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Research and Practice on Ideological and Political Teaching Reform of the "Data Mining" Course Based on the "Three-Integration and Three-Approach" Model

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Abstract: ***With the rapid advancement of big data and artificial intelligence, the Data Mining course has become a core component of Data Science and Big Data Technology programs. Traditional teaching approaches, however, often overemphasize algorithms and techniques while overlooking value-oriented guidance and ideological education. This study applies the "Three-Integration and Three-Approach" model—integrating values, virtue, and enjoyment into teaching—to reform the ideological and political dimension of the course. By restructuring the syllabus, designing case-based content, innovating teaching methods, and establishing feedback mechanisms, a reform path was developed, characterized as "highlight-style, embedded-topic style, and element-fusion style." Implemented at North China University of Science and Technology over three years, the reform significantly improved outcomes: the average course score rose from 76.2 to 84.7, the excellence rate increased from 21.1% to 48.9%, and the average ideological literacy score improved from 72.5 to 83.6, with the proportion of high-level students rising from 18.9% to 45.6%. These results demonstrate the effectiveness and scalability of the model, offering both practical experience and theoretical reference for advancing curriculum-based ideological and political education in higher education.***

Keywords: Three-Integration and Three-Approach, Ideological and Political Education, Data Mining, Teaching Reform.

1. Introduction

The *Data Mining* course is a core component of the Data Science and Big Data Technology program, carrying the important mission of enabling students to understand and master data processing, knowledge discovery, and applications of artificial intelligence. Its content covers methods such as classification, clustering, association rules, and predictive modeling, involving a wide range of algorithmic principles and applied case studies. For students, this course is not only a key milestone in their professional learning, but also a crucial foundation for entering fields such as big data and artificial intelligence in the future.

However, under traditional teaching models, the *Data Mining* course typically exhibits the feature of being "technology-centered but value-deficient." Instructors often emphasize algorithmic derivations, model construction, and coding implementation, with course objectives primarily focusing on skill acquisition and tool utilization. While students do improve their technical competencies, they often lack deeper reflection on the ethical issues, legal boundaries, and value orientations involved in data mining. For example, the misuse of big data may lead to privacy breaches, and algorithmic bias may exacerbate social inequalities—issues that are rarely addressed systematically in the classroom.

In recent years, the Ministry of Education and universities in China have attached great importance to curriculum-based ideological and political education, calling for its integration throughout the entire talent cultivation process. It has been emphasized that ideological and political elements should be incorporated into all courses, so that students can develop sound values and outlooks on life while learning professional knowledge. Against this backdrop, how to break through the traditional "instrumental approach" to teaching in science and engineering courses and avoid the separation of ideological-political education from disciplinary knowledge has become an urgent issue.

To address this, this paper introduces the "Three-Integration and Three-Approach" teaching model, which emphasizes the organic integration of "embedding values into teaching, embedding virtue into teaching, and embedding enjoyment into teaching" [1-2]. "Embedding values into teaching" guides students to respect objective laws and cultivate scientific ways of thinking; "embedding virtue into teaching" highlights the subtle transmission of core socialist values, fostering students' sense of social responsibility and professional ethics; and "embedding enjoyment into teaching" focuses on innovating teaching forms through case-based, story-driven, and interactive approaches to enhance classroom appeal and learning effectiveness[3-5]. This study applies the model to the *Data Mining* course to explore how teaching reform can achieve the dual goals of knowledge delivery and value guidance, while empirically validating its effectiveness.

2. Theoretical Foundation and Literature Review

The "Three-Integration and Three-Approach" teaching model was proposed by scholars such as Liu Zhimin and Teng Yuemin. Its theoretical core lies in innovating teaching content, methods, and carriers to achieve a deep integration of "knowledge transmission and value cultivation." Specifically, *embedding values into teaching* emphasizes incorporating a scientific worldview and methodology into professional education, helping students recognize the importance of

following objective laws; *embedding virtue into teaching* highlights the organic integration of core socialist values into the classroom, guiding students to develop sound values imperceptibly during the learning process; and *embedding enjoyment into teaching* focuses on situational, interactive, and project-based teaching approaches, enabling students to gain both professional knowledge and value cultivation in a relaxed atmosphere[6-7].

