

Reform and Practice of Ideological and Political Education in Advanced Mathematics under the OBE Concept

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Abstract: In the context of the new era of education, advanced mathematics not only undertakes the function of knowledge transmission but also plays a vital role in cultivating logical thinking, scientific spirit, and value orientation. However, traditional teaching has overemphasized knowledge instillation while neglecting value guidance, making it difficult to meet the demands of cultivating interdisciplinary talents. This study introduces the OBE concept and constructs a “knowledge–ability–value” teaching framework, integrating outcome orientation, backward design, and diversified evaluation to promote the systematic incorporation of ideological and political education into the curriculum. Taking limits, definite integrals, and series as representative knowledge points, the paper designs case-based pathways to foster dialectical thinking, patriotism, and scientific spirit. Practice has shown that this model effectively unifies knowledge education and value education, enhancing students’ logical reasoning, sense of responsibility, and scientific literacy. The study provides an operational pathway for the reform of ideological and political education in advanced mathematics courses and carries practical significance for implementing the goal of “all-round education.”

Keywords: OBE concept; Advanced mathematics; Ideological and political education; Teaching reform; Case-based teaching

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1. Introduction

1.1. Research background and significance

In the context of the new era, China attaches great importance to the construction of ideological and political education (IPE) in the curriculum, requiring all courses to undertake the fundamental mission of “fostering virtue through education”^[1]. As a core foundational course for science and engineering majors, advanced mathematics is not only the starting point for students to enter professional learning but also an essential pathway for cultivating rational thinking and scientific spirit. However, traditional teaching has largely emphasized knowledge transmission while paying insufficient attention to value guidance, making it difficult to meet the requirements of

cultivating interdisciplinary talents in the new era. Integrating IPE organically into advanced mathematics teaching helps students strengthen their sense of social responsibility and historical mission while mastering knowledge and methods, thereby realizing the deep integration of knowledge education and value education^[1].

The OBE (Outcome-Based Education) concept emphasizes student learning outcomes, focusing on “what students can do.” Through backward design and diversified evaluation, it promotes the achievement of learning goals. This provides an effective pathway for IPE, enabling teachers to embed value guidance throughout the teaching process and achieve the coordinated development of both “learning ability” and “personal growth”^[2].

1.2. Literature review

In recent years, scholars at home and abroad have explored the integration of the OBE concept and IPE in advanced mathematics. Existing research generally agrees that advanced mathematics, as a fundamental course for science and engineering students, also serves as an important vehicle for cultivating logical thinking and value orientation. The integration of OBE and IPE can optimize course objectives and evaluation systems under the principles of outcome orientation and student-centeredness, thereby achieving the unity of knowledge, ability, and value^[2-5]. Moreover, advanced mathematics contains abundant ideological and political resources. If teachers actively explore and integrate case-based instruction, they can effectively promote the integration of disciplinary education and value education^[6,7]. Current practices have attempted to incorporate elements such as mathematicians, scientific achievements, and typical knowledge point cases, expanding classroom teaching from “knowledge transmission” to “holistic education”^[4,8]. In addition, blended teaching models and formative assessment further enhance the educational function of mathematical knowledge^[9-10].

Overall, existing studies provide both theoretical and practical references for IPE in advanced mathematics, but there remain limitations in systematic design, case resource development, and sustainable promotion. Building on this foundation, this paper proposes a teaching logic of IPE based on the OBE concept and validates its effectiveness through representative cases.

2. Integration logic of OBE concept and course ideology

2.1. Core connotation of OBE concept

The OBE concept emphasizes a learning-outcome orientation, focusing on clarifying the competencies and qualities that students should possess. It designs course content through backward planning and evaluates the achievement of goals via diversified assessments. Its concern lies not only in “what students have learned,” but more importantly in “what they can do,” highlighting the unity of knowledge acquisition, ability cultivation, and value shaping^[2].

2.2. Fundamental goals of course ideology

Course ideology aims to integrate ideological and political education into all types of courses, realizing the coordinated development of professional education and value guidance^[6]. In the teaching of advanced mathematics, embedding value guidance into logical thinking training enables students to enhance abstract thinking and rational analysis abilities, while at the same time gradually cultivating correct values and a sense of responsibility.

2.3. Supporting role of OBE concept for course ideology

The OBE concept provides a closed-loop mechanism of “goal orientation – backward design – evaluation feedback” for course ideology:

- (1) At the goal level, course objectives cover knowledge, ability, and values, making ideological objectives an inherent component;
- (2) At the process level, teaching content and activities are organized around value cultivation, enabling ideological elements to be naturally integrated into the knowledge system;
- (3) At the evaluation level, formative and summative assessments are combined to measure the achievement of responsibility awareness, scientific spirit, and other qualities^[2,6].

On this basis, this paper constructs the “Teaching Logic Framework for Advanced Mathematics Course Ideology under the Guidance of OBE Concept,” as shown in **Figure 1**.

