

Exploration and Practice of Ideological and Political Elements in Chemical Engineering Courses in the Background of Sanquan Education

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Abstract: In the context of modern holistic education, integrating “ideological and political education” into specialized courses is a new requirement for professional teaching. In order to seamlessly integrate ideological education into academic disciplines through subtle influence, it is essential to identify and design suitable ideological elements. Based on the interdisciplinary nature of chemical engineering curricula, this paper focuses on core socialist values, patriotic sentiment, professional ethics, and the spirit of scientific innovation. It identifies key ideological elements such as “a strong chemical industry makes a strong nation” and “patriotism and maritime power,” analyzes their manifestations of value, and explores their relevance and significance in ideological education across different chemical engineering courses.

Keywords: Higher education; Sanquan education; Ideological and political education; Chemical engineering majors; Curriculum ideological and political education

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1. Introduction

The fundamental mission of higher education is to cultivate virtue and nurture talent. This serves as a strategic imperative for national development and represents the essence of education itself. This philosophy emphasizes the establishment of moral integrity and professional competence as core standards, building a comprehensive Sanquan education system that engages all personnel, spans the entire process, and covers every aspect. The aim is to develop talented individuals with noble ethical values, solid professional expertise, a strong sense of social responsibility, and an innovative spirit. Within this comprehensive educational framework, a key focus of higher education reform is to foster students’ ideological and political awareness, psychological resilience, physical fitness, and overall well-being, while imparting knowledge and developing practical skills.

Therefore, in order to implement the spirit of the conference on ideological and political work in colleges

and universities, realize the education for the Party and the country, and strive to provide education that satisfies the people, it is particularly necessary to dig into the ideological and political elements contained in the professional courses of colleges and universities.

2. Exploration and design of ideological and political elements in the chemical engineering curriculum

Chemical engineering curricula encompass core disciplines such as Principles of Chemical Engineering, Chemical Technology, Chemical Thermodynamics and Industrial Catalysis, as well as specialized courses including Polymer Synthesis Technology, Polymer Material Processing Technology, Environmental Chemistry and Fine Chemical Synthesis. These courses cover extensive technical knowledge and integrate historical narratives of chemical advancements, biographies of chemists, and the developmental contexts of key industrial processes, providing a foundation for ideological education^[1]. Systematically incorporating political education elements into these courses also enhances students' sense of professional pride in chemical engineering and related fields.

In the new era, there are new requirements for ideological and political education in schools. The ideological and political link in higher education should be transformed from a single “ideological and political course” to an all-round “ideological and political course”^[2]. Drawing on years of teaching experience, this paper explores interdisciplinary case studies that can be adapted to chemical engineering curricula. By aligning with the knowledge characteristics of chemical engineering disciplines and the professional development needs of students, we integrate three core industry dimensions—energy, resources, and the environment—into course instruction. This approach naturally instills proper value orientations while proactively embedding the educational objectives of cultivating ideals, convictions, and patriotic sentiments into teaching practices in the classroom.

2.1. Curriculum ideological and political element 1: Chemical industry makes the country strong

The chemical industry is the cornerstone of material wealth, meeting essential needs such as clothing, food, housing, and transportation. Advances in this sector drive progress in agriculture, pharmaceuticals, energy, and related industries^[3]. According to a 2019 report by the International Federation of Chemical Industry Associations, the chemical industry is involved in almost all production industries, which shows that the progress of the chemical industry has played a huge role in promoting the rapid growth of national comprehensive strength. Students should therefore fully recognize that the chemical industry is a pillar of the national economy. Its robust development strengthens the nation's prosperity and cultivates pride and honor among chemical engineering professionals.

The design element encompasses the connections between the chemical industry and all aspects of daily life, including clothing, food, housing, transportation, and healthcare. Examples include synthetic fibers used in garment manufacturing, agricultural fertilizers that increase crop yields, food additives used in processing, wall coatings that improve the functionality of walls, vehicle surface treatments, and non-woven fabrics used in masks—all of which are products of the chemical industry. With China's rapid economic growth, green chemistry has become a universal requirement across industrial sectors. It is crucial to achieve energy-efficient, eco-friendly manufacturing processes to enhance chemical production standards, which in turn increases the demand for technological innovation. Therefore, chemical engineering students should fully embrace the

philosophy that “a strong chemical industry makes a strong nation.”