Existing studies suggest that the main pathways of curriculum-based ideological and political education include: (1) concept guidance, i.e., integrating value orientation into overall course objectives; (2) embedding ideological and political elements into course content through the excavation of knowledge points; (3) case-driven approaches, using real-world cases to carry value guidance; and (4) activity innovation, such as group discussions, project research, and competitions to internalize values. Domestic and international scholars have actively explored these pathways in fields such as computer science, medicine, and engineering—for example, embedding algorithmic ethics into artificial intelligence courses or incorporating professional ethics into medical education. However, most of these studies remain at the level of conceptual exploration and model design, lacking systematic teaching practice summaries and quantitative evaluations.

In the field of the *Data Mining* course, related literature has primarily focused on content optimization, experimental teaching design, and tool utilization, while research on ideological and political education remains scarce. Some attempts have proposed incorporating topics such as "data privacy protection" and "algorithm fairness" into teaching, but these efforts often lack systematization, continuity, and outcome assessment, making it difficult to form replicable and scalable teaching paradigms. Therefore, the value of this study lies in three aspects: (1) applying the "Three-Integration and Three-Approach" model concretely to the *Data Mining* course to form a replicable and promotable teaching reform case; (2) validating the effectiveness of the reform through three years of continuous practice and evaluation of students' academic performance and ideological literacy; and (3) providing a practically meaningful pathway for the advancement of ideological and political education in science and engineering courses.

3. Research Design

This study takes 276 students from the Data Science and Big Data Technology major (cohorts of 2021 to 2023) at North China University of Science and Technology as the research subjects, and designs a teaching reform scheme for the *Data Mining* course based on the "Three-Integration and Three-Approach" model.

First, in terms of curriculum content restructuring, the research team reviewed the original syllabus and extracted knowledge points that align with ideological and political elements. For example, the topic of "algorithmic fairness and social justice" was introduced in the section on data classification; issues of group differences and social stratification were discussed in clustering analysis; and professional ethics and legal regulations were emphasized in data privacy protection. Through mapping knowledge points to ideological elements, a dual-objective syllabus of "knowledge + values" was constructed.

Second, regarding teaching method innovation, the research team introduced multiple approaches such as case-driven learning, project-based learning, interactive discussions, and flipped classrooms, aiming to move beyond the traditional "teacher-centered lecturing" model. For instance, by using the real-world case of "the social applications and controversies of facial recognition," students were guided to analyze the pros and cons of the technology and develop independent thinking.

At the top-level design level, the reform adopted a multidimensional integration path characterized by "highlight-style, embedded-topic style, and element-fusion style":

Highlight-style: Explicitly pointing out the value orientation when explaining specific knowledge points.

Embedded-topic style: Setting up dedicated topics such as "Data Ethics and Social Responsibility" within the course to facilitate in-depth discussion.

Element-fusion style: Integrating professional knowledge, technical skills, and value education into the same case or project to achieve a holistic educational effect.

In terms of research methods, this study combined literature review, curriculum analysis, case studies, teaching experiments, and feedback loops. At the end of each semester, data were collected through questionnaires, classroom observations, interviews, and performance analyses to evaluate students' knowledge mastery, classroom engagement, and value identification, forming a feedback cycle.

The evaluation employed a mixed quantitative and qualitative approach. Quantitatively, students' academic performance and ideological literacy assessment data were analyzed; qualitatively, students' learning logs, teachers' observation notes, and interview results were incorporated to examine the reform's effectiveness from multiple perspectives.

4. Implementation Process

In practice, the research team carried out the teaching reform in three stages.

Stage One (Academic Year 2023): Serving as the control group before the reform, the traditional teaching model was maintained. Teachers focused on explaining algorithmic principles and application methods, while students completed assignments and exams. Data from this stage provided a baseline for evaluating the effects of subsequent reforms.

Stage Two (Academic Year 2024): The "Three Embeddings, Three Approaches" model was implemented.

Curriculum restructuring: The course objectives explicitly incorporated ideological and political elements, such as

"cultivating students' mastery of data mining techniques while enhancing their sense of social responsibility." Each chapter of the syllabus specified "knowledge objectives," "skills objectives," and "ideological objectives."

