International Journal of Social Science and Education Research Volume 9 Issue 8, 2026
ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202608_9(8).0021

Teaching Reform and Practice of Ideological and Political Education in the Numerical Analysis Course

Jingyuan He[1, a]

[1]School of Mathematics and Computer Science, Yan'an University, Yan'an 716000, China

[a]18992118537@163.com

Abstract

In response to the demands of emerging engineering education development and the fundamental task of fostering virtue through education, this study focuses on prominent problems existing in the teaching practice of the Numerical Analysis course. These problems include rigid integration of curriculum ideological and political elements, insufficient value guidance, the long-standing imbalance between theoretical teaching and practical training, weak engineering ethics awareness among students, and a unitary teaching evaluation model. Guided by the teaching philosophy of "Consolidating theoretical foundation through rigorous numerical thinking, and shaping students' values through practical cultivation", this study constructs a four-dimensional curriculum ideological and political education system that integrates the cultivation of scientific spirit, patriotic consciousness, engineering ethics, and innovative practical awareness. This study implements a series of teaching reforms, including restructuring the dual-threaded teaching content that integrates professional knowledge and ideological and political education, innovating a diversified teaching mode that combines case-driven teaching, project-based teaching and blended learning, and establishing a three-dimensional teaching evaluation system covering knowledge mastery, ability development and ideological literacy. The proposed teaching reform effectively achieves the trinity educational goal of integrating value guidance, knowledge imparting and ability cultivation. At present, remarkable practical results have been obtained: students have won 4 discipline competition awards, completed 2 provincial college student innovation training projects, obtained 5 software copyrights and published 4 academic papers; the teaching team has also undertaken 3 provincial and ministerial-level teaching reform projects. This practice provides solid support for the cultivation of high-quality application-oriented engineering talents.

Keywords

Curriculum ideological and political education; blended teaching; case-driven teaching; engineering ethics; patriotism.

1. Introduction

Numerical Analysis presupposes advanced mathematics, linear algebra, and programming fundamentals as prerequisite courses. With core computer-aided numerical computing methods and fundamental theories for solving mathematical problems as its central content, the course combines theoretical instruction with practical application, focusing on the accuracy, stability, convergence, and computational efficiency of numerical algorithms. Boasting a complete and logically rigorous knowledge framework, the course has both rigorous scientific mathematical attributes and significant practical engineering application value.

The teaching objectives of this course are formulated as follows: enable students to master the principles, structural logic, and optimization methods of numerical algorithms, proficiently

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202608_9(8).0021

complete algorithm design, programming implementation, result analysis, and performance evaluation, establish systematic scientific and engineering computing thinking, and improve the ability to solve complex engineering computing problems. While consolidating students' professional foundation and cultivating their engineering practice ability and innovative capability, the course integrates the scientific spirit, craftsmanship spirit, and patriotism into the entire teaching process, fulfills the fundamental task of fostering virtue through education, and provides support for cultivating high-quality application-oriented and innovative computer professionals that meet the development requirements of the industry.

Based on the practical exploration of emerging engineering education reform and centered on the fundamental task of fostering virtue through education, the course adheres to the trinity education model integrating knowledge imparting, ability cultivation, and value guidance. It transforms mathematical theories into practical engineering computing competence, and cultivates students' scientific computing thinking, rigorous academic attitude, patriotism, engineering ethics, and innovative and pragmatic spirit. The course has constructed an integrated education system featuring "endowing mathematics with soul, standardizing computation with principles, and implementing education with intention", which serves the high-quality cultivation of application-oriented and innovative talents for emerging engineering disciplines.

2. Analysis of Learning Situations and Teaching Pain Points

In alignment with the established talent cultivation objectives, this paper systematically investigates students' learning status, current teaching practices, and the implementation effectiveness of ideological and political education through academic performance analysis, questionnaire surveys, classroom observation, and teacher-student seminars. In this study, a total of 15 teaching feedback reports and 255 valid student questionnaires were collected. The survey results identify multiple typical problems in current teaching practice, namely the superficial integration of ideological and political elements, the weak connection between theoretical teaching and practical training, the one-sided orientation of students' learning objectives, and the incomplete teaching evaluation system. A detailed analysis of the above problems is presented as follows:

