

Integration and practice of ideological political elements in civil engineering management courses under the carbon peak and carbon neutrality goals in China

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Abstract: It is essential to incorporate moral education and promote the high-quality development of civil engineering management talent cultivation to effectively construct curriculum thinking and politics under the carbon peak and carbon neutrality goals ("dual carbon" goals). Through a comprehensive analysis of the new characteristics of the ideological and political thinking of civil engineering management courses under the "dual carbon" goals, we have identified the key elements to integrate ideological and political concepts into civil engineering management courses. In particular, we have focused on the civil engineering management course "urban ecology and urban environmental protection" as an example of how to optimize the integration of ideological and political elements in civil engineering management courses under the "dual carbon" goals. Which provides a reference to improving the quality of talent training in civil engineering management.

Keywords: "dual carbon" goals, civil engineering management, curriculum ideological and political, integration and practice

1. Introduction

According to the "Research Report on Building Energy Consumption and Carbon Emissions in China (2022)," the construction and building sector in China accounted for a significant portion of the country's energy consumption and carbon emissions. In 2020, the sector's energy consumption was 2.27 billion metric tons of standard coal, representing 45.5% of the country's total energy consumption. The sector's carbon emissions in the same year were 5.08 billion metric tons of carbon dioxide, accounting for 50.9% of the national carbon emissions [1]. These figures highlight the importance of the construction industry in achieving carbon peak and carbon neutrality goals.

For the field of civil engineering management, the call to reduce carbon emissions and achieve carbon neutrality presents new challenges and opportunities. To meet these demands, the development of the civil engineering management profession must keep pace with the times and adapt to the future development of the construction industry [2-5]. This requires exploring the integration of ideological and political education in the curriculum of civil engineering management and the development of the carbon peak and carbon neutrality goals. By integrating ideological and political education into the curriculum of civil engineering management, we can promote the fundamental task of fostering virtues and talents while improving the quality of civil engineering management talent cultivation. This innovative approach is a significant measure to implement the Party's educational policies and support the construction industry's accelerated greening transformation.

2. "Dual carbon" goals pose challenges to the field of civil engineering management

According to the "14th Five-Year Plan for the Development of the Construction Industry" and the "14th Five-Year Plan for Energy Conservation and Green Building Development in the Construction

Industry", the construction industry needs to continuously improve building efficiency, vigorously promote the green and low-carbon transformation of the construction industry, and accelerate the synergistic development of intelligent construction and new building industrialization [6-10]. Therefore, under the carbon peak and carbon neutrality goals, the challenges faced by the field of civil engineering management can be summarized into two aspects: external and internal factors. (1) Deep integration of engineering construction and management with the new generation of digital information management technologies. In traditional talent development programs and curriculum designs for civil engineering management, the integration between engineering construction courses and civil engineering management courses with digital information management technologies is not profound, and the course structures are relatively independent. However, in the context of carbon peak and carbon neutrality, the new generation of digital information management technologies has penetrated every aspect of construction and management, including architectural design, material selection, construction, schedule control, and quality control, to achieve established project management goals and energy-saving environmental objectives. The deep integration and interdependence between these aspects are essential. (2) Increasing demand for highly skilled and versatile engineering and management professionals. The gradual application of emerging green construction and low-carbon energy technologies, such as prefabricated buildings, passive buildings, 3D printing, BIM, photovoltaic building integration, heat recovery, and air suspension systems, as well as the development of emerging low-carbon building management systems like IBUILDING carbon management system and Haier's intelligent building low-carbon management platform, has led to a growing objective demand for highly skilled and versatile engineering and management professionals in the field of civil engineering management. The existing single-track talent development system can no longer meet the characteristics of the era where the construction industry is transitioning towards green and low-carbon development under the carbon peak and carbon neutrality goals.