2.2. Curriculum ideological and political element 2: Patriotism and maritime power

Patriotic education is an ongoing part of China’s educational endeavors. To promote the spirit of patriotism, we must make patriotic education an eternal theme and integrate it throughout the entire process of national education and spiritual civilization construction. As chemical engineering educators in the new era, therefore, it is our sacred duty to incorporate patriotic narratives into our lectures. In the new era of building a modern socialist country and advancing towards the second centenary goal, developing and utilizing marine resources has become increasingly vital. We should care for the ocean as we care for life, promote the building of a community with a shared future in the ocean, and take the building of a maritime power as an important part of the cause of socialism with Chinese characteristics^[4-6]. Teachers should therefore help students realize that China is both a land power and a maritime nation with abundant marine resources. The security of marine resources has historically played a crucial role in safeguarding national security and protecting people’s safety, and developing them will significantly boost national progress. Thus, loving one’s country is fundamental for contemporary youth, and protecting, developing, and utilizing marine resources represents the modern pursuit of chemical engineering professionals.

The content of the design of this element includes: Using marine resources as an example, it first introduces students to the basic situation of China’s territorial sea, the importance of marine resources for the development of countries worldwide, and existing issues in international relations. This makes students aware that the territorial sea is currently not peaceful. Through these explanations, we aim to inspire students’ patriotic enthusiasm and remind them that, as contemporary college students, they must take responsibility for national security, safeguarding the maritime security of China’s territorial sea. Each student has an inescapable duty to be prepared to contribute to the nation’s defense at all times. Secondly, we will explain the extraordinary significance of developing and protecting far-sea and deep-sea resources for China’s development. This will help students to truly understand the importance of building a maritime power in order to realize the “China Dream.” This content implements the concept of becoming a maritime power and constructs a marine awareness education system. It strengthens students’ education and cultivation in marine strategic awareness, maritime security awareness, marine technological awareness, marine chemical awareness, and marine ecological awareness^[7]. By teaching students to learn from, understand, and love the sea, we can effectively enhance their ability to contribute to the marine economy and industrial development. This approach provides patriotic education, inspiring students to serve and defend their country, stimulating their patriotic enthusiasm, and invigorating their national spirit and pride. It also guides students in integrating their personal development with national progress, social advancement, and the rejuvenation of the nation. Ultimately, it cultivates qualified, idealistic, moral, cultured, and disciplined socialist youth^[8].

2.3. Curriculum ideological and political element 3: Ecological civilization and carbon dioxide strategy

The construction of an ecological civilization concerns people’s well-being and the future of the nation. As a chemical engineering discipline closely related to the construction of ecological civilization, integrating the concept of Beautiful China throughout the curriculum not only provides an excellent opportunity to instill environmental protection and green chemical concepts into future chemical industry practitioners but also represents a serious study of the philosophy of ecological civilization. In light of the dual-carbon strategy, the

chemical industry's development faces greater requirements and challenges, necessitating urgent transformation and upgrading. It is therefore crucial to help students understand the impact of chemistry on sustainable economic, environmental, and social development, and to cultivate their ability to evaluate the potential hazards and risks that chemical products and production processes pose to humanity and the environment. Chemical professionals must earnestly adhere to the principle that "lucid waters and lush mountains are invaluable assets" and recognize that ecological civilization construction forms the foundation of China's overall socialist plan with a five-sphere integrated approach. The "Beautiful China" concept must be ingrained in both consciousness and practice.

The design content of this element includes: Firstly, it introduces the severity of atmospheric pollution issues in China. The severe haze in some cities has significantly impacted people's daily lives, highlighting the serious atmospheric pollution caused by sulfur produced from petrochemical resources. This enables students to experience China's environmental pollution problems first-hand, encouraging them to explore the importance of deep desulfurization through catalytic methods in petroleum refining processes. This emphasizes the importance of protecting ecological civilization and building a beautiful China. Secondly, the design aims to help students recognize the importance of environmental protection and enhance their awareness of environmental issues, instilling a sense of responsibility for safeguarding ecosystems and building a beautiful China ^[9]. Thirdly, it explains that achieving the planned goals of "carbon peaking" and "carbon neutrality" on schedule requires a gradual reduction in dependence on existing high-carbon resources while ensuring continued development. This leads to discussions about how the vigorous development of hydrogen and biomass energy can effectively control and reduce carbon dioxide emissions while accelerating the circular economy. Consequently, students understand that, under the guidance of the "Dual Carbon Strategy," the chemical industry faces new challenges and opportunities for development and upgrading, fostering a sense of professional honor and urgency to serve the nation.

