

Exploration on Ideological and Political Elements in the Course of Basic Principles of Steel Structure

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Abstract

This paper takes the core course 'Fundamentals of Steel Structures' in the Civil Engineering major as a research object, and, based on the course's own characteristics of engineering, practicality, and standardization, systematically explores the ideological and political elements contained in the course, including patriotism, craftsmanship, scientific thinking, professional quality, and engineering ethics. It analyzes the prominent problems in the current teaching of ideological and political education in the course and proposes a four-in-one deepening path of 'theoretical foundation, case empowerment, methodological innovation, and evaluation safeguarding.' Combined with teaching practice, it constructs a practical and verifiable system for ideological and political education, providing theoretical reference and practical models for the reform of ideological and political education in civil engineering courses, and contributing to the cultivation of high-quality applied engineering talents who possess both professional competence and national sentiment.

Keywords

Ideological and political education in courses; Basic principles of steel structures; Civil engineering; Fostering virtue through education; Teaching reform.

1. Introduction

Since December 2016, when General Secretary Xi Jinping proposed the educational concept that 'all types of courses should be aligned with ideological and political theory courses to create a synergistic effect,' universities across the country have been actively carrying out reforms and practices in ideological and political education through courses.^[1] In February 2020, the Ministry of Education issued the "Key Points of Work for 2020 by the Department of Higher Education of the Ministry of Education" (Document No. JGSIH [2020] 1), which emphasized that 'the educational functions of all courses should be fully utilized, and the ideological and political education content inherent in each course should be deeply explored.'

In April 2024, at the 2024 National Conference of Directors of Higher Education hosted by the Department of Higher Education of the Ministry of Education and organized by the Anhui Provincial Department of Education and Anhui University, Zhou Tianhua, Director of the Department of Higher Education of the Ministry of Education, gave a speech titled 'Accelerating the Reform and Innovation of Higher Education, Fully Improving the Quality of Training Top-notch Innovative Talents,' in which he deployed the main tasks for 2024 focusing on building a high-quality higher education system. He emphasized the deep advancement of ideological and political courses, integrating Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era throughout the entire education and teaching process, as a main line of work.

As the hope and future of our country and nation, college students demand universities to keep focused on the core educational mission: who we train, how we train them, and for what purpose we train them, while steadily promoting ideological and political education for

undergraduates.^[2] Civil engineering is a core discipline that supports national infrastructure construction and is directly related to national development, people's well-being, and public safety. As a core foundational course for the civil engineering major, "Fundamentals of Steel Structures" combines both theory and practice, covering essential content such as materials, connections, and component design. It is not only a key course for cultivating students' engineering design abilities and construction management skills but also an important vehicle for integrating ideological and political education and shaping students' correct values. As the future main force in national infrastructure construction, college students' professional competence, professional spirit, and sense of national responsibility directly affect project quality and industry development. Therefore, university professional course teachers must not only be proficient in their specialized knowledge but also improve their political theory level, fully explore the ideological and political elements in professional courses, and integrate value shaping, knowledge imparting, and ability cultivation.^[3] Based on the teaching practice of the "Fundamentals of Steel Structures" course in the Civil Engineering program at Anhui Xinhua University, this paper systematically explores the identification of ideological and political elements in the course, integration pathways, and practice deepening, to provide a reference for the reform of ideological and political education in similar courses.

2. Course Introduction

2.1. Basic Course Information

As a core foundational course for undergraduates majoring in Civil Engineering at Anhui Xinhua University, Fundamentals of Steel Structures is delivered in the junior fall semester with a total of 40 teaching hours, consisting of 36 hours of classroom lectures and 4 hours of lab experiments. It serves as an essential bridge between prior courses like Three Major Mechanics and Civil Engineering Materials and subsequent courses such as Steel Structure Design and Building Construction Technology. The main content of the course includes the properties and selection of steel materials, steel structure connections (welding, bolted connections), axially loaded members, bending members, axial-bending and tension-bending member performance and design principles, as well as fatigue calculation and anti-corrosion design of steel structures. The core objective is to cultivate students' mastery of basic steel structure design methods, develop their engineering practical analysis abilities, and establish a correct engineering concept.