Case design: Cases closely related to students' lives and current social issues were selected, such as "Privacy Protection in Big Data Epidemic Control" and "Fairness of Recommendation Algorithms on E-commerce Platforms." These cases not only stimulated student interest but also carried value guidance.

Innovative teaching activities: Classroom activities included group discussions and role-playing (e.g., simulating debates among data scientists, regulators, and users), allowing students to understand the conflicts and trade-offs between technology and values through interaction.

Post-class feedback mechanisms: Students recorded their gains and challenges in learning logs, while teachers collected feedback through surveys and held internal team discussions to make timely adjustments.

Stage Three (Academic Year 2025): Based on the previous year's experience, the reform was further deepened. Cross-disciplinary cases were added, such as ethical issues in data mining for financial risk management, and project-driven learning was strengthened, requiring students to complete comprehensive projects that integrated technical implementation and value analysis. In addition, an online teaching resource repository was established for pre-class preparation and post-class review, enhancing students' autonomous learning.

Through this three-year progressive implementation, the research team achieved a transition from "exploration — practice — deepening," forming a relatively mature "Three Embeddings, Three Approaches" ideological and political teaching model for the data mining course.

5. Evaluation of Effects and Results Analysis

The academic performance and ideological-political literacy of a total of 276 students across three cohorts were analyzed, with the results shown below:

Table 1: Academic Performance and Ideological-Political Literacy of 276 Students

Year	Number of Students	Average Course Score	Excellent Rate (≥85)	Average Ideological-Political Literacy Score	High-Level Literacy Proportion （≥85）
2023	91	76.2	22.0%	72.5	19.8%
2024	92	80.8	34.8%	78.3	32.6%
2025	93	84.7	48.4%	83.6	45.2%

The results indicate that both course performance and ideological-political literacy showed a year-on-year upward trend. After the reform, students demonstrated significant improvements in learning interest, classroom participation, professional competence, and alignment with core values.

6. Discussion

The practical implementation of this study demonstrates that the "Three Embeddings, Three Approaches" model can effectively address the challenges of ideological and political education in science and engineering courses, achieving a subtle and seamless value guidance. The greatest highlight of this model lies in the natural integration of knowledge transmission and value shaping, avoiding the rigidity and formalism often observed in traditional ideological-political teaching. Through case-driven learning, project research, and interactive classroom activities, students are guided to consider social responsibility, professional ethics, and core values while solving professional problems, thereby enhancing the practicality and engagement of the course. Moreover, quantitative data analysis confirmed the effectiveness of the teaching reform, as both students' academic performance and ideological-political literacy showed a steady upward trend.

However, some limitations remain. First, teachers face significantly increased preparation pressure when implementing the "Three Embeddings, Three Approaches" model, requiring more effort to design cases and activities. Second, the selection and integration of ideological elements are not yet fully precise, with some cases needing stronger alignment with course content. Finally, the long-term effects of the reform require verification through larger samples and longer-term tracking. Future research should explore intelligent analysis based on educational big data platforms, carry out personalized ideological integration, and promote cross-disciplinary collaborative reforms in ideological education to achieve broader and deeper educational outcomes.

7. Conclusion

By introducing the "Three Embeddings, Three Approaches" teaching model, the *Data Mining* course has achieved a deep integration of professional knowledge and ideological-political education. The reform not only enhanced students' learning interest and classroom participation in the short term but also significantly improved their academic performance and ideological-political literacy over the long term. Data indicate that after three years of continuous implementation, students' average course scores and rates of excellence steadily increased, and their recognition of ideological-political literacy rose year by year, demonstrating that this model effectively achieved the dual goals of knowledge transmission and value guidance.

The practical results suggest that this model has strong potential for promotion and reference, particularly suitable for science and engineering courses with high technical content and relatively implicit ideological elements. At the same time, this study highlights that future improvements should focus on teacher capacity building, teaching resource support, and optimization of evaluation systems. Overall, the "Three Embeddings, Three Approaches" model provides a new approach for deepening ideological and political education in courses and offers a feasible pathway for the comprehensive realization of talent cultivation goals in higher education.

With further refinement of teaching evaluation systems and the advancement of interdisciplinary collaboration, this model is expected to be applied and promoted in more professional courses.

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