

Integration of Ideological and Political Education into Finite Element Method Courses: Exploration and Practice

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Abstract: *In the context of contemporary educational reform, integrating ideological and political education into professional courses has become an important means of enhancing students' comprehensive qualities. This paper explores the necessity and feasibility of incorporating ideological and political education into finite element method (FEM) courses. By analyzing the current state and challenges of FEM teaching, this study discusses the significance and demand for ideological and political education in engineering education. Drawing from domestic and international practice cases, specific strategies for integrating FEM with ideological and political education are proposed. Detailed teaching content and objectives are designed, employing diverse teaching methods and tools to enhance students' professional capabilities, sense of social responsibility, and ethical awareness. Finally, the paper summarizes potential challenges during implementation and proposes corresponding countermeasures. These efforts aim to cultivate engineering talents with high moral standards and social responsibility, better prepared to face the complex challenges in the engineering field.*

1. Introduction

Implementing ideological and political education in the finite element method (FEM) course is a significant topic in current educational discussions. With the deepening of educational reform and the increasing emphasis on ideological and political education in higher education, integrating such education with professional courses has become a vital approach to enhancing students' overall qualities. As a fundamental course in engineering, FEM's theoretical framework and practical applications demand not only the imparting of professional knowledge but also the cultivation of students' innovative abilities, sense of responsibility, and social accountability. This paper aims to explore how to introduce ideological and political education elements into FEM courses to enhance students' ideological awareness, nurture their engineering ethics and social responsibility, and better prepare them to meet and lead future engineering technology developments.

Current State and Challenges of FEM Teaching: Describe the current state of FEM course teaching, including curriculum design, teaching methods, and students' learning situations. Analyze existing problems and challenges in the teaching process, such as the disconnect between theory and practice and the lack of student interest.

Importance and Need for Ideological and Political Education: Discuss the significance of ideological and political education in higher education, especially in engineering and technology disciplines. Explore the moral qualities and social responsibilities that engineering talents should possess in the current social context and their importance for career development.

Domestic and International Practices in Integrating Ideological and Political Education into Engineering Education: Summarize successful cases and experiences of

integrating ideological and political education in engineering education in different countries or regions, analyzing the factors and outcomes of their success to provide insights for this study.

Possibilities for Integrating FEM with Ideological and Political Education: Discuss the possibilities and necessities of introducing ideological and political education into FEM courses. Analyze how to effectively combine the two through curriculum design, teaching content arrangement, and assessment methods to enhance students' overall qualities and professional capabilities.

Future Trends and Recommendations: Anticipate future trends in engineering education and propose suggestions and strategies for incorporating ideological and political education into the curriculum. Considering current social demands and student characteristics, explore how to continue promoting this educational reform to cultivate engineering talents that meet contemporary requirements.

2. Teaching Content and Objective Setting

2.1 Teaching Content Design

Incorporating ideological and political education into FEM courses requires comprehensive teaching content design to ensure that students understand and apply key concepts such as ethical decision-making, engineering ethics, and professional ethics while learning professional knowledge.

Ethical Decision-Making and Social Responsibility:

Through case studies, students will delve into common ethical dilemmas in engineering fields, such as environmental protection and public safety. The cases should include realistic and challenging scenarios, such as balancing economic benefits and environmental impacts in engineering

design or ensuring public safety and technological innovation in construction projects. These cases not only showcase technical issues but also guide students to consider the profound impact of their technical choices on society, the environment, and public interests.

Engineering Ethics and Professional Ethics:

Introduce the professional ethics and social responsibilities engineers must adhere to, including but not limited to engineering safety, information protection, project transparency, and social responsibility. Through discussions and case analyses, students will learn how to identify and resolve ethical issues in engineering practice and how to demonstrate social responsibility and leadership in their professional behavior.

2.2 Teaching Objective Setting

Setting clear teaching objectives is key to ensuring students' comprehensive development and achieving educational goals. The specific teaching objectives are as follows:

Enhance Students' Understanding and Application of FEM: Through in-depth theoretical learning and practical operation, students will master the basic theories and advanced application skills of FEM.

Cultivate Students' Innovation Awareness and Ability to Solve Complex Engineering Problems: Emphasize innovative thinking and problem-solving abilities in engineering design and decision-making, encouraging students to propose new solutions when facing complex challenges.

