully embodies the philosophical theory of systems theory, emphasizing that everything is composed of subsystems with organization and complexity, and they interact and influence each other.

The concepts of mass transfer, momentum transfer, and heat transfer fully embody the Marxist theory of "matter is motion, and motion is the fundamental property of matter, and matter and motion are inseparable". The course involves various calculation problems and principles that, based on appropriate assumptions and numerous practices, can help students understand the principles and methods more quickly, fully demonstrating the idea that "practice is the sole criterion for testing truth". In the process of learning, philosophy concepts and viewpoints are applied to subdivide the knowledge points learned, so as to reduce the difficulty of learning, improve students' acceptance ability, cultivate students' logical thinking ability and deepen philosophy concepts.

Introducing knowledge related to environmental ethics such as sustainable development, and using the anecdote of "cutting off the source of water to catch the fish" helps students understand that economic development cannot focus only on immediate benefits, but must also achieve long-term development.

Using the concept of filtering in teaching content highlights the importance of removing impurities to obtain the essence. In the era of big data, students are easily tempted by various external factors and can lose their focus. Therefore, it is important to enhance their ability to self-purify, to remove negative energy, and to absorb positive energy.

4. Teaching Strategies of Ideological and Political Theories in the Course of Principle of Environmental Engineering

4.1. Attaching Great Importance to the Practical Implementation of Moral Cultivation

Our college should attach great importance to the fundamental task of cultivating students with high moral character and promote the integration of professional knowledge and ideological and political education based on the concept of “comprehensive, three-dimensional, and innovative ideological and political education”, also implement the new requirements of “holistic education”, and vigorously promote the construction of the “ideological and political education” teaching system, and actively guide full-time teachers to adhere to the teaching philosophy of cultivating students with high moral character while imparting knowledge. Ideological and political theories teaching in all courses should be set as one of the incentive evaluation targets, which should be linked to the annual performance evaluation, promotion to senior professional titles, teaching evaluation, and other assessment metrics, actively guiding teachers to pay close attention to this aspect.

4.2. Combining Science and Education to Feedback Teaching with Scientific Research

(1) To better enhance the quality of teaching and education, a team teaching approach is implemented for this course. The team members have excellent teaching backgrounds and rich practical experience, and have been involved in various national and provincial research projects related to the field of environmental science, such as National Natural Science Foundation projects, Science and Technology Department projects and Education Department projects of Sichuan Province, among others. The team integrates their research achievements in ecological restoration and wastewater treatment into classroom teaching, presenting them to students in the form of practical case studies that demonstrate research progress, theoretical foundations, experimental models, and transformation pathways. This approach makes it easier for students to understand theoretical knowledge and makes the classroom livelier and engaging, stimulating students’ interest in learning.

(2) Combining historical cases (such as the Eight Major Pollution Incidents), stories of famous figures (such as academician stories), real-time news reports (such as the Fukushima nuclear leak pollution incident in Japan), audiovisual materials (such as what the world would be like 100 years after human disappearance), picture collections, and scientific research cases, a multi-dimensional database of course-oriented ideological and political education for environmental engineering principles can be established. Online case databases, such as the Typical Cases of Ecological Product Value Realization by the Ministry of Natural Resources and Under the Dome by Chai Jing, can also be referred to. Guided by case-based teaching, both positive and negative stories and pictures may be used as teaching materials to encourage students to learn from excellent predecessors and to warn them to learn from historical lessons, enhancing students’ sense of responsibility and increasing their sense of integration.

4.3. Diversifying Teaching Methods and Increasing the Content of Ideological and Political Theories Teaching

(1) Blended teaching model

The teaching materials should be uploaded using the Chaoxing software, including the goals, teaching cases, celebrity stories, environmental protection videos of ideological and political education etc. Students are first allowed to self-study and conduct pre-class preview. Then, regular assignments, chapter exercises, discussions on major environmental issues, debates on current hot environmental views and other links are set up online to fully showcase students’ views and improve

their thinking abilities.

The offline approach mainly adopts a participatory classroom teaching method. The teacher first puts forward the viewpoints, and then the students organize discussions. Finally, group representatives are recommended to give speeches. Students can also discover environmental problems around them and propose their own solutions. This can exercise students' keen observation, as well as their speech, organization, and cooperation abilities.

(2) Problem-oriented teaching style

Based on the most pressing environmental issues of the present time, such as the construction of an ecological civilization, ozone depletion, eutrophication of water bodies, greenhouse effect, haze, and PM2.5, students are required to conduct group discussions using the computer to search for relevant cases or give presentations on a specific hot topic issue. Through this, the environmental policy guidelines in China can be closely integrated with professional course knowledge.

In response to the current COVID-19 pandemic, questions can be raised such as: Do you understand viruses? What are the transmission routes of viruses? How do masks prevent viruses? Here, the principle of adsorption can be used to explain and extend to how to eliminate air pollutants and prevent haze.

4.4. Optimizing the Assessment Method, and Improving the Proportion of Ideological and Political Theories Teaching in All Courses

A diversified classroom assessment approach will be implemented, departing from the traditional assessment mode that primarily relies on exam scores. In addition to evaluating academic performance, innovation ability, humanistic literacy, patriotism education, social responsibility, and practical skills will also be taken into consideration as assessment indicators, with the weight of each indicator being properly allocated. To better align with the teaching objectives of ideological and political education, the weight of process assessment will be increased for the Principles of Environmental Engineering, especially comprehensive evaluation of classroom performance. The assessment will cover students' attitude toward course activities, organizational ability, teamwork, humanistic literacy, innovation ability, social responsibility, and more, aiming to cultivate their professional ethics and social adaptability. The overall score for the course will be calculated based on the following weighting: final exam (50%), classroom discussion (20%), presentation (20%), and in-class assignments (10%). Through the reform of assessment, the ideological and political theories teaching will be integrated into various aspects of teaching, which can stimulate students' learning enthusiasm and enhance their comprehensive quality, as well as increase their environmental protection responsibility and professional ethics.

5. Conclusions

In summary, achieving the fundamental task of cultivating students' morality through courses requires the implementation of ideological and political theories teaching in all courses. While teaching students professional knowledge, teachers should also integrate ideological and political education concepts into their teaching design to achieve the goal of teaching and educating, by combining the knowledge objectives of environmental engineering principles with moral education objectives, exploring and excavating from different perspectives through appropriate teaching design, and ingeniously incorporating elements such as cultural confidence, philosophical thinking, socialist core values, national pride, and patriotism into the curriculum, which can enhance the affinity of ideological and political theories teaching in all courses and fully reflect the implicit function of ideological and political education.

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