

Exploration of the Mining of Ideological and Political Elements and Teaching Integration of Bridge Engineering Courses in Applied Undergraduate Programs

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Abstract: The questions of what kind of individuals university education should cultivate, how to cultivate them, and for whom they are being trained are pressing issues that require immediate solutions. Implementing ideological and political education is a fundamental way to address these challenges. Integrating political education into professional courses is just as important as imparting knowledge, fostering interest, transmitting values, and shaping students' character and spirit. The excavation of ideological and political elements in bridge engineering courses should comprehensively consider the dependent subject of ideological and political elements, the source of cases, the depth of excavation, the trade-offs between courses, the commonality and multifaceted nature of ideological and political elements, as well as the two ways of ideological and political elements integration. Ideological and political elements should be integrated into all stages of classroom lectures, course assignments, final examinations, course design, discipline competitions, school-enterprise cooperation, etc., so as to achieve the effect of educating people in the whole process.

Keywords: Ideological and political teaching; Bridge engineering; Ideological and political elements mining; Integration of ideology and politics

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1. Introduction

Education is the basis of the hundred-year plan, and education in the new era and journey still needs to unswervingly strengthen the implementation of the strategy of developing the country through science and education, the strategy of strengthening the country through talents, and the strategy of innovation-driven development. For contemporary university education, what kind of people to cultivate, how to cultivate people, and for whom to cultivate people are the problems that need to be solved urgently, and the promotion of the construction of ideological and political teaching is the fundamental means to solve this problem^[1]. The Ministry of Education has successively formulated and released the Implementation Outline of the Project to

Improve the Quality of Ideological and Political Work in Colleges and Universities ^[2] and the Guiding Outline for the Construction of Ideological and Political Teaching in Colleges and Universities ^[3], stressing that the construction of ideological and political teaching is an important task for comprehensively improving the quality of talent cultivation in colleges and universities, and specifying the objectives, requirements, and content focus of the construction of ideological and political teaching in accordance with the characteristics of different majors ^[4]. Under this system, every course requires its course team to take value shaping as the core, knowledge transfer as the root, and skill cultivation as the focus, and continuously improve the quality of talent cultivation. Under the construction of ideological and political teaching under such all-round coverage, every teacher is the main force, every course is the main battlefield, and every class is the main channel ^[5]. Bridge engineering is one of the main professional courses in the direction of road and bridge engineering of civil engineering in our university, which should give full play to its key role of value shaping.

Strengthening the ideological and political education in bridge engineering courses has the following effects: (1) Cultivating students' correct "three views" and shaping noble personality; (2) Guiding students to set up correct career development goals and a sense of social responsibility; (3) Cultivating students' craftsmanship ^[6]; (4) Enhancing the interest in this course and improve the learning effect; (5) Cultivating students' courage to face difficulties and solve them on their own; (6) Stimulating students' ambition to strengthen the country and serve the country, and make them willing to devote themselves to serving the national transport construction.

Applied undergraduate education focuses on reinforcing practical skills while continuously deepening theoretical knowledge, emphasizing the combination of "theoretical breadth and depth + practical application ability" ^[7]. Given the school's status as an applied undergraduate institution serving the development of the Chengdu-Chongqing region's twin-city economic circle, the design of the ideological and political education for bridge engineering should be based on both the professional talent cultivation program and the syllabus for professional ideological and political education.

2. Introduction of bridge engineering course

The bridge engineering course is a professional direction course for civil engineering majors (road and bridge engineering direction). It studies the structural principles, design calculation methods, and construction points of the superstructure and substructure of the commonly used small and medium-sized bridges, such as girder bridges, rigid frame bridges, and arch bridges, as well as the basic structure and construction methods of large-span bridges, such as cable-stayed bridges and suspension bridges. After having the relevant knowledge of structural mechanics, principles of engineering load and reliability design, basic principles of concrete structure, and some preliminary understanding of the structural characteristics and design principles of civil engineering structures, through the study of this course, students get more familiar with the structural form, construction principle, internal force calculation principle, design methods and steps of bridge engineering, and other professional knowledge, and have a preliminary understanding of the professional quality and ethics of bridge engineers, which will serve for the later course design and lay a good foundation for the later work in the road and bridge industry.

