

# Excavation and Practice of Ideological and Political Elements in the Science and Engineering Specialized Courses

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**Abstract:** The cornerstone of colleges and universities is moral education, which is also a fundamental requirement for personnel fostering. It is vital to implement the essential task of establishing morality education by comprehensively advancing the construction of "Courses for Ideological and Political Education". The most crucial link of the system of courses for ideological and political education is the specialized courses. It has become an urgent issue to be solved in the current ideological and political education in colleges and universities as to how to design and organize the courses for ideological and political education and bring the synergistic effect of moral education and the teaching activities of specialized courses into play. This article focused on ideological and political education in specialized courses of science and engineering. First, several common ideological and political elements, such as patriotism, integrity, philosophical thinking, and the spirit of scientific research, were summarized and elaborated, followed by the application in the immunology course of science and engineering major as case sharing. Moreover, several critical issues in implementing ideological and political education were discussed on this basis to improve teaching effects, which provides ideas for conducting ideological and political education in specialized courses of science and engineering.

**Keywords:** Morality Education, Science and Engineering Specialized Courses, Ideological and Political Elements, Course Design and Implementation

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## 1. Introduction

Talent cultivation is an essential task of colleges and universities, and the fundamental issue of "who and how to train, and to what end" is the vital topic confronting colleges and universities in the new era. Morality education is the cornerstone of talent cultivation in colleges and universities, and talent cultivation systems should be designed around it to achieve the organic unity of value shaping, knowledge transmission, and capability training. In October 2019, the Ministry of Education released the Opinions on Deepening the Teaching Reform of Undergraduate Education and Comprehensively Improving the Quality of Talent Cultivation (Gao Jiao [2019] No. 6) [1], which requires "to

take the construction of courses for ideological and political education as a key link in implementing the fundamental task of morality education, adhere to the unity of knowledge transmission and value guidance, the unity of dominant education and recessive education, and deeply exploit the ideological and political education resources contained in courses of all kinds and the teaching methods". Therefore, it is necessary to comprehensively promote the construction of "Ideological and Political Education in Courses", which is taken as a strategic measure to carry out the essential task of moral education for colleges and universities [2-4].

Ideological and political education is a brand-new educational idea, which guides all the courses in colleges and universities to realize their morality education roles so as to

form an atmosphere of "educate in the whole course" [5]. It is essential to expand the "main channel" of ideological and political education from single courses related with ideological and political theory to all the courses including the specialized courses in colleges and universities. During the teaching and learning activities, the ratios of both the specialized courses in the courses of training program and the teachers responsible for the specialized course tasks can reach 80%, so the teachers in specialized courses are most strongly correlated with students [6, 7]. In addition to imparting theoretical knowledge, they also carry out practical teaching activities, which means that they may spend more time with students and have more opportunities for face-to-face interactions. As a result, their words and behaviors are most likely to impact students' values and career decisions. As such, teachers of specialized courses play a significant role in implementing ideological and political education courses, notably serving as the system's most critical and least-solved component. The core of the concept of courses for ideological and political education is the excavation and extension of "Moral Education in Disciplines" [8]. It entails thoroughly exploring each specialized course's ideological and political elements and educational potential, integrating the elements above into each course using traditional and modern resources and rich carriers, and positively influencing students' ideologies, values, and actions in a subtle way, which eventually realize the unity of knowledge transmission, capacity training, and value moulding [9]. In fact, all courses in colleges and universities contain "ideological and political elements", and these factors play fundamentally the same role in different courses, only differing in terms of dominance/recessiveness and difficulty of excavation between courses [10, 11]. Additionally, the efficiency of the utilization of ideological and political elements is, to some extent, influenced by the abilities of the teachers of specialized courses, especially their sensitivity to such elements [12, 13].

Immunology is one of the basic frontier disciplines of life sciences, with a long history and rapid development in recent years [14]. Immunology is closely related to human health, whose history is a reflection of humankind's defence against infectious diseases [15]. This process contains various ideological and political materials rich in value orientation and responsibility, such as stories of scientists who have explored the essence of life through phenomena in their scientific research. Additionally, the knowledge in immunology contains abstract thinking and ideological and political elements, such as the immune system components working together to protect the body from infection, reflecting the spirit of teamwork; or the principle of proportionality that the body should maintain in the immune response, in accordance with the philosophical idea of dialectic. The combination of ideological and political elements and talent training will not only enrich the course's content but also increase students' interest in learning, giving them the sense of both gaining professional knowledge and the enrichment of growing up and genuinely realizing the

education without traces.