2.1. Superficial Integration of Ideological and Political Elements Weakens Value Guidance

In traditional teaching, professional knowledge instruction and computational skill training are positioned as the core primary objectives, which has led to the fragmented, labeled, and formalistic integration of ideological and political education into courses. Specifically, ideological and political elements are often mechanically inserted into classroom teaching, rather than deeply integrated with professional course content. This further results in the disjointed "two separate systems" phenomenon where professional teaching and value education operate disconnectedly from one another. Most students view *Numerical Analysis* as merely a tool-oriented computational course, focusing only on mastering superficial knowledge and skills, while neglecting the profound scientific spirit, rigorous academic attitude, and social responsibility embedded in numerical theories. Consequently, the course fails to deliver effective value guidance, and the trinity goal of integrating knowledge imparting and value cultivation cannot be achieved.

2.2. Theory-oriented Teaching System Hinders the Cultivation of Engineering Ethics and Responsibility

The traditional teaching paradigm excessively prioritizes theoretical derivation, yet insufficiently incorporates real-world engineering scenarios and industrial application cases.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202608_9(8).0021

This creates a disconnect between classroom instruction and practical engineering requirements. Long-term detachment from authentic research and engineering settings hinders students from comprehensively recognizing the core application value of numerical methods in key engineering domains. As a result, most students fail to develop systematic engineering thinking and clear engineering ethical awareness, and generally exhibit non-standard practices in numerical calculation and programming exercises. This gap significantly constrains the cultivation of students' engineering literacy and professional responsibility.

2.3. Single Learning Orientation Restricts the Cultivation of Innovative Thinking and Patriotism

In general, students tend to set utilitarian, one-dimensional learning objectives, focusing narrowly only on completing course assignments, debugging program code, and passing course assessments. They lack sufficient initiative for exploratory learning and in-depth academic research. In addition, students have insufficient understanding of the current status of industrial development and technical bottlenecks in the scientific computing field. Their grasp of key "bottleneck" technologies, development gaps, and China's current technological breakthroughs in related fields remains inadequate. Furthermore, traditional curriculum-based teaching design has not achieved effective integration between course-based talent development and national strategic needs. This has led to the weakening of students' innovation motivation, sense of mission, and patriotic awareness. Consequently, the development of students' innovative thinking and high-level scientific research capabilities is significantly constrained.

2.4. Rigid Traditional Evaluation Mode Restricts Quantitative Assessment and Closed-loop Implementation of Ideological and Political Education

The current evaluation system, which is predominantly composed of formative assessment and summative assessment, places excessive emphasis on rigid quantitative indicators such as theoretical knowledge mastery, programming outcomes, and written examination performance. This system is marked by unitary evaluation dimensions and outdated evaluation orientation.

At present, there is a lack of standardized evaluation criteria and quantitative indicators for assessing students' key ideological qualities, including rigorous academic attitudes and programming integrity. This has given rise to the prominent dilemma that "curriculum ideology and politics is implemented in the teaching process but absent in corresponding evaluation links".

Consequently, students lack sufficient awareness of cultivating comprehensive literacy. The effectiveness of curriculum ideological and political education cannot be quantitatively evaluated, dynamically fed back, or continuously improved, which further impedes the formation of a closed-loop teaching and education mechanism.

3. Reform Philosophy of Curriculum Ideological and Political Education

Centering on student-centered development and aligning with the construction requirements of emerging engineering education, this course adheres to the teaching concept of "Laying a Solid Foundation with Rigorous Numerical Thinking, Forging Students’ Soul through Diligent Practice", and constructs a four-dimensional curriculum ideological and political education system covering four core dimensions: scientific spirit, patriotism, engineering ethics, and innovation and pragmatism [1]. Based on the trinity implementation path of "value guidance, mathematical foundation consolidation, and engineering practice cultivation", this course deeply integrates professional knowledge teaching with ideological and political education. It transforms the traditional curriculum orientation from merely imparting computing tool

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202608_9(8).0021

knowledge to a dual-oriented training goal that integrates value guidance and competency improvement. This reform is oriented toward cultivating high-quality interdisciplinary engineering talents with a solid professional foundation and comprehensive literacy, to meet the demand of national scientific and technological innovation and industrial upgrading for innovative application-oriented talents.