This course mainly adopts the teaching method combining lectures, cases, and projects to improve students' learning interest and expand their professional vision through rich engineering examples. This course innovates the teaching content and methods, pays attention to value shaping in students, runs ideological and political education through the whole teaching process, takes educating people as the main teaching goal, integrates socialist core values into the classroom, and emphasizes the value leading function of the course.

According to the Guidelines for the Construction of Ideological and Political Teaching in Higher Education, the teaching system of ideological and political teaching is designed in a targeted manner, taking into account the characteristics of the professional courses. The teaching content, integration points, and the objectives of ideological and political teaching in each chapter are shown in **Table 1**.

Table 1. Ideological and political teaching integration into design and ideological and political goals corresponding to bridge engineering teaching content

Curriculum text	Teaching contents	Integration point of ideological and political teaching	Ideological and political goals
General introduction (10 hours)	<ol style="list-style-type: none"> 1. Introduction to bridge engineering 2. Composition classification and structure system of bridge 3. Principles of bridge planning and design 4. Effect of the bridge 5. Bridge deck layout and structure 	<ol style="list-style-type: none"> 1. The excellent bridge cases and relevant outstanding figures in Chongqing in history and today inspire the feelings of the family and the country and fulfill the mission 2. The classification system is the result of people's understanding of things, which contains rich philosophical thinking 3. How do engineers choose solutions to engineering ethics problems in bridge planning and design 4. The complex problem of bridge load is simplified into a practical engineering design method - a philosophical problem of the main contradiction and the main aspects of the contradiction 5. Bridge aesthetics -- the combination of engineering economics and engineering ethics 	<ol style="list-style-type: none"> 1. To build national pride, strengthen political identity, strengthen road confidence, stimulate the feelings of science and technology to serve the country, and practice the glorious mission 2. To cultivate the scientific spirit of Marxist standpoint, exercise philosophical thinking, and improve students' ability to correctly understand, analyze, and solve problems
Simple beam bridge (10 lessons)	<ol style="list-style-type: none"> 1. Design and construction of superstructure 2. Bridge panel calculation 3. Lever principle method 4. Rigid beam method 5. Internal force calculation of simple beam 	<ol style="list-style-type: none"> 1. The relationship between beam height and bridge span, the relationship between dimensional parameters of various parts - the philosophical problems of the main contradiction and the main aspects of the contradiction 2. Simplified philosophical thinking on complex engineering problems - a combination of focused, lean craftsman spirit 3. The main contradiction of things - teamwork spirit 4. Teamwork spirit - the main contradiction of things 5. Philosophical thinking that decomposes complex problems layer by layer and simplifies them 	<ol style="list-style-type: none"> 3. To strengthen engineering ethics education, and integrate ethical responsibility into students' professional ability and creative practice, so that engineering can promote human well-being 4. To cultivate a great craftsman spirit of continuous focus and excellence
Other bridges (8 hours)	<ol style="list-style-type: none"> 1. Basic composition and classification of arch bridges 2. Design points and construction methods of arch bridges 3. Continuous beam bridge and rigid frame bridge 4. Cable-stayed bridges and suspension bridges 	<ol style="list-style-type: none"> 1. The aesthetic quality of bridge refers to the recognition of the improvement and renovation of major country projects, the stimulation of national feelings, and the practice of mission responsibility 2. Engineering ethical issues to be considered in the selection of engineering schemes 3. The great power project promotes the renovation identity, stimulates the feelings of the family and the country, implements the philosophical thinking of mission responsibility and comparative analysis 4. The new progress of major country projects and bridges leads the world, enhances the renovation identity, inspires the feelings of the family and the country, and fulfills the mission responsibility 	<ol style="list-style-type: none"> 5. To enhance students' aesthetic quality, cultivate noble sentiments, and stimulate creative vitality
Bridge abutments, piers, and foundations (4 hours)	<ol style="list-style-type: none"> 1. Bridge support 2. Pier and foundation 	<ol style="list-style-type: none"> 1. Philosophical analysis of the main contradictions of things and the main aspects of contradictions 2. Engineering ethics in project scheme selection 	

3. Ideological and political elements mining and content refining sublimation

3.1. Subject to which ideological and political elements are attached

First, the use of engineering cases. In bridge engineering courses, practical case-based teaching is a key method, allowing students to grasp concepts more concretely by engaging with real-world engineering scenarios. By integrating ideological and political elements into these cases, it becomes easier to achieve what can be described as “value shaping” that works subtly, much like salt dissolving in water—imperceptible, yet impactful. Therefore, it is essential to explore these elements more deeply within the teaching cases and seamlessly blend ideological and political education with case-based learning.