In this study, we focused on ideological and political education in specialized courses of science and engineering. First, we clarified some ideological and political elements frequently covered in science and engineering specialized courses, followed by teaching cases integrated with such elements in the immunology course from science and engineering major. Moreover, several critical issues in implementing ideological and political education were discussed on this basis, which provides ideas for conducting ideological and political education in specialized courses of science and engineering.

## 2. Exploration of Ideological and Political Elements

### 2.1. Patriotism Element

"Science is not country-specific, but scientists are not all of the same nationality". Patriotism is the strongest and longest-lasting feeling known to humanity and the wellspring of one's virtue. The demands of the nation and society should guide the development of talents, and those talents should closely link their development to that of the nation. As a result, it is essential to incorporate patriotism-related elements into the specialized courses, such as highlighting the achievements made in the field of the subject, particularly some significant discoveries or breakthroughs that represent the world's level. This will greatly arouse students' patriotism, and further direct them toward consciously integrating their love for the nation, desire to strengthen the country, and actions to serve the nation in the struggle for national advancement and social progress.

In the introductory chapter of the immunology course, the human pox vaccination method was introduced to prevent smallpox by ancient Chinese physicians, which allows students to experience the sophisticated idea of Chinese people in immunology vaccination. In the innate immune response chapter, fecal microbiota transplantation, an "ancient prescription" tried by Ge Hong, a physician in the Eastern Jin Dynasty, and Li Shizhen, a physician in the Ming Dynasty, was introduced to treat diseases of the digestive tract, which is still in use today. The "bold" attempt enabled students to understand the application of intestinal microbiota better and impressed them the profoundness of traditional Chinese medical science. The outstanding work of China's scientific researchers in developing COVID-19 vaccines, as well as the national responsibility of China in the global fight against COVID-19, including multiple forms of assistance to other countries, were introduced in the immunization and prevention technology chapter alongside the current pandemic, which instilled students with a sense of pride in their own country.

### 2.2. Integrity Education Element

An old saying in China describes to this way, "People

cannot stand without integrity; a business cannot thrive without integrity; the country cannot survive without integrity". Integrity has been a traditional Chinese virtue since the beginning of the country's history, and it also serves as the foundational principle of morality and ethics in our society. There is an old saying in China, "People come here in droves with an eye to benefits; people go there in a bustle with an eye to benefits". It is critical for the students to figure out how to resist the temptation of benefits and keep the original intention in the future career. Teachers can integrate professional knowledge with integrity education by sharing some cautionary cases that violated integrity principle to help students follow the integrity principle and uphold integrity standards.

Immunology is a research discipline, and scientific research is required to be true and rigorous. In recent years, however, various types of academic misconduct have occurred repeatedly driven by interests, such as the MIT associate professor Parijs, who was once known as a world-class "prodigy" in the field of immunology. He fabricated research data to obtain research funding, which led to his eventual expulsion and the end of academic career, from which students learned to take a correct attitude toward research and avoid academic misconduct in the presence of such situations. Immunology-related techniques are regularly utilized in disease prevention, diagnosis, and treatment in addition to scientific research, all of which are primarily concerned with human health and cannot tolerate any erroneous manipulation. The fake vaccine incident of Changchun Changsheng Bio-Technology involved in the falsification of production records and the production of substandard vaccines was presented, and students were guided to deeply understand the potential threat of fake vaccines to the human body, as well as the negative social effects triggered by the incident such as panic and trust crisis, to deepen their understanding of the consequences of breach of trust.

### **2.3. Element of Philosophy Thought**

Disciplines evolve dynamically, and knowledge is constantly updated. New laws are continually discovered and outdated knowledge will be revised or even abandoned as science advances. Therefore, one should learn to view scientific knowledge from a dialectical and developmental perspective. Based on this, teachers can arrange for students to participate in various discussion activities related to the theoretical material covered in the lectures. They can also direct students to present opinions and arguments freely, and learn to perceive the pertinent theoretical knowledge with philosophical thinking, and ultimately develop a scientific worldview and methodology to guide theory and practice.

Immunity is a dynamic process itself that aims to maintain homeostasis, and both excessive and insufficient immunity are harmful to the organism. For students to develop the ability to consider both aspects objectively, the significance of the central and peripheral immune organs in the immune response was discussed in small groups for the immune

organs chapter. Students were instructed to view opportunistic bacterial pathogens from a dialectical perspective when referring to the microbial barrier, which are suppressed when the beneficial bacteria are the dominant bacteria while propagate largely when the commensal flora is out of balance, endangering human health. As a typical clinical pathological response, the inflammation is the body's defence mechanism for aggressively fending off infection; however, it can also result in localized physical damage and discomfort, including redness, swelling, fever, and functional impairment. Students were instructed to comprehend this phenomenon from its positive and negative aspects.