4. Innovative Reform Measures

4.1. Four-dimensional Integrated Foundation Building to Construct a Full-coverage Ideological and Political Education System

To align with the talent cultivation objectives of emerging engineering education, this course adheres to the core teaching philosophy of *"Laying a Solid Foundation with Rigorous Numerical Thinking, Forging Students' Souls through Diligent Practice"* and breaks down the isolation between traditional professional teaching and ideological and political education. We have constructed a four-dimensional curriculum ideological and political education system that integrates the scientific spirit, patriotism, engineering ethics, and innovative pragmatism, and established a four-in-one supporting system consisting of "knowledge points, ideological and political points, case points, and evaluation points". This design prevents the fragmented and stereotyped implantation of ideological and political elements.

This teaching reform embeds ideological and political education throughout the entire process of professional teaching, forming an integrated education pattern that realizes the deep integration and coordinated development of knowledge impartation and value guidance.

We clarify the core educational orientation under the four-dimensional framework. The teaching of error theory cultivates students' rigorous scientific spirit; combining the industrial application of numerical algorithms with national strategic needs cultivates students' patriotism and sense of national responsibility; interpreting the reliability of calculation results enhances students' awareness of engineering ethics; algorithm optimization and practical programming training cultivate students' innovative and pragmatic literacy. This approach consolidates the fundamental foundation of curriculum ideological and political education.

4.2. Dual-mainline Empowerment to Build Integrated Teaching Content of Professional Knowledge and Ideological Education

Based on the original curriculum knowledge framework, this research reconstructs a dual-mainline teaching system that integrates professional knowledge and ideological and political education. By incorporating disciplinary historical heritage, major national engineering cases and engineering ethics norms into core numerical algorithm modules, this teaching reform addresses traditional deficiencies including excessive emphasis on theory, insufficient ideological guidance and weak practical training, and realizes the synchronous construction and coordinated development of the knowledge system, ability cultivation and value education.

This research fully taps the inherent ideological and political education resources of the discipline. Ancient Chinese numerical achievements represented by the Qin Jiushao Algorithm are integrated into basic teaching modules such as introduction to numerical computation and error analysis. This reform also introduces advanced patriotic research practices, including the academic contributions of Academician Feng Kang and the independent research and development efforts of domestic CAE and scientific computing software teams. These teaching contents inherit the wisdom of traditional Chinese mathematics, demonstrate the dedication of contemporary researchers to serving the country through scientific and technological innovation, and effectively enhance students' disciplinary confidence and sense of mission for national scientific and technological development.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202608_9(8).0021

Focusing on major national engineering application scenarios, the course constructs a practice-oriented teaching system to achieve the precise alignment of theoretical knowledge with industrial needs. Linear equation algorithms are linked to structural simulation of bridges and dams and aerodynamic calculation in aerospace engineering; interpolation and fitting methods are applied to medical image reconstruction and meteorological numerical forecasting; numerical integration techniques support satellite orbit calculation and high-precision data processing; numerical solutions of ordinary differential equations serve new energy battery simulation and chip thermal field analysis. Such diversified application scenarios allow students to fully recognize the practical engineering value of numerical methods. Furthermore, the course adds a special engineering ethics module with the thematic teaching content of "Computational Errors and Engineering Safety". Drawing on typical engineering accident cases caused by computational negligence, the course clarifies the professional norms of scientific computing and guides students to assume lifelong ethical responsibility for all engineering computational results.

4.3. Multi-mode Collaboration to Build a Three-dimensional Blended Teaching Model

This course breaks through the conventional single lecture-based teaching paradigm and adopts a synergistic teaching framework that integrates case-driven instruction, project-based learning, and blended teaching [2-3]. It restructures the full-process teaching sequence covering pre-class, in-class, and after-class sessions, transforming the traditional passive knowledge indoctrination model into active inquiry-based learning to comprehensively improve students' engineering practical ability and comprehensive ideological literacy.

A standardized case teaching system with deep ideological-political integration has been constructed. Taking error theory and numerical stability as core teaching contents, a closed-loop ideological-political teaching mechanism is established. Teaching activities are initiated with typical engineering cases where uncontrolled calculation errors lead to experimental failures, helping students establish the professional cognition that "computational precision equals engineering responsibility". This course elaborates on error sources, error propagation rules, and stability discrimination principles, emphasizing the rigor of theoretical derivation and the controllability of computing processes. Students are required to complete algorithm programming based on Python, submit systematic error analysis reports, and sign commitment documents for computing integrity [4]. Ultimately, the professional value that "scientific computing tolerates no negligence, and data reliability constitutes the fundamental bottom line" is sublimated, realizing the organic unification of knowledge acquisition, capability improvement, and value shaping.