The inherent characteristics of the course create natural advantages for the integration of ideological and political education. First, it boasts strong engineering practicality. Closely integrated with real-world engineering projects, the course content enables the infiltration of national sentiment and professional responsibility through typical engineering cases. Second, it features prominent standardization. Covering multiple national codes including the Standard for Design of Steel Structures (GB 50017-2017), the course helps strengthen students' awareness of rules and the concept of the rule of law; third, innovation is significant, as the iterative upgrades in steel structure technology (such as prefabricated steel structures and the application of BIM technology) can stimulate students' innovative thinking; fourth, this discipline demands extreme preciseness. Precise design of structural members and calculation analysis are critical to engineering safety, serving to foster students' dedication to craftsmanship and sense of mission.

2.2. The Role of Ideological and Political Education in the Curriculum

In light of the training goals for civil engineering majors and the unique features of this course, the core ideological and political teaching orientation of Fundamentals of Steel Structures can be defined as follows: taking specialized expertise as the medium and value-oriented education

as the central focus, guided by the talent training tenet of “building the nation via engineering practice”, we embed ideological and political elements into every segment of classroom teaching. The ultimate goal is to nurture students equipped with four key competencies:

1. A profound sense of patriotism, inspiring them to hold firm ideals and convictions to devote themselves to national infrastructure development;
2. Sound professional ethics, cultivating a meticulous, practical, devoted and perfection-seeking craftsman spirit;
3. Scientific attainment, including logical scientific thinking, innovative consciousness, and the capacity to tackle complicated engineering challenges;
4. Moral awareness in engineering, which requires students to abide by engineering ethical norms and always put people’s lives and property safety in the first place.

The educational goals of moral and ideological education are organically integrated with the professional teaching objectives, forming a trinity teaching objective system of 'knowledge objectives, ability objectives, and quality objectives': The knowledge objective is to master the basic principles and design methods of steel structures; the ability objective is to possess skills in component design, experimental operations, and engineering case analysis; the quality objective is to cultivate patriotism, craftsmanship, professional responsibility, and engineering ethics, achieving the simultaneous enhancement of 'learning knowledge, practicing abilities, and fostering character.'

3. Current Teaching Situation of Ideological and Political Education in the Basic Principles of Steel Structure Course

In traditional teaching, professional instructors often focus more on the training and imparting of professional knowledge and business skills, but rarely guide students' values correctly in combination with the future industry development needs under the background of the new engineering discipline [4-5]. Currently, the course 'Fundamentals of Steel Structures' still faces the following problems in the construction of ideological and political education within the course:

3.1. Insufficient attention, lack of systematic design in the integration of ideological and political education

Currently, some instructors still adhere to the traditional teaching concept of 'focusing on the major while neglecting ideological and political education,' believing that the core task of courses is to impart professional knowledge and skills, while ideological and political education is the responsibility of teachers of ideological and political courses. In course syllabi, the inclusion of ideological and political elements is only vaguely stated, without setting specific goals, points of integration, or implementation methods based on the course content, resulting in a fragmented and arbitrary integration of ideological and political education—often merely mentioned briefly when explaining engineering cases, without being deeply integrated with professional knowledge, making it difficult to achieve the subtle and pervasive educational effect. In addition, in course training plans, the time for theoretical teaching is tight and the content is heavy, so teachers, in order to complete professional teaching tasks, often neglect the systematic integration of ideological and political elements, further exacerbating the disconnection between ideological and political education and professional teaching.

3.2. Faculty competency is inadequate, and instructors lack targeted professional instructions to embed ideological and political content into course teaching

Instructors of specialized courses act as the primary participants in developing curriculum-based ideological and political education. Their comprehensive ideological attainment and instructional competence exert a decisive influence on the effectiveness of embedding ideological and political elements into professional teaching. Currently, all educators delivering Fundamentals of Steel Structures have a sound command of domain expertise, yet notable gaps exist in their ideological and political cultivation, which are reflected in three aspects: First, their mastery of political theories remains inadequate. Without thorough systematic learning of Marxist theories and Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, they fail to fully comprehend the core implications and implementation standards of curriculum ideological and political education. Second, they are deficient in the capacity to realize organic curriculum ideological integration. Lacking practical techniques to naturally weave value-oriented elements into specialized teaching content, many instructors adopt rigid, blunt addition of ideological materials. This disjointed mode separates value guidance from professional knowledge, and even triggers negative feedback among students. Third, most teachers lack the initiative to conduct research on curriculum ideological and political teaching. Few take part in relevant training programs or academic studies on course-based moral education. As a result, they cannot dig out the profound value connotations matching the features of steel structure courses, which limits the depth and coverage of ideological penetration in classroom teaching.