3. Under the "dual carbon" goals, the ideological and political education in civil engineering management courses exhibits new characteristics

Coordinating and advancing the integration of ideology and politics into the curriculum is a strategic measure to nurture and cultivate individuals with the spirit of thoughts on Socialism with Chinese Characteristics for a New Era. It serves as an effective approach for universities to fulfill the fundamental educational task of fostering students' moral character and personal development. Meanwhile, the "dual carbon" goals have placed the construction industry at the forefront of a significant technological, material, standard, and management revolution. Therefore, under the "dual carbon" goals, the construction of ideological and political education in civil engineering management courses has also presented new opportunities, changes, and characteristics.

3.1. New opportunities: Accelerated greening of the construction industry

China, as a renowned infrastructure powerhouse with the largest construction scale in the world, is set to make significant investments in green and low-carbon industries, including energy, industry, transportation, construction, and agriculture, reaching a total of 150 trillion yuan by 2050, with the construction industry accounting for 15% [11-13]. The construction industry in China will closely follow the pace of the green and low-carbon development wave, ushering in a critical window of opportunity for the green transformation and development of the entire industry chain, including building materials, design, construction, and facilities [14]. Therefore, ideological and political education in civil engineering management courses will encounter favorable opportunities under the carbon peak and carbon neutrality goals.

3.2. New changes: Refinement, complexity, and high integration

The actual transformation and development of the entire construction industry chain towards low carbon are characterized by continuous innovation in construction materials, construction techniques, and management methods. This includes the refinement of whole-process project management and the deep integration of the "three major goals" of civil engineering management with the green and low-carbon objectives. Therefore, under the carbon peak and carbon neutrality goals, there will be new changes in the talent training programs, ideological and political education system, and evaluation methods in civil engineering management, requiring adjustments towards refinement, complexity, and high integration.

3.3. New features: Deepening digitization and informatization

The construction industry serves as both the carrier of digital technology innovation and a major source of carbon emissions. Currently, digitization has become an important engine driving the achievement of the "dual carbon" strategic goals in the construction industry. Nowadays, more and more construction companies are compelled to integrate digital technology into aspects such as safety, quality, and progress, completing digital transformation and upgrading to achieve low-carbon environmental protection. Therefore, the talent training programs and curriculum systems in civil engineering management need to be adjusted to keep pace with the times and align with digitization and informatization.

4. The integration approach of ideological and political elements in the civil engineering management curriculum under the "Dual Carbon" Goals

Under the "dual carbon" goals, the integration of ideological and political elements into the curriculum of civil engineering management courses presents new opportunities, changes, and characteristics. Traditional experiences and methods are now constrained. Therefore, it is crucial to update, integrate, and optimize the ideological and political education in civil engineering management courses to cultivate talents who embody the spirit of craftsmanship, national pride, and high-quality engineering technology and management capabilities that are aligned with the development of the times. This integration approach can be manifested in the following aspects.

(1) Give full play to the leading role of ideological and political education in the talent cultivation program of civil engineering management.

Under the "dual carbon" goals, the construction industry is in a crucial period of accelerating green transformation throughout the entire industry chain. The construction of ideological and political education in civil engineering management courses is facing unprecedented opportunities. The "dual carbon" goals have added new content to the talent cultivation objectives in civil engineering management. Students not only need to grasp theories and methods related to green construction, such as BIM, Internet of Things (IoT), and green construction technologies but also need to deeply integrate the concept of green and sustainable development into every aspect of engineering construction and management. This requires fully leveraging the leading role of ideological and political education in the talent cultivation program of civil engineering management and aligning the overall curriculum layout with the guiding principles of "whom to cultivate, what kind of talents to cultivate, and how to cultivate" when formulating the cultivation objectives. In terms of course offerings, in addition to the core compulsory courses in civil engineering management, elective courses should be inclined towards the "dual carbon" goals and the directions that are urgently needed for national and industry development. In textbook selection, it is important to keep up with the times by updating the textbooks and prioritizing the use of excellent domestic

(2) Strengthen the role of ideological and political education as a link in the teaching of civil engineering management courses.