Second, Marxist philosophical principles. For many theoretical knowledge points related to mechanics knowledge, calculation principles, structural composition systems, and those related to bridge engineering courses, when specific engineering cases cannot be applied, the relevant ideological and political elements should be explored from the Marxist philosophical principles, such as the main contradiction and its aspects, the interconnection of all things, the progressive decomposition and induction of analytical thinking, etc., in order to improve students’ correct understanding of problems, problem analysis, and problem-solving skills.

3.2. Sources of ideological and political cases

First, the principle of local priority is adhered to. Chongqing, being a hub for bridges, offers a wealth of practical examples, from ancient to modern bridges, along with many renowned bridge engineers, such as Deng Wenzhong. These resources should be fully utilized in teaching. After learning in the classroom, students can easily visit these sites, gaining hands-on experience that enhances their perceptual understanding, deepens their thinking, and strengthens the overall educational impact. Adhering to the principle of local priority aligns with the school’s applied undergraduate focus and its mission to serve the Chengdu-Chongqing Twin Cities Economic Circle.

Secondly, the principle of comparing multiple cases is adopted. From the comparison of ancient Chinese and foreign bridge engineering relics and contemporary Chinese and foreign bridge engineering construction achievements, we can deeply feel the glorious history of ancient China, the rapid development speed of contemporary China, the emergence of outstanding individuals, and the great engineering achievements. This can stimulate patriotism, solidify the political identity, strengthen the courage to face and overcome difficulties, and practice the glorious mission to bear.

Third, we must keep pace with the times and foster an international perspective. Teaching cases cannot be static, we should keep pace with the times, keep track of hot news of bridge engineering at any time, and dig ideological and political elements from hot spots. For example, the collapse of the Baltimore Bridge in the United States due to a ship collision on March 26, 2024, and its subsequent rescue, salvage, and construction progress are a good new teaching case that can excavate ideological and political elements from many aspects. Keeping pace with the times also requires teachers to pay attention to the country’s major policies, and integrate curricular elements of the Belt and Road strategy, the transportation strategy, and the rural revitalization strategy into their teaching.

3.3. Excavating ideological and political elements

For an engineering case, the ideological and political elements can be deeply excavated from four aspects, such as people, objects, history, and politics^[8]. “People” means typical historical figures and famous industry experts, such as Tianyou Zhan, Yisheng Mao, Guohao Li, Wenwen Deng, and so on. “Things” are well-known historical projects and major projects, such as the construction and demolition of the Yunyang Bridge, the first cable-stayed bridge in China; the Chaotianmen Bridge, the world’s largest span of rigid bridge; Shibampo

Bridge and so on. “History” is the history of scientific development, including the development of mechanics systems closely related to bridge engineering, the development of construction materials for the bridge main body, the development of construction technology, etc. “Politics” is the relevant national policies, regulations, guidelines, etc., examining the background of the era of engineering projects, thinking about the contemporary construction of the same project in the bridge program. For an engineering case, through the excavation of the four aspects of the case related to people, things, history, and politics of the ideological and political elements, complete ideological and political elements can be built. Ideological and political elements from different sides of the same engineering case can be applied to different chapters according to their relevance.

After the mining of ideological and political elements, it is necessary to refine and sublimate to form themes. In the course of teaching, ideological and political teaching is refined into five themes: feelings of family and country, philosophical thinking, engineering ethics, craftsman spirit, and aesthetic quality.