3.3. Teaching methods are monotonous, and the integration of ideological and political education lacks appeal and effectiveness

Currently, ideological and political education in courses still mainly follows the traditional model of 'classroom lectures and case mentions,' with relatively single teaching methods, lacking innovation and interactivity. On the one hand, teachers mostly explain ideological and political elements in engineering cases verbally, lacking visual and immersive teaching methods, making it difficult to stimulate students' learning interest; on the other hand, there is a lack of interactive and inquiry-based teaching design, and students are mostly in a passive receiving state, making it difficult to actively think about the internal connection between ideological and political elements and professional knowledge, resulting in ideological and political education being merely formal and unable to truly internalize into students' values and behavioral habits. In addition, in the experimental teaching sessions, there is much focus on the standardization of experimental operations and data processing, without fully exploring the ideological and political elements in the experimental process (such as rigor and teamwork), resulting in insufficient coverage of ideological and political integration.

3.4. The evaluation system is imperfect, and the ideological and political education lacks effective feedback

Currently, the assessment of the 'Fundamentals of Steel Structure' course still focuses on 'knowledge assessment' as the core, using the 'usual performance (40%) and final exam score (60%)' assessment model: the usual performance mainly consists of experimental and homework completion, without involving the evaluation of ideological and political literacy; the final exam score mainly tests professional theoretical knowledge and engineering calculation ability, without reflecting the mastery of ideological and political elements and educational effects. Such a monotonous evaluation system fails to offer sufficient incentives for both faculty and learners to attach importance to curriculum ideological and political integration. On the one hand, instructors lack internal drive to carry out value-oriented teaching activities; on the

other hand, students have no subjective awareness to take the initiative to upgrade their ideological and political accomplishment. Meanwhile, the absence of a full-cycle feedback system for evaluating the outcomes of moral education embedded in courses prevents educators from timely grasping how students perceive ideological and political content as well as shifts in their value systems. Consequently, educators cannot adjust and refine ideological teaching plans with clear pertinence.

4. In-depth Exploration and Systematic Integration of Ideological and Political Elements in the Basic Principles of Steel Structure Course

This teaching method integrates chapter contents of Fundamentals of Steel Structures and real engineering traits, breaking away from the random extraction pattern of curriculum ideological materials. It systematically excavates value education points covered in each chapter along five dimensions: national sentiment, craftsmanship, scientific logic, professional proficiency and engineering ethics. Through accurate matching and categorized integration of ideological resources and domain expertise, it makes curriculum-based ideological education well-grounded, substantial and far-reaching (see Table 1).

Table 1. Classification of Ideological and Political Elements in the Basic Principles of Steel Structure Course and Corresponding Integration Table

Category of ideological and political elements	Corresponding course chapter	Core integration point	Educational Goals
Patriotic sentiment	Overview of Steel Structures, Steel Structure Materials	Major national steel structure projects and steel industry development	Inspire national pride and establish the belief in serving the country through engineering
Craftsman spirit	Steel structure connections, experimental teaching, course design	Construction process quality control, standard experimental operations, design detail optimization	Cultivate a rigorous and practical attitude, and a pursuit of excellence
Scientific thinking	Steel structure materials, steel structure connections, component design	Steel technology innovation, advanced technology application, tracking research frontiers	Inspire innovative awareness, cultivate scientific thinking and innovative ability
Professionalism	Component mechanical performance and code application	Engineering Accident Case Analysis, Compliance with National Standards	Strengthen professional responsibility by loving and being dedicated to one's job and performing duties conscientiously
Engineering Ethics	Design of bending members, design of corrosion protection for steel structures	Design plan optimization, balancing environmental protection and safety	Uphold the ethical bottom line in engineering and assume social responsibility