The accelerated implementation of the "Dual Carbon" strategic goals serves as the driving force behind the green development of the entire construction industry chain. Seizing this opportunity, it is important to strengthen the role of curriculum ideology and establish an organic connection between curriculum ideology and the "Dual Carbon" goals. For instance, in engineering case studies, examples such as the construction of the Huoshenshan Hospital in 10 days and the sustainable construction of the Xiaotiancheng building in 19 days demonstrate China's remarkable architectural capabilities and the concept of "China's speed." Taking students to visit the Wuhan Citizen's Home allows them to gain a direct understanding of the technical means of green building and experience the charm of green architecture, evoking their resonance, inspiring their craftsmanship spirit, and igniting a strong sense of patriotism and national pride. By integrating the vivid achievements emerging from engineering projects, such as Lin Ming, the chief engineer of the Hong Kong-Zhuhai-Macao Bridge, who pursued a fulfilling life and pursued dreams, and Li Jianhua, the project manager of the Beijing Daxing International Airport terminal core area project, who overcame global challenges and filled technological gaps in domestic and international airport construction, students are presented with role models who exemplify the spirit of craftsmanship, perseverance, scientific exploration, innovation, and hard work. This encourages students to strive for excellence. In courses on construction laws and regulations, bidding, and engineering contracts, the principles of contracts and professional ethics should be consistently

emphasized. Additionally, by incorporating major international cooperation projects such as the Padma Bridge and river dredging projects, the Asmat Ali Khan Bridge, and the Saudi Aramco Yanbu Refinery, which are part of the Belt and Road Initiative, it showcases China's commitment and infrastructure capabilities in the new era, enhances students' sense of historical mission and national pride, and underscores the importance of complying with international engineering laws and mastering FIDIC contracts in international engineering projects.

(3) Promoting the Integration and Optimization of Curriculum Ideology and Professional Courses through the "Dual Carbon" Goals

The effective integration of ideological elements into professional courses has always been a challenge in curriculum ideology construction. The "Dual Carbon" goals impose comprehensive requirements on the field of civil engineering management, such as green construction technology, modern management techniques, green materials, informatization, and intelligence. These requirements call for students to construct a more comprehensive knowledge system and a "green" thinking framework. This provides a breakthrough for the deep integration of curriculum ideology and professional courses and enriches the entry points for curriculum ideology in professional courses. Moreover, diverse forms such as teaching practice sessions, academic competitions, internships, and innovation and entrepreneurship activities can be combined to incorporate curriculum ideology into every aspect of talent development. On the other hand, the "Dual Carbon" goals accelerate the updating and iteration of professional courses. By utilizing the latest construction, management, and innovation achievements in the field of engineering in our country, the integration level between curriculum ideology and professional courses can be sustainably promoted.

5. Examples of the integration and optimization of curriculum ideology and professional courses in the context of the "dual carbon" goals in civil engineering management

Civil engineering management is an interdisciplinary field that combines engineering and management disciplines. The professional courses involved in this field are broad, and each course has its unique elements and paths for curriculum ideology. Figure 1 depicts the teaching content and knowledge structure of the course "Urban Ecology and Urban Conservation" in the traditional teaching mode for civil engineering management courses. It can be observed that the knowledge points are relatively independent, and the logical structure between the contents is rather dry, resulting in low student engagement. The following example, seen in Table 1, will specifically illustrate the approach for integrating and optimizing curriculum ideology and professional courses under the "dual carbon" goals using this course as an illustration.