Strengthen Students' Sense of Social Responsibility and Ethical Awareness: Cultivate students to actively participate in social and environmental protection in engineering practice, guiding them through ethical decision-making case analyses and discussions to consider the far-reaching significance of engineering technology choices on society.

Improve Students' Interdisciplinary Communication Skills and Teamwork Spirit: Emphasize the importance of teamwork through group projects and interdisciplinary teaching activities, cultivating students' ability to communicate and collaborate effectively in diverse teams.

These teaching objectives not only focus on the transmission of academic knowledge but also aim to shape students' overall qualities and abilities, enabling them to become highly responsible and innovative professionals in future engineering practice.

3. Teaching Methods and Tool Selection

3.1 Teaching Methods

Integrating ideological and political education into FEM courses requires diverse teaching methods to achieve educational goals. The specific teaching methods are as follows:

Case Analysis and Discussion:

Introduce real cases, especially those involving ethical issues in engineering. Through group discussions and classroom debates, students will face specific engineering decision-making situations, such as how to balance environmental protection and economic benefits during the design phase. These discussions help students understand the complexity of engineering technical choices and encourage deep thinking from the perspectives of ethics and social responsibility, thereby enhancing their ethical awareness and decision-making abilities.

Interdisciplinary Teaching:

Collaborate with humanities and social sciences disciplines to conduct interdisciplinary ideological and political education courses. By working with teachers from philosophy, sociology, or ethics disciplines, students are guided to understand and analyze ethical and social issues in engineering practice from multiple dimensions. For example, combining ethical theories and sociological perspectives to explore how technological progress affects social structures and individual lives, thereby deepening students' understanding of social issues.

3.2 Teaching Tools

To support the implementation of teaching methods, selecting appropriate teaching tools is crucial. The recommended teaching tools are as follows:

Virtual Simulation Platforms:

Use virtual simulation platforms for engineering case simulations. This way, students can experience the complexity and impact of ethical decision-making in a safe virtual environment. For example, through virtual simulation platforms, simulate a city infrastructure project where students can try different decision paths and observe the potential impacts on the environment, community, and economy, thereby deepening their understanding and application abilities of ethical decision-making.

Online Resources and Multimedia Materials:

Provide diverse online resources, such as academic articles, expert interviews, and video materials. These resources not only help students understand FEM's theory and practice but also broaden their horizons and knowledge. For example, academic articles help students understand the latest technological developments and application cases, while expert interviews and video materials showcase ethical challenges and solutions in real engineering practices, stimulating their interest in learning and thinking.

Through the selection of these teaching methods and tools, FEM courses can not only transmit academic knowledge but also cultivate students' interdisciplinary thinking abilities, ethical awareness, and innovation capabilities, laying a solid foundation for their future engineering practice and career development.

4. Evaluation and Feedback Mechanisms

4.1 Evaluation Indicators Setting

To comprehensively evaluate the effectiveness of integrating ideological and political education into FEM courses, the following comprehensive evaluation indicators can be set:

Academic Performance:

Traditional academic performance evaluations will ensure that students master the basic theories and application skills of FEM. This includes mid-term and final exams, classroom assignments, and project reports.

Course Assignments:

Evaluate students' mastery of theoretical learning and practical application through course assignments. Assignments can cover mathematical modeling, engineering case analyses, and ethical decision evaluations.

Personal Reports and Team Projects:

Personal reports and team projects aim to assess students' performance in engineering practice. Personal reports can require students to analyze a specific engineering ethical issue and propose solutions. Team projects focus on students' abilities in teamwork and interdisciplinary communication.

Effectiveness of Ideological and Political Education:

Evaluate students' cognitive and attitudinal changes towards ethical awareness and social responsibility through questionnaires and student feedback. Questionnaires can be designed to be distributed periodically to explore students' understanding of course content and ideological and political education and their application abilities in actual engineering practice.

Engineering Practice Ability:

Evaluate students' abilities to comprehensively consider technical, economic, environmental, and social factors in engineering decision-making through actual projects and simulation exercises. This can be achieved through project reports, simulation result analyses, and group discussions, ensuring that students can effectively apply learned skills and knowledge in real situations.