3.4. Selection of ideological and political elements

After the preliminary completion of the mining steps of ideological and political elements, the course team found that there were a lot of ideological and political elements related to each knowledge point and class. It can be considered that it is simple to complete the ideological and political teaching task, and the ideological and political elements should be selected according to the teaching design in specific use. The specific ideological and political elements must first meet a strong correlation, and only the strongly related ideological and political elements can be quietly and naturally integrated, students will not feel the abruptness and can really play a role in shaping value. Secondly, keeping pace with the times, the ideological and political elements with timeliness and news value can arouse students’ interest in learning.

3.5. Commonality and multi-faceted ideological and political elements

The new situation requires all courses to become the main channel of value shaping, and there must be interconnection between multiple courses of the same major. The interconnected nature of the courses often leads to a common issue: the same engineering case is repeatedly used across different assignments and subjects. Multiple instructors may incorporate similar ideological and political elements, but their explanations can vary, creating confusion among students. As a result, students might become resistant, unsure of which version is accurate when faced with differing interpretations from various teachers. Therefore, the elements of ideological and political teaching between different courses of the same major should form a system, and the teachers should share information with each other, avoiding the repeated citation of the same side of the same case in different courses, and avoiding different explanations of the same case.

Overloading students with too many cases is not an ideal approach. It is more effective for multiple courses to share the same case, with each teacher examining the engineering case from different angles based on the specific knowledge points of their lectures. This allows for the integration of ideological and political elements that correspond with the course content while reducing the number of cases and lightening the students’ learning load. Sharing the same case across courses also helps prevent inconsistencies in explanations among teachers, ensuring a more coherent and unified learning experience for students.

3.6. Methods of integrating ideological and political elements

The most important principle of ideological and political teaching is that it is silent and subtle, and plays a role in shaping values. Therefore, not all ideological and political teaching has to be spoken, and the elements of ideological and political teaching need to be combined with implicit integration, and the two ways of integration together contribute to the goal of value shaping.

Display integration refers to what students can hear and see, including the teacher's presentation of bridge history, which highlights China's ancient world-leading achievements, and contemporary bridge engineering, which emphasizes China's modern global leadership. It also includes showcasing the spirit of outstanding bridge masters, such as the dedication of national craftsmen. Additionally, the teacher's preparation, professional appearance, well-organized materials, and passionate lecture delivery are all part of the display of ideological and political elements in the classroom. Some of these elements do not necessarily need to be explicitly explained, as they can still convey important messages. For example, mentioning alumni contributions or a teacher's research achievements can be subtly integrated into the course material without taking up additional class time. A simple note on the PowerPoint slide may suffice, allowing the focus to remain on the primary teaching content while still incorporating these ideological and political elements^[9].

4. Exploration of integrating ideological and political elements into the teaching process

4.1. Classroom teaching stage

Given that undergraduate students spend most of their time listening to lectures, the classroom becomes the primary stage for integrating ideological education. Each class and every knowledge point should serve the dual purpose of knowledge transfer and value shaping. This can be achieved by teaching through various lenses, such as the history of Chinese bridge development and its contemporary achievements, the contributions of bridge masters from different eras, and national strategies like the Belt and Road Initiative, the goal of becoming a Transportation Power, and the Rural Revitalization plan. Additionally, policies like the 14th Five-Year Plan and the 2035 Vision can provide valuable context. The case study teaching method can further highlight real-world applications, while lectures can foster critical thinking and connect scientific analysis with Marxist perspectives and the scientific spirit. Engineering ethics and the role of aesthetics in bridge engineering can also be emphasized, extending beyond technical knowledge to cultivate a sense of professional responsibility and appreciation for the beauty inherent in engineering.

Regardless of the aspect being taught or the teaching method employed, the first principle of integrating ideological and political elements is that it should be natural and seamless, avoiding any sense of abruptness. The incorporation of these elements should feel organic, blending into the overall teaching process without disrupting the flow of the lesson.

As smart teaching facilities become more prevalent, the effectiveness of ideological and political education can also be enhanced. Classroom lectures should fully leverage the features of these technologies, such as discussions, group tasks, peer evaluations, and other interactive tools. By doing so, every ideological and political session has the potential to engage and influence all students, ensuring a deeper and more meaningful impact.

