The investigation and implementation of case-based teaching in Structural Mechanics within the context of curriculum ideological and political education

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Abstract: This paper investigates the innovative application of case-based teaching in Structural Mechanics within the framework of curriculum ideology and politics. It analyzes the importance and core values of ideological and political components in the curriculum while integrating them with the teaching features of Structural Mechanics, a case-driven teaching model incorporating ideological and political components is developed for the Mechanics chapter. The findings indicate that this teaching model significantly enhances students' mastery of professional knowledge while fostering their ideological and political awareness, providing a meaningful guide for incorporating ideological and political education into engineering courses.

Keywords: Curriculum ideological and political; Structural mechanics; Case teaching; Teaching reform

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Introduction

In the grand context of higher education reform in the new era, implementing the fundamental task of cultivating virtue and fostering talent has become an important goal, while curriculum ideological and political construction is regarded as a key measure. As a core course in civil engineering, Structural Mechanics is an ideal carrier for implementing curriculum ideological and political education, with strong theoretical foundations and prominent practical applications. However, traditional "Structural Mechanics" teaching often neglects knowledge transmission while emphasizing ideological and political education functions. Therefore, exploring case-based teaching models for "Structural Mechanics" under the background of curriculum ideological and political education is of great significance for achieving the organic unity of knowledge transmission and value guidance. This paper aims to construct a case-based teaching model for "Structural Mechanics" that incorporates ideological and political elements through theoretical analysis and practical exploration, providing reference for ideological and political construction in engineering courses.

1.The Connotation and Importance of Curriculum Ideological and Political Education

Curriculum ideological and political education refers to organically combining knowledge transmission with value guidance in professional course teaching, integrating ideological and political education elements to achieve their coordinated unity. It emphasizes integrating ideological and political education throughout the entire educational process, fully leveraging the educational function of various courses, but without simply attaching political labels[1-2]. The proposal of curriculum ideological and political education is based on new requirements for higher education in the new era, aiming to effectively implement the fundamental task of cultivating virtue and fostering talent through this important means.

In engineering education, curriculum ideological and political education is particularly important. Engineering majors typically focus on knowledge transmission and technical skill cultivation while easily neglecting the improvement of students' ideological and political qualities. To cultivate engineering and technical talents with both virtue and ability, curriculum ideological and political education in engineering can integrate content such as socialist core values, engineering ethics, and innovative spirit into professional teaching. This not only helps improve students' political and ideological awareness but also enhances their social responsibility and professional ethics, laying a solid foundation for future engineering practice.

2.Characteristics and Teaching Status of "Structural Mechanics" Course

"Structural Mechanics" is a core course in civil engineering, mainly studying the stress, deformation, and stability of engineering structures. This course has strong theoretical foundations, abstract concepts, and relatively complex calculations, thus placing high demands on students' mathematical and mechanical foundations. At the same time, "Structural Mechanics" is a highly practical course closely related to engineering practice, playing an important role in cultivating students' engineering thinking and practical problem-solving abilities.

In the teaching process, students generally report that studying structural mechanics is quite tedious and difficult, with low exam pass rates. Some students lack determination, have poor autonomous learning motivation, and develop learning aversion, which significantly impacts course teaching and brings great difficulties to teaching work. Therefore, in structural mechanics teaching, how to enhance students' understanding of the subject, stimulate their learning interest, and guide them to establish correct learning attitudes is particularly important. If ideological and political elements are skillfully integrated into the teaching process, it can not only provide positive guidance for students but also help cultivate correct life and value perspectives, shape qualities of hard work and perseverance, enhance students' independent thinking and practical problem-solving abilities, thereby optimizing teaching effectiveness and ensuring effective achievement of teaching objectives.