### **2.4. Elements of Scientific Research Spirit**

The struggle of scientists is chronicled in science history, but so are the spirits of scientists. Their innovative spirit of reaching the top and being the first, their pragmatic spirit of seeking the truth and rigorous pursuit of learning, their dedication to apathy toward fame and fortune and their devotion to research are all priceless spiritual treasures for us. The spirits are also valuable resources for ideological and political education in the classroom. Teachers share the stories behind scientific research while imparting "hard-core" knowledge to instil a positive research spirit, pique students' interest in scientific research, and illuminate students' scientific research ideas. The teaching methods also implicitly exert a subtle influence on students and inspire the young to devote themselves to science to serve the country through the power of role models.

In immunology classroom, students learned from the scientific research of Behring, the Nobel Prize winner in Physiology and Medicine who discovered serum antitoxin and applied his "serum therapy" in the prevention and treatment of diphtheria in the chapter on antibodies. The story helped students develop the scientific research concept of "make assumptions boldly; find proofs with care". Complements were first identified by Bordet, another Nobel laureate in physiology and medicine, and the experimental procedure is a good example to inspire students how to design an experiment to dig out the unknown. Students were guided by questions step by step, followed the experimental thought of Bordet, and finally impressed by the rigour and ingenuity of scientific experiment. The introduction of antigen "cross-presentation" in the antigen presentation chapter aided students in comprehending the biological significance of the "out of rule" behaviors of antigen peptides/MHC molecules, deepened their understanding of "exceptional events" in immunology, and piqued their interest in investigating unknown metabolic pathways in living things.

### **2.5. Elements of Professionalism**

Professionalism is the inner cultivation of a person, which is an important reflection of core competitiveness and a key factor in determining the height of a career [16]. Professional skills are examples of explicit professionalism, which can be

easily acquired through education and training. However, the improvement of implicit professionalism, such as commitment, responsibility, execution, team awareness, etc., requires a long-term process. Similar elements underlying theoretical phenomena can be analogized to professionalism and worth of excavation in the lectures of specialized courses. In addition, team assignments provide more opportunities for students to experience how to achieve teamwork. These efforts are to strengthen implicit professionalism education, further students' soft skills and lay a strong foundation for their future careers.

The immune system is a perfect model of teamwork itself in which each team member has its own role and collaborates efficiently. Each cell takes different responsibilities in the immune response, ranging from recognizing antigens, activating downstream cells, and killing pathogenic microorganisms among numerous species of immune cells, all of which are indispensable and work diligently in their own positions. Immune cells respond quickly and cooperate with each other to defend against antigen invasion. Many of them are "dedicated" immune cells, such as neutrophils, whose apoptosis proceeds rapidly after completing the "killing" task to avoid unnecessary damage to the human body, thus guiding students to establish an overall view and properly manage the relationship between individual and collective interests. A win-win cooperation concept is reflected in the interaction between B cells and Th cells, where the activation of native B cell depends on the assistance of Th cell. In contrast, B cells can further activate Th cells as antigen-presenting cells after activation, achieving a common goal in the process of cooperation between the two. The organism can basically achieve real-time monitoring of the intra- and extracellular "enemy situation" through the "upstream" antigen presentation step in the antigen presentation chapter. It is worth studying and following this efficient and sophisticated top-level design concept.

### **2.6. Elements of Humanistic Care**

Humanistic care is the regular self-care of individuals, and its foundation is primarily the affirmation of human nature and values. It is mainly seen in the maintenance and concern for human dignity, personality, value, destiny, and other spiritual aspects, in consideration of human beings' social and survival status, as well as in their requirements for advancement and the assurance of adequate living conditions [17]. Education in the humanities and science are complementary. Science education falls short and is soulless without a humanistic focus. Self-centeredness, disregard for others, and distorted values can readily result from a lack of humanistic care. As a result, professional education and humanistic education ought to be organically intertwined.