4.2. Course assignment stage

Students' completion of course assignments plays a crucial role in their education and serves as a key platform for ideological and political education. By designing all assignments around exemplary bridge cases, incorporating discussions of engineering ethics into every question, and integrating philosophical reflections into the explanations of answers, students will naturally absorb values as they work through their tasks.

Assignments should include hands-on research of engineering cases, where students gather information through real-world exploration, internet research, or literature reviews. This approach allows them to engage more deeply with the material and retain knowledge more effectively. To ensure that these assignments fulfill

their role in value shaping, teachers must thoughtfully prepare in advance. This involves establishing clear guidelines for value judgments, setting boundaries and guidance to prevent potential misunderstandings, and providing explicit criteria that align with the intended values. By doing so, the assignments will not only enhance students' knowledge but also instill ethical and philosophical insights.

4.3. Final assessment stage

Although the final examination marks the conclusion of a course, its role in value shaping should not be overlooked. The approach to ideological and political education during the final assessment can mirror that of the coursework phase, ensuring that each question students answer stems from an engineering example. This method enables students to clearly understand the practical purpose of their studies and the intrinsic value of the knowledge they have acquired. To reinforce the value of engineering ethics, exam questions should consistently emphasize ethical judgment in engineering, helping to strengthen students' professionalism and instill ethical principles in their minds. By incorporating philosophical reflections into the reference answers provided, the exam can continue to guide students toward deeper insights. Additionally, questions related to bridge aesthetics and the contributions of renowned bridge engineers can be included to further integrate value-based education into the assessment. In this way, students receive continuous value-shaping education, even as they complete their final course assessments.

4.4. Course design stage

The design phase of the course is completed by students themselves, which mainly cultivates students' craftsmanship of concentration and excellence. By completing the design work of the bridge project, students can feel the joy of putting what they have learned into practice and achieving what they have learned, and stimulate students' national sentiment and mission to serve the country with science and technology.

The evaluation of the course design results should focus on the consideration of engineering ethics, so that students understand the necessity of adhering to engineering ethics in bridge engineering.

4.5. Course competition stage

Bridge engineering is a highly practical course that encourages hands-on learning and active participation. The course, guided by professional standards, motivates students to engage in disciplinary competitions, where they bridge the gap between structural theories and tangible models. Through activities such as creating hand-made models, learning finite element software, and conducting structural analysis during competitions, students gain a clearer understanding of how bridge structures relate to design principles and basic engineering concepts. This approach fosters the integration of competition with teaching, enhancing the overall learning experience. Teachers actively encourage students to participate in the annual National Structural Design Competition for College Students, offering systematic training and guidance in areas such as topic analysis, finite element software application, model conception, and model making. In their spare time, students learn to use finite element software, conduct structural modeling and mechanical analysis, and handcraft structural models using bamboo. By performing loading tests, they analyze the force mechanisms and failure modes of structures, which provides an intuitive grasp of mechanical properties and strengthens their understanding of structural design. Through these competitions, students not only consolidate their foundational knowledge in mechanics and materials science but also deepen their comprehension of bridge structures. Additionally, the process enhances students' practical skills, teamwork abilities, and innovative thinking. It also serves as an avenue for engineering ethics education, reinforcing professional responsibility and ethical awareness in their learning journey^[10].

4.6. School-enterprise cooperation stage

One of the characteristics of our university is school-enterprise cooperation and integration of industry and education. Enterprises can invite engineers with rich practical experience in engineering to give lectures on engineering practice and social responsibility and encourage students to move forward and think about the future blueprint with excellent engineering cases and representatives of outstanding individuals. Students' internship practice in enterprises can enhance their ability to solve practical engineering problems, understand engineering ethical issues at a deeper level, and improve their professionalism^[1].

5. Conclusion

Bridge engineering, as one of the main professional courses in the direction of road and bridge engineering of civil engineering, should be the main battlefield for students' ideological and political education, and the integration of ideological and political education in teaching not only completes the value shaping of students but also helps to enhance students' interest in learning, so as to improve the teaching effect and strengthen students' engineering practice skills. The integration of ideological and political education in professional courses is as important as imparting knowledge to students in terms of transferring spirit, enlightening interest, and shaping value.

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