This course carries out thematic project-based learning oriented to core domestic technical demands in the field of numerical computing [5]. A series of practical projects are designed, including physical field simulation based on the finite difference method corresponding to the independent research and development of domestic CAE software, interpolation fitting and error evaluation based on real meteorological and survey data that supports national strategic development, and optimization design of efficient solving algorithms for high-performance computing industries. All practical projects are equipped with complete evaluation modules, which enable students to apply theoretical knowledge to solve practical engineering problems and cultivate their pragmatic spirit of tackling core technical bottlenecks for national development.

A complete online-offline blended teaching platform is constructed to support full-cycle personalized learning. Online ideological-political and professional resources are integrated via Superstar Learning and MOOC platforms to build an exclusive curriculum resource library. Offline experimental teaching implements standardized management mechanisms to prohibit

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202608_9(8).0021

academic misconduct, standardize students' research behaviors, and cultivate rigorous and realistic academic literacy.

4.4. Three-dimensional Closed-loop Management to Improve the Full-coverage Quantitative Education Evaluation System

Against the deficiency of traditional evaluation models that overemphasize academic performance and neglect the cultivation of comprehensive literacy, this research innovatively constructs a three-dimensional closed-loop evaluation system integrating three dimensions: knowledge mastery, practical ability, and ideological literacy. By optimizing the weight distribution of assessments, enriching multi-dimensional evaluation indicators, and adding independent assessment dimensions for ideological and political education, this teaching reform establishes an integrated teaching-learning-evaluation closed-loop mechanism, and effectively addresses the challenge that the effect of curriculum ideological and political education is difficult to quantify.

Process assessment accounts for 50% of the total course score, and covers a multi-dimensional set of educational indicators. Classroom interaction performance is used to evaluate students' scientific critical thinking ability. After-class assignments and programming experiments are applied to assess the rigor of computational methods and the standardization of academic behaviors. Course project reports are adopted to examine students' team collaboration ability, algorithm innovation level and engineering application competence. Students' ideological perception sharing and project summary reports are utilized to quantitatively evaluate their value recognition and patriotic literacy.

Summative assessment accounts for the remaining 50% of the total course score. Based on the traditional theoretical examination, subjective questions related to algorithm engineering ethics, domestic engineering application scenarios of numerical technology and the connotation of scientific spirit are added, which integrates ideological literacy assessment into the final evaluation system [6]. Independent quantitative ideological and political indicators are developed to incorporate implicit literacy including honest programming, error review and rectification, team contribution, and patriotic practice into the standardized scoring system. The constructed evaluation mechanism is quantifiable, monitorable, and iteratively optimizable, which provides a guarantee for the practical effectiveness and continuous improvement of curriculum ideological and political education.

5. Reform Effects

5.1. Improving Learning Quality through Teaching Reform to Cultivate Students' Comprehensive Competencies

Supported by an innovative teaching model that integrates case-driven instruction, project-based learning, and blended learning, in conjunction with a three-dimensional evaluation system, this teaching reform has fundamentally corrected students' undesirable learning biases: namely, overemphasizing learning outcomes over learning processes, and prioritizing computational operations over theoretical analysis. Consequently, students' professional learning quality and engineering practical capabilities have achieved comprehensive improvement.

In the context of daily learning, students have demonstrated significant progress in assignment quality, experimental standardization, analytical completeness, and code readability, accompanied by a substantial decline in non-standard learning behaviors. The incidence of non-standard academic behaviors has decreased by over 80%, and students have generally developed rigorous professional literacy. In terms of innovative practice, the number of students actively participating in various academic competitions and practical projects has

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202608_9(8).0021

increased by 30% compared to the pre-reform period. Through curriculum-based capacity cultivation, students have won 4 awards in discipline competitions, undertaken 2 provincial college students' innovation training projects, obtained 5 software copyrights, and published 4 academic papers. This indicates that students have achieved all-round improvement in theoretical foundation, practical ability, and innovative thinking.

5.2. In-depth Student-Centered Education and Effective Value Leadership in Ideological and Political Education

Rooted in the student-centered educational philosophy, and guided by the educational concept of "consolidating fundamental knowledge via rigorous numerical thinking, cultivating students' ideological character through down-to-earth practice" as well as the four-dimensional integrated ideological and political education system, this course realizes the in-depth integration of professional teaching and value guidance, and comprehensively improves students' disciplinary cognition, patriotic consciousness, and professional literacy.