Table 1: Ideas for the construction of civil engineering management courses with "urban ecology and urban environmental protection" as an example

Teaching content	Main teaching methods and student skill enhancement points	Ideological and political education mapping points
Chapter 1: Fundamentals of ecology 1. The concept and development of ecology 2. Ecological factors and their roles 3. Population 4. Community 5. Ecosystem 6. Restoration of damaged ecological systems	The case study method involves using the documentary "The Mixed-Color Wolf" to discuss the relationships between population, community, and ecosystem with the students. Based on this, the concept of ecology, ecological factors, and their functioning principles are explained. Using the example of the "Kubuqi Miracle," the restoration of damaged ecological systems is taught. Skills enhanced: Critical thinking and expressive abilities.	Using the example of the "Kubuqi Miracle," students are encouraged to experience the scientific approach to desertification control, which emphasizes respect for nature and continuous innovation. This aims to inspire students' spirit of innovation and enhance their sense of national pride.
Chapter 2: Urban ecology 1. Cities and urbanization 2. Research content and development of urban ecology 3. Urban ecosystem 4. Structure and functions of urban ecosystems	Discussion-based teaching, case Analysis. Engage students in a discussion to explore the concept of a city and its constituent parts. On this basis, explain the research content and development of urban ecology. Utilize the example of Kangbashi, a grassland new city, to illustrate the structure and functions of urban ecosystems. Skills Enhanced: Transfer knowledge and analyze Problems.	Using "Xi'an" as an example, students are encouraged to experience the rich history and splendid culture of cities in China, fostering patriotism and a sense of national pride among students. Through analyzing the policies of the "Wuhan Retention Program" aimed at retaining millions of university students, students will gain a practical understanding of how Wuhan has created a better urban ecosystem to retain talents. Additionally, students will be encouraged to continuously strive for progress and work hard to become innovative professionals who can contribute to local economic and social development.
Chapter 3: Urban ecological planning	Case Study Method.	The development process of the Sino-Singapore Tianjin