5. Exploration on Deepening the Integrated Ideological and Political Education Mode in the Fundamentals of Steel Structures Course

Teaching objectives occupy the core status and represent the soul of instructional work, which guides all instructional procedures throughout the whole teaching process [6]. To tackle the existing drawbacks within curriculum-based ideological and political education, and based on the excavation and fusion of ideological-political resources, this research establishes an integrated four-dimensional improvement framework consisting of "laying theoretical underpinnings, enriching case-driven instruction, updating teaching modes, and perfecting assessment guarantee mechanisms". This framework aims to facilitate thorough amalgamation between ideological and political cultivation and specialized professional courses, so as to boost educational outcomes. Combined with the practical teaching experience of Civil Engineering majors at Anhui Xinhua University, the detailed implementation schemes are illustrated below:

5.1. Theoretical Foundation: Improving the Design of the Curriculum Ideological and Political Teaching System

First, revise the course syllabus by incorporating the ideological and political education objectives into the overall teaching goals of the course. Combine these with the content of each chapter to clearly define the ideological and political integration points, methods of integration, and educational requirements for each lesson, forming a three-dimensional teaching system of 'chapter knowledge - ideological elements - educational goals.' For example, in the chapter 'Overview of Steel Structures,' the ideological integration point is 'cases of major national projects,' the integration methods are 'case explanations and group discussions,' and the educational goal is 'to inspire patriotism.' In the chapter 'Steel Structure Connections,' the ideological integration point is 'welding quality control and craftsmanship spirit,' the integration methods are 'process demonstrations and case analysis,' and the educational goal is 'to cultivate a rigorous and pragmatic professional quality.'

Secondly, develop supporting teaching resources for curriculum ideological and political construction. Teachers need to match disciplinary knowledge with value-oriented educational points, and supplement auxiliary materials covering landmark national infrastructure projects, role models of skilled craftsmen, and typical engineering failure cases. This way, value education can be seamlessly blended with specialized expertise instead of being mechanically embedded. Take the chapter of axially loaded member design as an illustration: instructors may cite the steel member design practice of the Hong Kong-Zhuhai-Macao Bridge. While elaborating the design theories and calculation approaches for structural members, teachers can pass on engineers' perseverance in tackling technical obstacles and relentless pursuit of high-quality works, thus realizing the synchronous transmission of professional expertise and moral education.

Thirdly, boost the development of teaching teams and upgrade instructors' ideological and political accomplishment as well as instructional competence. The college should arrange regular training sessions and academic forums on curriculum-based ideological and political education for course teachers. It can also invite teachers of ideological and political theory courses together with industrial specialists to deliver special lectures, so as to guide faculty members to dig out value-education resources and formulate targeted lesson plans featuring ideological and political integration. Meanwhile, educators should be motivated to conduct relevant research on curriculum ideological and political construction for the advancement of their teaching research capacity. A joint lesson-preparation system uniting professional faculty and ideological-political teachers shall be built to collectively develop diversified integration strategies, which guarantees that the combination of professional teaching and value education remains professionalized and well-targeted.

5.2. Case Empowerment: Building a 'Positive and Negative' Case Teaching System

Case-based teaching is an effective vehicle for integrating ideological and political education, constructing a dual case teaching system of 'positive cases and negative cases,' and enhancing the appeal and persuasiveness of ideological and political education.

Positive examples focus on major national projects and outstanding engineering cases, conveying positive energy. For instance, when explaining the 'application of steel structures,' the construction process of the Hong Kong-Zhuhai-Macao Bridge (Figure 2) steel structure project is described in detail—engineers overcame technical difficulties such as marine environment corrosion and strong typhoons, independently developed high-strength steel and new welding technologies, achieving a technological breakthrough in steel structure engineering, guiding students to learn the engineers' patriotism, innovative spirit, and sense of responsibility. When explaining 'prefabricated steel structures,' take Huoshenshan and Leishenshan Hospitals as examples, introducing the advantages of prefabricated steel structures as 'quick to assemble and environmentally friendly,' showcasing China's capability in steel structure technology and the advantages of the national system, inspiring students' national pride.