2.4. Curriculum ideological and political element 4: Engineering ethics and legal awareness

A chemical genius can be either an angel, benefiting human society, or a demon, endangering it. Therefore, it is particularly crucial to cultivate students' engineering ethics literacy and strengthen their legal awareness. Including the characteristics of chemical industries, ethical issues, and legal systems in classroom education is a vital preparatory step before entering the profession. Combining knowledge transmission, skill development, and value guidance will advance chemistry, engineering ethics, and legal awareness simultaneously. It is important to emphasize that "we must uphold the unity of values and knowledge, embedding value guidance into knowledge instruction" ^[10].

This design element focuses on the recovery and recycling of sulfur from coal, oil, and other resources. It sheds light on illegal emissions from enterprises such as refineries and steel mills, particularly in cases where companies continue to discharge pollutants during periods of severe pollution. The analysis reveals the environmental impact of the chemical industry and shows that China's pollution is partly caused by unethical businesses and corrupt managers who disregard national regulations for personal gain, resulting in severe ecological damage in some regions. These explanations warn students that the chemical industry is a double-edged sword. Working in this field requires strict adherence to national regulations and proper scientific principles; otherwise, it can have serious consequences for society and individuals. The discussion then moves on to engineering ethics principles, encouraging students to prioritize human safety, health, and environmental

protection when carrying out their professional duties. Students are encouraged to take responsibility for current and future human health, ecology, and society, and to actively promote green chemistry and sustainable development. Concrete case studies help students to develop correct environmental values, ethical principles, and legal awareness during their chemistry studies. From a moral education perspective, this approach cultivates students' ability to "take on social responsibilities, comply with laws and regulations, and apply professional knowledge for the benefit of people and society"^[11], emphasizing legal constraints and ethical standards.

2.5. Curriculum ideological and political element 5: Scientific and technological innovation spirit

Chemical engineering is an experimental science discipline in which strong scientific literacy and innovative thinking are essential for becoming a highly accomplished professional in the field. In the classroom, educators typically use the "inspiration-thinking-exploration" approach to encourage students to independently explore course-related questions and develop an awareness of innovation^[12]. By integrating professional narratives with moral education elements, instructors design ideological-political teaching plans meticulously. Through case studies, these methods enhance the effectiveness of ideological education in specialized courses, achieving the educational objectives of political education in technical disciplines^[13]. This approach helps students to understand the definition and essence of the scientific spirit and recognize its vital importance for personal growth and societal development. It also emphasizes the significance of maintaining a scientific mindset, respecting scientific principles, upholding scientific cognition, and implementing scientific measures^[14].

The design content of this element includes: Since the establishment of New China, and particularly since the reforms and opening up, the nation's scientific and technological level has made significant progress alongside the continuous advancement and rapid development of our country's economic construction^[15]. Several chemical scientists' research results have reached world-leading levels, and major original research achievements have been successively applied. There is a growing trend throughout society to popularize scientific knowledge, disseminate scientific ideas, and advocate scientific methods. Consequently, university students should have a profound understanding of the essence of the scientific spirit^[16], where ideals, beliefs, empirical methods, critical attitudes, and trial-and-error models are particularly important. This enables students to recognize the importance of adhering to scientific principles and adopting a scientific approach^[17].