<p>1. Overview of urban ecological planning</p> <p>2. Ecological city construction</p> <p>3. Ecological landscape city construction</p>	<p>Using the development of the Sino-Singapore Tianjin Eco-City as an example, teach students the specific content of urban ecological planning and ecological city construction. Using the creation of Wuhan as an ecological landscape city as an example, teach students about ecological landscape city construction.</p> <p>Skills enhanced: Summarizing and inductive thinking.</p>	<p>Eco-City illustrates to students the need for ecological city construction to adapt, innovate, and embrace the dual drive of "ecology + intelligence." This aims to cultivate students' awareness of innovation.</p> <p>Showcasing Wuhan's creation as an ecological landscape city, allow students to truly experience that each individual is a witness, participant, and practitioner of Wuhan's ecological civilization construction. Guide students to integrate personal growth with urban development.</p>
<p>Chapter 4: Urban environmental issues</p> <p>1. The concept and elements of the environment</p> <p>2. Environmental science</p> <p>3. Environmental issues</p> <p>4. Urban environmental</p>	<p>Case-based teaching, discussion-based teaching.</p> <p>The chapter adopts typical environmental cases to compare and explain environmental issues in the "early," "modern," and "contemporary" periods. Subsequently, students engage in group discussions and share their thoughts on environmental issues in Wuhan city and the measures taken to address them.</p> <p>Skills developed: Divergent thinking, comparative analysis, and expressive abilities.</p>	<p>By using typical domestic and international environmental case studies as a starting point, this chapter helps students gain a correct understanding that solving current ecological and environmental problems requires global cooperation and the establishment of a macro perspective of building a community with a shared future for humanity. It also aims to deepen students' understanding of China's national strategy of ecological civilization, the concept of green development, the "dual-carbon" goal, and the significance of building a "Beautiful China." Furthermore, it aims to enhance students' sense of national pride, historical mission, and a sense of being active participants in shaping their future.</p>
<p>Chapter 5: Urban Pollution and its prevention</p> <p>1. Air pollution and its prevention</p> <p>2. Solid waste pollution and its prevention</p> <p>3. Water pollution and its prevention</p> <p>4. Urban noise pollution and its prevention</p> <p>5. Other types of pollution and their prevention</p>	<p>Discussion-based teaching.</p> <p>In the form of small groups, each group selects a representative who will explain a specific type of urban pollution and its prevention methods on stage. The other groups will evaluate and score the performance of the presenting group. The teacher will provide comments, supplement information, and summarize the discussions. Following this, a discussion will be held on the topic of "dual-carbon" goals and our actions.</p> <p>Skills developed: Teamwork, public speaking, divergent thinking, and practical abilities.</p>	<p>Under the theme of "dual-carbon" goals and our actions, students will engage in discussions, develop practical action measures, and carry out post-class practices to enhance their practical abilities.</p>
<p>Chapter 6: Urban disasters and their prevention</p> <p>1. Overview of urban disasters</p> <p>2. Prevention of urban disasters</p> <p>3. Urban green spaces for disaster prevention and mitigation</p>	<p>Discussion-based teaching.</p> <p>First, students are asked to discuss the main types of disasters in cities. Then, an overview of urban disasters and their prevention methods will be presented. The important role of urban green spaces in disaster prevention and mitigation will be taught, focusing on the resilient city of Wuhan, including its emergency systems and disaster prevention and mitigation planning.</p> <p>Skills developed: Applied knowledge abilities.</p> <p>Case-based teaching, discussion-based teaching.</p>	<p>By exploring urban disasters, students will be encouraged to see themselves as future builders and managers of cities and recognize that "safety" is the lifeblood of cities and the foremost element in modern urban development. This will enhance students' sense of professional responsibility.</p> <p>By using examples such as "sponge city" construction and the "smart city disaster prevention and mitigation system," students will deeply appreciate the important role of professional knowledge, technological innovation, and effective management in addressing urban disasters. This will strengthen students' sense of professional pride.</p>
<p>Chapter 7: Urban green spaces</p> <p>1. Urban green spaces and urban ecology</p> <p>2. Functions of urban green spaces</p> <p>3. Types of urban green spaces</p> <p>4. Indicator system for urban green spaces</p>	<p>Using Wuhan's urban green space planning as an example, teach the concepts, classification, types, functions, and indicator systems for urban green spaces. Conduct group discussions on the relationship between urban green spaces and the urban heat island effect.</p> <p>Skills developed: Independent thinking and problem-solving abilities.</p>	<p>Using examples such as the ecological restoration of the Yangtze River shoreline and the transformation of old neighborhoods in Wuhan, guide students to closely align their personal development with the historical intersection of China's poverty alleviation and rural revitalization strategies, emphasizing the importance of their historical mission.</p>
<p>Chapter 8: Urban landscape ecology</p> <p>1. Landscape and landscape ecology</p> <p>2. Basic types of landscape elements</p> <p>3. Urban landscape patterns</p> <p>4. General principles of urban landscape ecology</p> <p>5. Urban landscape characteristics and planning</p>	<p>Case-based teaching.</p> <p>Begin by teaching the meaning of urban landscapes and the basic types of landscape elements. Then, using examples such as Suzhou Gardens, Xi'an, and Wuhan, analyze with students the characteristics and planning features of urban landscapes in different cities.</p> <p>Skills developed: Transfer of knowledge, and analytical abilities.</p>	<p>China is renowned as the "Mother of World Gardens," and by using "Suzhou Gardens" as an example, students can appreciate the ancient art of garden design, which combines human effort with the beauty of nature and embodies the meticulous craftsmanship of artisans. Simultaneously, students can transfer this knowledge to modern urban landscape design, emphasizing the importance of a people-centered approach and the values of harmonious coexistence between humans and nature. This cultivates a sense of patriotism, strengthens students' cultural confidence, and enhances their sense of national pride.</p>