Figure 1. Hong Kong–Zhuhai–Macao Bridge



Figure 2. Xinjia Hotel steel structure collapse

Reverse cases mainly focus on engineering accident cases, reinforcing education on professional responsibility. For example, when explaining 'brittle failure of steel structures,' a detailed analysis of the Quanzhou Xinjia Hotel steel structure collapse (Figure 2) is presented — causes including design violations, substandard construction, and inadequate management, guiding students to deeply realize the importance of 'respecting standards and upholding responsibility,' and to establish an engineering philosophy of 'safety first, quality above all.' When explaining 'bolted connections,' a case of collapse caused by loose bolts in a steel structure factory building is discussed, emphasizing the importance of quality control in bolted connections and cultivating a rigorous and practical professional attitude in students.

At the same time, organize students to carry out case discussions, focusing on the ideological and political elements and professional knowledge in the cases, guiding students to think actively and speak positively, and internalize the values in the cases as their own code of conduct. For example, in the case of the construction of the Hong Kong-Zhuhai-Macao Bridge, organize students to discuss 'As future engineering and technical personnel, how should we base ourselves on our profession and serve the country,' further strengthening students' belief in contributing to the nation through engineering.

5.3. Method Innovation: Enriching the Implementation Forms of Ideological and Political Education

Break the limitations of traditional teaching models, combine the characteristics of the course with students' cognitive patterns, innovate ideological and political teaching methods, and enhance the attractiveness and interactivity of teaching.

First, adopt a 'online-offline' integrated teaching model. Offline classes mainly focus on professional knowledge lectures, interspersed with ideological and political case explanations, group discussions, craft demonstrations, and other segments; online, platforms such as Xuexitong and MOOCs are used to upload videos of ideological and political cases, deeds of outstanding craftsmen, cutting-edge industry technologies, and other materials, and assign online discussion questions (such as 'How to understand the professional responsibility of engineering technicians'), guiding students to independently study in their spare time and expand the coverage of ideological and political education.

Second, strengthen the integration of ideological and political education in practical teaching. In the experimental teaching sessions, integrate ideological and political elements throughout the entire experiment process: before the experiment, emphasize experimental norms and safety awareness to cultivate students' sense of responsibility; during the experiment, require students to operate rigorously and record precisely to cultivate students' craftsmanship spirit; after the experiment, organize students to analyze the causes of experimental errors to cultivate scientific thinking and problem-solving abilities. In the course design sessions, set themes such as 'Green Steel Structure Design' and 'Prefabricated Steel Structure Design' to guide students to consider technical feasibility, economic benefits, and social benefits, thereby strengthening engineering ethics education.

Third, various curriculum ideological and political practice activities should be launched. Organize students to visit steel structure construction sites and invite frontline engineers to explain construction processes and their professional experiences, which enables students to gain an immersive understanding of craftsmanship and professional accountability; hold a 'Steel Structure Innovative Design Competition' to encourage students to carry out innovative designs by combining cutting-edge industry technologies and stimulate students' innovative awareness; organize students to participate in volunteer services (such as infrastructure safety promotion) to strengthen their sense of social responsibility.

5.4. Evaluation Escort: Building a Diversified Ideological and Political Education Evaluation System

Establish a diversified ideological and political education evaluation system of 'formative assessment, summative assessment, and feedback assessment,' break the assessment model of 'emphasizing knowledge over literacy,' and achieve that quantifiable results and timely feedback of curriculum ideological education.

First is process evaluation (accounting for 40%), which mainly examines students' ideological and political performance in classroom learning, experimental operations, course design, and group discussions, including aspects such as patriotism, craftsmanship spirit, sense of responsibility, and teamwork. For example, in classroom discussions, students' quality of

speech and value orientation are evaluated; in experimental operations, students' standardized operations and rigorous attitudes are evaluated; in course design, students' design concepts and ethical awareness are evaluated.

Secondly, summative assessment (accounting for 30%) is conducted in conjunction with the final exam. Political and ideological questions are added to the exam paper, such as analyzing engineering cases to address topics like "the professional qualities that engineering technicians should possess" and "how to uphold engineering ethics in steel structure design," in order to assess students' understanding and mastery of political and ideological elements, as well as the formation of their values.