Professional education shall have warmth in addition to depth and breadth. Teachers of specialized courses are supposed to stick to the idea of "caring", pay attention to their students' emotional needs except for learning, assist them in handling problems. To transmit humanistic care and

establish an immersion method of education, teachers should infect students with their own words and deeds in daily activities. In addition, incorporating certain pertinent cases into the lectures teachers enables students to experience the warmth of humanistic care and subtly raises students' awareness of it. Numerous actual medical cases were utilized in immunology classes to impart ideological and political education on topics like organ transplantation and immunological disorders. For instance, the report about Wu Yue, a brave girl who completed bilateral lung transplantation was shared in the lecture of the major histocompatibility complex chapter, from which students were instructed to reevaluate the eternal subject of life expectancy and quality of life, to pay tribute to donors with great love, and take courage from recipients who face life head-on. In the immunization and prevention chapter, students were given the opportunity to experience the humanistic concept of life first and people-centred idea through the active prevention policies adopted by China under COVID-19, such as cutting off the transmission route, accelerating vaccine R&D, and providing free vaccination for every citizen.

## **3. Implementation of Ideological and Political Education in the Specialized Courses**

### **3.1. The Improvement of Ideological and Political Skills**

Teachers of specialized courses in colleges and universities are supposed to constantly refine their ideological and political skills in theory and practice. It is necessary for them to "consciously establish themselves with virtue, learn with virtue, teach with virtue, and strive to be 'Si You' good teachers with ideal beliefs, moral sentiments, solid knowledge, and a loving heart" [18]. This enables them to keep up with the times and bring forth the new through the old of their education work. On the one hand, teachers of specialized courses in colleges and universities, on the basis of solid mastery of professional knowledge, try to gain an understanding of national policies, major development strategies, social hotspots related to the courses, cutting-edge achievements of academic research and technical applications, master the knowledge of various aspects of the history and traditions of the development of the field to build a case library of ideological and political courses and integrate them into the specialized courses. On the other hand, they need to maintain strict self-discipline and set an excellent example for their students, so that they can relate to the values teachers convey through influencing, instilling, and cultivating, as well as leading values shaping through the power of example, realizing the entire process of immersion education mode.

### **3.2. The Teaching Design Refinement**

The process of designing courses for ideological and

political education is supposed to follow the rules of systematic design and be carried out in a systematic and organized way. First of all, the teaching objectives of the moral education are required to be set, followed by the rearrangements of the teaching contents of the curriculum accordingly. Second, the teaching implementation plan will be formulated meticulously, including the selection of ideological and political elements and the appropriate teaching content for presentation in class. Third, the teachers should design the corresponding teaching methods and approaches, and apply the moral education contents with a combination of teaching methods to the relevant chapters. Finally, the teaching effects are supposed to be pre-designed and evaluated to ensure the consistency of "objectives, strategies and evaluation".

### 3.3. Teaching Methods Improvement

The concept of "educate in the whole course" is implemented in constructing the courses for ideological and political education, which also abide by the rules of education, teaching, and student development. Education should be given during the entire teaching process, including "before class, during class, and after class". On the one hand, situational and case study teaching methods are good choices for teachers used in the classroom, with an organic combination of the professional knowledge points and the excavated ideological and political elements to avoid the tedious one-way knowledge transmission. On the other hand, contemporary information technology teaching techniques are utilized fully to assign preview tasks and discussion topics, which will encourage students to think independently, improve communication between students and teachers, and enable ideological and political education to change from passive acceptance to active resonance.

## 4. Conclusion and Recommendation

It is an essential measure to implement the "Three-wide Education" by integrating the ideological and political education into the specialized courses. On the one hand, it can help students develop a correct view of life and values as well as stimulate students' sense of responsibility, mission, and patriotism by utilizing the platform of specialized courses for ideological and political education; on the other hand, the rich ideological and political education elements and the deft introduction can also increase the student's interest and impact the study of specialized courses in various ways. One such organic combination of teaching and ideological and political education creates a synergistic effect of "1+1>2".

Nowadays, more and more teachers devoted to the construction of ideological and political education in the specialized courses, however the teaching effects are still unknown. As is known to all, teaching assessment is an indispensable link in the teaching-learning activities, which can promote the refinement and improvement of teaching

effects continuously. Therefore, it is necessary to focus on the assessment of ideological and political education in specialized courses. The key to assess the teaching effects of ideological and political education is to examine students whether or not to achieve "unity of knowledge and practice". Based on this, the teachers can track down the students' behaviors continuously and record the students' feedback by various interactive assignments through information technology method. However, it is noteworthy that any goal of morality education can not be accomplished at one stroke, which requires a long time. Therefore, an effective multiple assessment index system is necessary to be established and will play a guiding role in the development of ideological and political education.

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