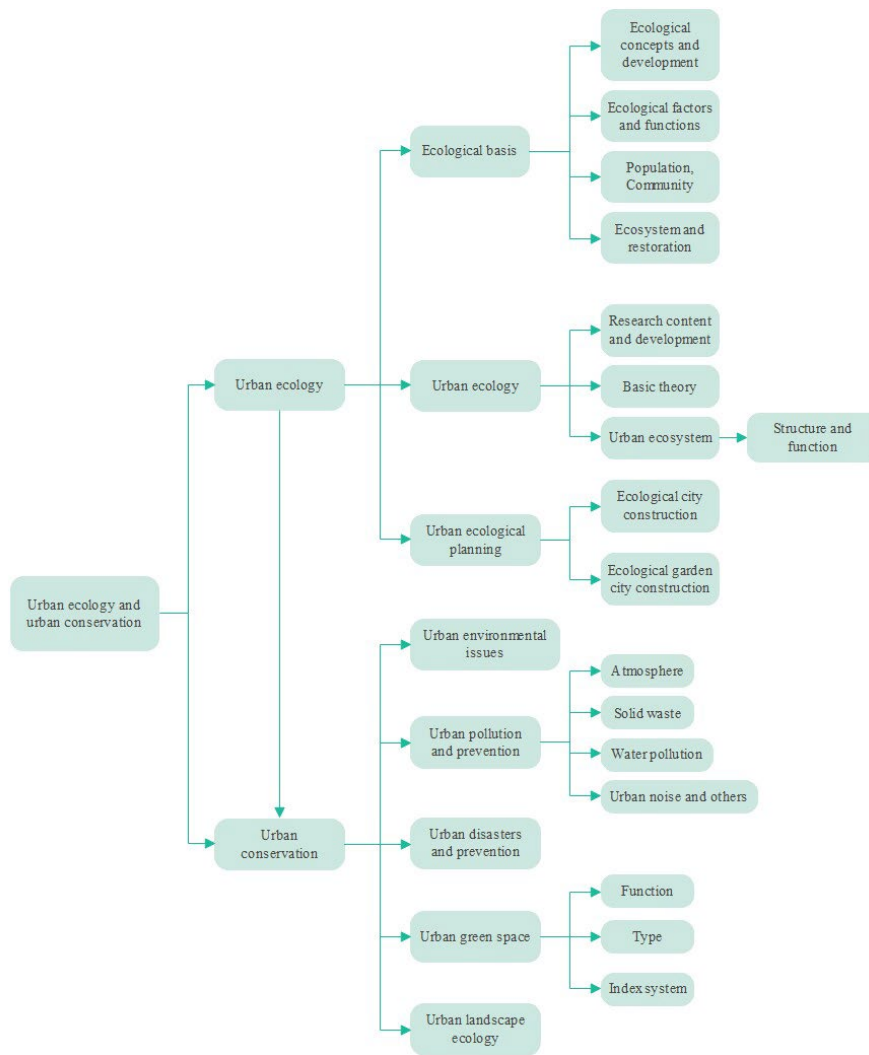


Figure 1: Urban ecology and urban environmental protection course content structure

6. Conclusions

Under the "dual-carbon" goals, the construction industry is facing a significant historical opportunity for accelerating green transformation and innovative development across the entire industry chain. Therefore, the field of civil engineering management is confronted with dual challenges, both internal and external. The construction of ideological and political education in civil engineering management courses presents new opportunities, changes, and characteristics. Ensuring the construction of ideological and political education in civil engineering management courses is an inherent requirement for implementing the goal of fostering virtue and talent and promoting the high-quality development of civil engineering management personnel. Therefore, it is essential for the field of civil engineering management to fully leverage the guiding and cohesive role of ideological and political education in talent cultivation. This entails deeply exploring ideological and political elements, promoting the integration of ideological and political education into professional courses, and the "dual-carbon" goals. By doing so, we can cultivate high-quality engineering and management personnel who can serve the nation's strategic needs.

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