The third component is feedback evaluation, which accounts for 30% of the total assessment weight. By adopting assessment approaches including questionnaire surveys, student in-depth interviews and peer evaluation among faculty, this module can figure out how well students accept curriculum-based ideological and political education, track shifts in their value concepts, and measure the actual effects of teachers' value-oriented instruction. It gathers feedback and proposals in a timely manner so that targeted adjustments can be made to the ideological and political teaching schemes. To illustrate, student questionnaires will be distributed upon the completion of every semester to measure learners' satisfaction with moral education cases and instructional modes. According to the collected feedback data, instructors will revise course contents and implementation approaches correspondingly.

6. Teaching Practice Effects and Reflection

6.1. Teaching Practice Effect

Drawing on practical experience of integrating ideological and political education into the Fundamentals of Steel Structures course for 2022 and 2023 civil engineering undergraduates of Anhui Xinhua University, the adoption of the aforesaid promotion paths has achieved a remarkable improvement in moral cultivation effectiveness within professional courses: First, students' ideological and political literacy has improved significantly. Survey data demonstrate that more than 90% of students stated that through the course study, they enhanced their patriotic feelings and sense of professional responsibility, and established a rigorous and pragmatic learning attitude and craftsmanship spirit; second, students' professional and innovative abilities have been enhanced. In course design and innovation competitions, students are able to integrate ideological and political concepts and design works that combine technical feasibility with social value, and some students' design proposals have won university-level awards; third, teachers' ability to teach ideological and political education has significantly improved. Most teachers are able to skillfully identify ideological and political elements, design reasonable ideological and political teaching plans, and achieve a deep integration of ideological and political education with professional teaching.

6.2. Existing Shortcomings and Reflections

Especially some positive outcomes generated by curriculum ideological and political construction, multiple defects still exist. First, insufficient depth can be found in the mining of ideological resources; the combination of these resources and specialized knowledge remains loose and forced in partial chapters. Second, teaching approaches are in urgent need of innovation. Digital ideological teaching materials are inadequate, and their interactive functions have room for improvement. Third, the operability of the ideological assessment system needs upgrading. Vague formative evaluation criteria hinder the precise quantification of students' ideological and political attainment.

To address the above shortcomings, future efforts will focus on optimizing from three aspects: first, continuously deepen the exploration of ideological and political (IAP) elements,

combining industry development and engineering practice, constantly enriching IAP materials, and promoting the deep integration of IAP elements with professional knowledge; second, strengthen the construction of online IAP teaching resources, develop high-quality IAP videos, case libraries, and other resources, innovate online interactive teaching methods, and enhance teaching appeal; third, refine IAP evaluation standards, improve the assessment indicators for process-oriented evaluation, enhance the operability and scientific nature of the evaluation system, and ensure that the educational effects of IAP are effectively realized.

7. Conclusion

The construction of ideological and political education in the course "Basic Principles of Steel Structure" serves as a vital strategy to fulfill the core mission of moral education and to cultivate high-quality civil engineering talents. This paper systematically analyzes the current situation and deep-seated issues in ideological and political education within the course, and deeply explores the ideological and political elements embedded in the course from five dimensions: patriotism, craftsmanship, scientific thinking, professional quality, and engineering ethics. It constructs a four-in-one deepening path of "theoretical foundation, case empowerment, methodological innovation, and evaluation safeguard," and its practicability and effectiveness have been validated through practical teaching implementation.

The construction of ideological and political education in courses is a long-term and systematic project. It requires teachers to continuously improve their ideological and political literacy and teaching abilities, consistently optimize the teaching system and implementation paths, and break the barrier between value-oriented cultivation and specialized instruction, attaining an organic integration of 'knowledge imparting, ability cultivation, and value shaping.' In the future, we will continue to align with the development needs of the civil engineering industry and the cultivation goals of students, deepen the reform of ideological and political education in courses, enrich the forms of integration, and enhance the effectiveness of education, in order to cultivate more high-quality engineering and technical talents with both professional competence, patriotism, and professional ethics, providing talent support for the development of infrastructure construction in our country.

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