4.2 Feedback Mechanism

To ensure the effectiveness of course design and teaching strategies, establishing an effective feedback mechanism is crucial:

Regular Teaching Evaluation Meetings:

Schedule regular teaching evaluation meetings, inviting participating teachers and students to discuss course progress and students' learning situations. Analyze the strengths and areas for improvement in course design. Teachers can share their observations and feedback, and students can provide suggestions on course content and teaching methods.

Student Participation Meetings:

Regularly organize student participation meetings to hear their opinions and suggestions on the course. These meetings can be conducted through group discussions, online feedback forms, or face-to-face communication, ensuring that all students' voices are fully expressed and heard.

Collecting Teacher and Student Feedback:

Collect and analyze feedback from teachers and students, and promptly adjust course design and teaching strategies. This can be done through anonymous questionnaires, online feedback forms, or individual interviews, ensuring the comprehensiveness and accuracy of feedback.

By setting clear evaluation indicators and establishing an effective feedback mechanism, the quality and effectiveness of integrating ideological and political education into FEM courses can be continuously improved, ensuring that students' overall qualities and professional abilities are comprehensively developed.

5. Anticipated Challenges and Response Strategies

5.1 Anticipated Challenges

Integrating ideological and political education into FEM courses may face several challenges:

Student Acceptance Variability:

Different students may have varying degrees of acceptance and enthusiasm for ideological and political education content. Some students may focus more on professional knowledge and ignore the significance of ideological and political education. Others may feel uninterested in or resistant to the introduced ethical and social issues, leading to inconsistent participation and engagement levels among students.

Teacher Training and Professional Development Needs:

To effectively integrate ideological and political education into FEM courses, teachers need relevant training and professional development. Teachers need to master interdisciplinary knowledge and teaching methods and be capable of guiding students to deeply think and solve ethical issues. However, some teachers may lack experience or interest in this aspect, making it difficult to ensure the smooth implementation of teaching plans.

Cross-disciplinary Collaboration and Resource Coordination:

Successfully integrating ideological and political education requires collaboration between different disciplines and departments. Establishing effective cross-disciplinary collaboration mechanisms and coordinating teaching resources can be challenging. In practice, challenges such as insufficient collaboration time, resource sharing difficulties, and different teaching philosophies may arise.

5.2 Response Strategies

To address these challenges, the following response strategies can be adopted:

Implementing Personalized Teaching Strategies:

To address students' varying acceptance and enthusiasm levels, personalized teaching strategies can be implemented. By understanding students' individual interests and needs, teachers can adjust teaching content and methods to ensure effective learning for each student. Personalized strategies include individual tutoring, differentiated assignments, and flexible learning plans.

Strengthening Teacher Training and Professional Development:

Provide teachers with opportunities for relevant training and professional development to enhance their interdisciplinary teaching abilities and practical experience. Teacher training can include seminars, workshops, and interdisciplinary teaching practice opportunities. Encouraging teachers to participate in academic exchanges and collaborative research projects can also enhance their professional capabilities.

Establishing Cross-disciplinary Collaboration Mechanisms:

To achieve effective cross-disciplinary collaboration, establish formal collaboration mechanisms, including regular communication and resource sharing. Create interdisciplinary teams, consisting of teachers from different disciplines, to collaboratively design and implement teaching plans. Organize regular interdisciplinary seminars and teaching experience exchange meetings to promote mutual understanding and cooperation.

By implementing these response strategies, the challenges faced during the integration of ideological and political education into FEM courses can be effectively addressed, ensuring smooth teaching implementation and improved student learning outcomes.

6. Conclusion

Integrating ideological and political education into FEM courses is an important direction in current educational reform. Through in-depth analysis of the current state and challenges of FEM teaching, this paper discusses the importance of ideological and political education in engineering disciplines and proposes specific teaching content and objective settings. By adopting diverse teaching methods and tools, including case analysis, interdisciplinary teaching, virtual simulation platforms, and online resources, the paper suggests effective ways to integrate ideological and political education into FEM courses. Comprehensive evaluation indicators and feedback mechanisms are established to ensure continuous improvement in course quality and effectiveness.

Despite potential challenges in student acceptance, teacher training, and cross-disciplinary collaboration, response strategies such as personalized teaching, enhanced teacher training, and formal collaboration mechanisms are proposed

to address these issues. The ultimate goal is to cultivate engineering talents with high moral standards and social responsibility, better prepared to meet the complex challenges of future engineering practice.

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