3.Practical Case: Using the "Force Method" Chapter as an Example

3.1 Mining Ideological and Political Elements

3.1.1 Patriotic Education

National Major Engineering Cases: When explaining the force method, major engineering cases in China that utilize force method principles for design and construction can be introduced, such as large bridges and high-rise buildings. For example, during the construction of the Hong Kong-Zhuhai-Macao Bridge, under the direction of chief designer Meng Fanchao who devoted 15 years[3,4], engineers used structural mechanics methods including the force method to analyze and design the bridge's statically indeterminate structure, ensuring the bridge's safety and stability. President Xi Jinping highly praised Meng Fanchao and the builders of the Hong Kong-Zhuhai-Macao Bridge: "The construction of the Hong Kong-Zhuhai-Macao Bridge has created many world records, which is extraordinary. It embodies a nation's fighting spirit of building roads through mountains and bridges over water, reflects our country's comprehensive national strength and independent innovation capability, and demonstrates the national aspiration to create world-class achievements."[5] This great project fully demonstrates China's strong capabilities in infrastructure construction, enabling students to deeply feel the country's development and progress, gain further understanding of the Party's innovative theories, achieve political, ideological, and emotional recognition, and strengthen their confidence in the "four confidences" of socialism with Chinese characteristics.

Historical Architecture Heritage: Introduce the mechanical wisdom embedded in ancient architecture, such as China's ancient mortise and tenon structures. Although ancient times lacked modern force method theory, craftsmen achieved structural stability and reasonable force distribution through long-term practice and accumulated experience. Combining ancient architectural wisdom with modern force method theory allows students to understand the Chinese nation's long architectural culture and mechanical wisdom, inspiring students' national pride and spirit of inheritance and innovation.

3.1.2 Craftsman Spirit Education

Rigorous Scientific Attitude: The calculation process of the force method is relatively complex, involving extensive mathematical operations and application of mechanical concepts. During teaching, engineering accidents caused by calculation errors or careless analysis in actual engineering cases can be used to emphasize the importance of a rigorous scientific attitude. As is well known, a major earthquake occurred in Wenchuan, Sichuan in 2008, causing massive casualties and severe economic losses, mainly due to building collapses, which also exposed some

engineering quality and design problems. Through this case, students understand that in the engineering field, any negligence can bring serious consequences, cultivating students' rigorous, meticulous, and scrupulous craftsman spirit. An accurate and reasonable calculation model is the absolute guarantee for building structural safety and reliability[6].

Selfless Dedication Spirit: Tell stories of engineers who, to ensure structural safety and engineering quality, studied force method and other mechanical problems day and night during engineering construction, tirelessly conducting on-site monitoring and data collection. They silently dedicated their time and energy for the smooth progress of projects, and this selfless dedication spirit is an important embodiment of the craftsman spirit. Guide students to have this spirit of dedicating themselves to their profession and career in their studies and future work.

3.1.3 Pioneering and Progressive Education

Development of Mechanical Theory: Introduce the development history of force method theory, from initial proposal to continuous improvement and innovation. In China's engineering construction field, when encountering technical difficulties monopolized by foreign countries, domestic engineering experts worked hard to overcome obstacles, constantly exploring and pioneering new methods and theories, successfully conquering technical challenges one by one. Chief designer Lin Yuanpei faced enormous challenges in complex bridge internal force calculations during the design phase of Yangpu Bridge. Through continuous exploration, he creatively proposed the new theory of spatial structure stability, successfully solving the bridge internal force calculation problem. After verification, his calculation accuracy significantly exceeded that of international bridge experts, earning high recognition and praise from international bridge experts[7]. This example allows students to personally experience the importance of innovation in theoretical learning, encouraging students to bravely challenge tradition and actively explore new knowledge in their studies and research, cultivating awareness of pioneering innovation.

Interdisciplinary Application: Emphasize the interdisciplinary application of the force method in different fields, such as aerospace and mechanical engineering. With technological development, the force method is not limited to civil engineering but plays important roles in other fields. Guide students to break disciplinary boundaries, broaden their horizons, cultivate interdisciplinary thinking and comprehensive application abilities, encourage students to actively explore force method applications in different fields in future work, contributing their own strength to promoting interdisciplinary integration and innovation development.

2.Teaching Case Design

Case 1: Force Method Application in Hong Kong-Zhuhai-Macao Bridge

Course Objectives: Enable students to master the application of force method in analyzing statically indeterminate structures of large bridges while cultivating their patriotic feelings and craftsman spirit.