With the continuous advancement of teaching reform and the deepening of curriculum ideological and political construction, students' sense of gain and recognition of this course have improved significantly, and the overall course satisfaction rate has risen from 81% to 90%. Students have abandoned the one-sided misconception that Numerical Analysis is merely a tool-oriented course, and developed a correct disciplinary understanding: numerical calculation is the core foundation of engineering practice, the core technical support, and the strategic guarantee for national technological development. Based on this correct perception, students fully grasp the professional responsibilities and missions underlying scientific computing.

The results of the final questionnaire survey show that more than 92% of students can correctly interpret the scientific spirit and engineering ethics by combining the knowledge points of this course, and 85% of students take the initiative to pay attention to the independent development of China's domestic scientific computing and industrial software industry. Students' patriotic consciousness and awareness of serving the country through scientific and technological progress have been significantly enhanced, which proves that the value guidance function of this curriculum has been effectively implemented in teaching practice.

5.3. Cultivation of Professional Literacy Adaptive to Industrial Development Based on Industry-Oriented Education Concepts

Aligned with the talent cultivation requirements of emerging engineering education and centered on the practical demands of the industrial sector, the systematic and standardized integration of professional teaching and ideological-political education can comprehensively enhance students' core professional literacy. The talents cultivated through this reform demonstrate strong adaptability to professional positions including scientific research simulation, engineering calculation, industrial software development, and precision simulation testing.

Based on graduate tracking surveys and employer feedback, the rigorous and pragmatic academic attitude, data integrity awareness, problem-solving ability, and team collaboration spirit cultivated through the curriculum effectively support students' long-term career development and post competency. Employers generally note that graduates educated through this reform have solid mathematical foundations, standardized engineering thinking, rigorous academic styles, and clear professional ethical bottom lines. With proficient professional competence and deep-rooted patriotic sentiments, these graduates can rapidly adapt to the requirements of industrial positions and fully meet the cultivation objectives of high-quality applied and innovative engineering talents in the new era.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202608_9(8).0021

6. Conclusion

Focusing on the pain points in practical teaching and grounded in integrated educational approaches, this study, oriented toward comprehensive talent cultivation, promotes the transformation of the *Numerical Analysis* course from pure instrumental knowledge teaching to the "trinity" educational paradigm that integrates value guidance, knowledge impartment, and capability cultivation. It also effectively addresses the prominent issue of rigid and superficial integration of ideological and political elements into the course. This research has established a distinct teaching philosophy: "Consolidate foundations through rigorous numerical thinking, and cultivate students' values through down-to-earth practice." In future research, we will further deepen the integration of science education, industrial-educational collaboration, and artificial intelligence-enabled teaching. We will continuously incorporate real-world enterprise computing projects and application cases of domestic industrial software to improve the pertinence, temporal relevance, and effectiveness of curriculum-based ideological and political education, so as to contribute to the cultivation of high-quality innovative engineering talents.

Project Funding

Supported by the 2024 Industry-University Cooperation and Collaborative Education Project (241203492033734).

References

[1] Li, M. X., & Dong, Y. (2022). Integrating ideological and political education into teaching and embedding scientific research in teaching—Teaching philosophy of numerical analysis course based on curriculum ideological and political education. Journal of Higher Education, 8(34), 184-187, 192.

[2] Yang, H. L., & Zeng, X. Y. (2023). Research and practice on teaching reform of curriculum ideological and political education under the background of emerging engineering education. China Educational Technology & Equipment, (24), 132-134.

[3] Yin, X. L., Zhao, C. Y., Li, Q. P., et al. (2025). Practical teaching reform of numerical analysis course under the OBE concept. Journal of Science of Teachers' College and University, 45(10), 57-63.

[4] Zhang, L. (2025). Exploration and analysis of ideological and political elements in the course of numerical analysis. Education and Teaching Forum, (23), 29-32.

[5] Wang, Y. J., Zheng, E. X., & Qu, K. (2025). Research on the teaching mode reform of numerical analysis oriented to solving practical problems. Journal of Higher Education, 11(8), 134-137.

[6] Fang, S. J., & Zhou, J. W. (2025). Exploration on ideological and political integration and teaching evaluation in the classroom teaching of science and engineering numerical analysis course. University, (29), 97-100.