3. Conclusion

"Though the road is long and arduous, progress will be made through action." In response to the new requirement to integrate ideological and political elements into professional course instruction, we call on chemical engineering educators to fulfil their professional duties, guide students' development, and explore the ideological and political aspects of professional knowledge in depth. They should then apply these aspects flexibly in the classroom to achieve the educational effect of "salt dissolving in water" and "silent nourishment." While achieving teaching objectives and imparting professional knowledge, we continuously improve teaching concepts, innovate teaching methods, optimize teaching models, and integrate the thought of socialism with Chinese characteristics and socialist core values into courses. This enables students to understand the importance of upholding professional ethics and adhering to engineering ethics as future practitioners in the chemical industry, earnestly abide by the green chemical concept that "lucid waters and lush mountains are invaluable assets," and emphasize that chemical professionals must embrace the vision of "Beautiful China" and integrate the belief in building a strong chemical nation into their work. Our goal is to nurture modern chemical

professionals who are patriotic, have strong professional integrity, and embody a spirit of scientific innovation. We seek to develop individuals with a solid theoretical foundation in chemistry and chemical engineering who demonstrate comprehensive growth in moral, intellectual, physical, aesthetic, and labor education. These individuals will become pillars of national development in the new era.

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References

- [1] Xi J, 2020, Curriculum-Based Ideological and Political Education is a Key Course for Implementing the Fundamental Task of Cultivating Virtue and Fostering Talent, People's Publishing House, Beijing, 4–10.
- [2] Xi J, 2020, The Governance of China (Volume III), Foreign Languages Press, Beijing, 463–464.
- [3] Wang L, Liu S, 2024, Chemical Engineering and Technology: Balancing Theory and Practice. *Journal of Examination and Admissions*, (Z1): 106–107.
- [4] Li S, Zhuo X, Shi H, et al., 2021, Exploring and Practicing Ideological and Political Education in Chemical Engineering Courses under the New Engineering Education Initiative. *Guangzhou Chemical Industry*, 49(24): 157–159.
- [5] Zhou H, Bian X, 2021, From Management to Governance: Party Building in Higher Education Institutions Leading the Modernization of Governance. *Higher Education Management*, 15(05): 55–63.
- [6] Yan X, 2020, On the Ideological and Political Elements, Practical Pitfalls, and Educational Evaluation of Curriculum-based Ideological Education in Universities. *Research on Ideological Education*, (2): 88–92.
- [7] Wang Z, 2020, Marine Higher Education is an Important Support for the Strategy of Building a Maritime Power, *Guangming Daily*, February 4, 2020, (0013).
- [8] Shi H, 2020, Construction of the “Three-in-One” Ideological and Political Education Model in Higher Vocational Colleges. *Journal of Huainan Vocational and Technical College*, 20(02): 40–42.
- [9] Liu F, Li M, 2022, Two Lines and Five Dimensions: Exploring the “Green Education” Model in Higher Education from the Perspective of Core Competencies—A Case Study of Cangzhou Normal University. *Journal of Cangzhou Normal University*, 38(03): 13–18.
- [10] Gu R, 2021, Ideological and Political Curriculum and Curriculum-based Ideology and Politics: Moving in the Same Direction. *Jiangsu Education*, (75): 7–11.
- [11] Zhang D, 2021, Curriculum Ideology and Politics: The Fundamental Guideline for Moral Education in the New Era. *China Higher Education Research*, (1): 5–9.
- [12] Song X, Li Y, 2021, Exploring and Practicing Ideological and Political Education in Freshmen's Inorganic Chemistry Course. *Chemical Education (Chinese& English)*, 42(14): 32–36.
- [13] Luo J, Li L, 2021, Deepening the Recognition of Ideological and Political Education in Professional Courses by Teachers. *China Higher Education*, (9): 43–45.
- [14] Yu X, 2022, Research on the Same-Direction and Same-Process Teaching Reform of “Course Ideology and

- Politics” Construction in Chemical Engineering Courses. *Chemical Engineering Design Bulletin*, 48(2): 124–126.
- [15] Xi J, 2018, Excerpts from his Discourse on the Overall National Security Concept, Central Documents Press, Beijing, 41–42.
- [16] Dai D, Kang L, Zhao H, 2021, Multi-Dimensional Integration Design and Practice of Curriculum Ideology and Politics in Professional Education: A Case Study of Chemical Engineering and Pharmaceutical Major Courses. *Innovation and Entrepreneurship Theory Research and Practice*, (23): 161–163.
- [17] Ma J, 2023, A Pathway Discussion on Full-Course Coverage of Implicit Education Review of “Curriculum Ideology and Politics: A Profound Reform.” *China Journal of Education*, (5): 138–141.

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