Case Teaching: When explaining the force method, the Hong Kong-Zhuhai-Macao Bridge, a national major project, can be selected as a case. First, display magnificent pictures and popular science videos of the bridge, mainly introducing the bridge's construction background and engineering significance. Then explain in detail how the force method was used to analyze the bridge's statically indeterminate structure during design, including how to select basic structures and establish force method equations. During the explanation, emphasize that engineers conducted extensive calculations and analyses to ensure the bridge's safety and stability, reflecting a rigorous scientific attitude. Finally, explain to students that the construction of the Hong Kong-Zhuhai-Macao Bridge reflects China's advantage in concentrating efforts on major tasks, demonstrating the superiority of the socialist system, thereby enhancing students' institutional confidence.

Teaching Strategy: Adopt discussion teaching method, allowing students to discuss in groups the key issues and challenges of force method application in Hong Kong-Zhuhai-Macao Bridge construction and the insights gained. Guide students to think about how to apply learned force method knowledge to contribute to the country's infrastructure construction in future engineering projects.

Case 2: Combination of Ancient Architecture and Force Method

Course Objectives: Enable students to understand the mechanical wisdom in ancient architecture and combine it with modern force method theory, aiming to cultivate students' national pride and innovative spirit.

Case Teaching: Using the palace architecture of the Forbidden City as an example, introduce Chinese ancient mortise and tenon structure buildings. First, use pictures and physical models to show students the mortise and tenon structure, explaining its connection methods and force principles. Then guide students to think about how to use modern force method theory to analyze and optimize mortise and tenon structures. By comparing mechanical analysis methods of ancient and modern architecture, let students understand the development and inheritance of mechanical theory. Finally, emphasize that without support from modern scientific theory, ancient craftsmen created such exquisite building structures through practice and experience, demonstrating the wisdom and innovative spirit of the Chinese nation, enhancing students' sense of national honor.

Teaching Strategy: Adopt problem-oriented teaching method, raising questions for students to consider, such as "What similarities exist between mortise and tenon structures and modern statically indeterminate structures?" "How can the force method be used to improve and innovate mortise and tenon structures?" Guide students to find solutions through autonomous exploration and group discussions, thereby enhancing students' innovative thinking and practical abilities.

3.Teaching Implementation and Reflection

3.1 Teaching Implementation

During the teaching process, conduct targeted teaching according to well-designed teaching cases. While explaining force method knowledge, timely integrate ideological and political elements, guiding students to think and realize through case analysis and discussion. For example, when analyzing the Hong Kong-Zhuhai-Macao Bridge case, enable students to deeply appreciate the country's strength and the advantages of the socialist system; when explaining ancient architecture cases, let students personally experience the wisdom and cultural heritage of the Chinese nation.

Simultaneously, strengthen communication and interaction with students, encourage active participation in discussions and speaking, while providing timely feedback on student performance. Through classroom discussions, homework assignments, and exams, assess students' understanding and mastery of force method knowledge and ideological and political content.

3.2 Teaching Reflection

The selection of teaching materials should be more precise, both accurately reflecting force method knowledge points and effectively integrating ideological and political elements. Teaching materials should be close to students' real life, easily resonating with students, thereby stimulating their learning interest and achieving targeted and precise teaching.

During the teaching process, pay more attention to guiding students' thinking and insights, allowing students to truly gain inspiration and education from ideological and political cases. Additionally, some open-ended questions can be set to guide students to express their own views, thereby cultivating their critical thinking and value judgment abilities.

Continuously summarize teaching experience, combine student feedback and actual teaching effects to optimize and adjust teaching cases and methods, thereby improving the teaching quality and effectiveness of curriculum ideological and political education.

4.Conclusion

The exploration and practice of case-based teaching of "Structural Mechanics" under the background of curriculum ideological and political education demonstrates that integrating ideological and political education into

professional course teaching is feasible and effective. Through carefully planned cases and diversified teaching methods, not only can students' professional competence be enhanced, but their ideological and political qualities and engineering practice skills can also be strengthened. This teaching model provides important reference significance for ideological and political construction in engineering courses, helping achieve deep integration of knowledge transmission and value guidance, cultivating engineering and technical talents with both moral cultivation and professional abilities. In the future, we will continue to deepen curriculum ideological and political reform, explore more innovative teaching methods, and contribute to cultivating high-quality engineering talents in the new era.

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