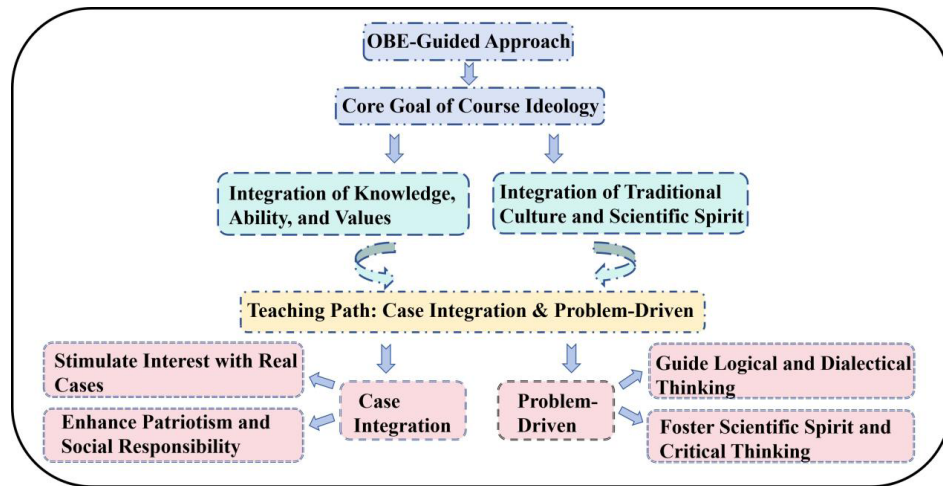


Figure 1. OBE-guided framework for advanced mathematics course ideology.

3. Teaching case practice: Exploration of integrating ideological and political elements into advanced mathematics

To demonstrate the integration of advanced mathematics knowledge points with ideological and political elements, this paper selects three typical topics—limits, definite integrals, and series—and outlines their teaching content, ideological entry points, and objectives, as shown in **Figure 2**.

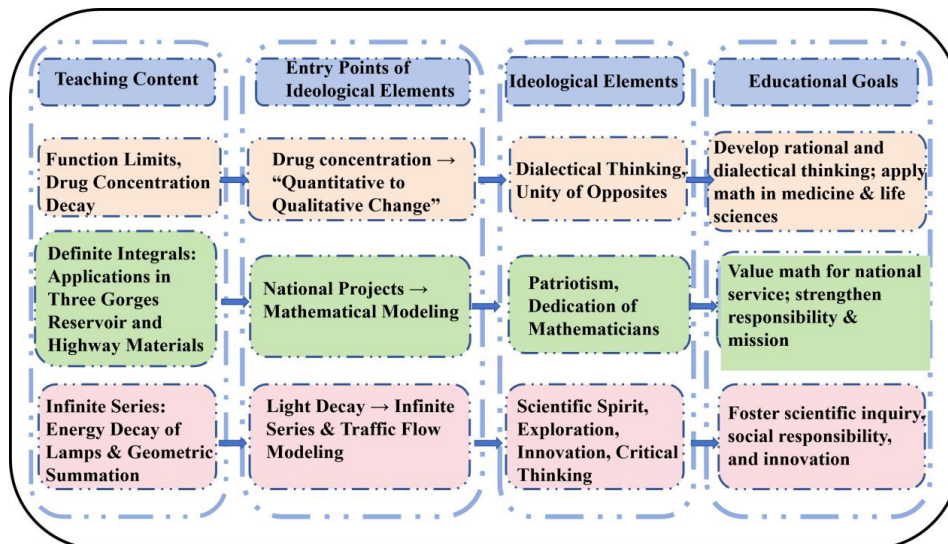


Figure 2. Integration path of ideological elements in advanced mathematics.

3.1. Case 1: Limits and dialectical thinking

When teaching limits, the context of “drug concentration decreasing over time” is used to illustrate the essence of “approaching but not equal,” guiding students to connect mathematical limits with dialectical thinking. Further links are made to the philosophical idea of “quantitative change leading to qualitative change,” helping students realize that accumulation beyond a threshold triggers transformation. When discussing cases where limits do not exist, the notion of the “unity of opposites” is emphasized.

This case not only deepens students’ understanding of abstract concepts but also cultivates dialectical analysis, enhancing their awareness of the connections between mathematics and life sciences.

3.2. Case 2: Definite integrals and patriotism

In teaching definite integrals, the example of calculating the water storage of the Three Gorges Project highlights mathematics’ role in national development and fosters patriotic awareness. Other applications, such as estimating pavement material volumes for highways, show the practical value of mathematics in infrastructure and economic growth. The spirit of Hua Luogeng—“writing mathematics on the land of the motherland”—and Chen Jingrun’s perseverance under difficult conditions are also introduced, encouraging students to appreciate the dedication and persistence of scientists.

This case helps students grasp the idea of “whole and part” in integrals while guiding them to reflect on the relationship between the individual and the nation, thus strengthening patriotism and social responsibility.

3.3. Case 3: Series and scientific spirit

In studying infinite series, the problem of “light intensity decay with reflections” introduces geometric series, encouraging students to appreciate logical reasoning and the spirit of scientific inquiry. The works of Euler, Riemann, and other mathematical masters are presented to highlight the importance of persistence and trial-and-error in exploration. As an extension, students are assigned a modeling task on “urban traffic flow prediction,” applying series and approximation methods to real-world problems.

This case not only develops their mastery of series but also fosters critical thinking, innovation awareness, and a sense of social responsibility through practice.

4. Conclusion

4.1. Achievements and insights

The reform of ideological and political education in advanced mathematics under the OBE framework has achieved a “three-dimensional orientation” of course objectives by integrating knowledge acquisition, ability cultivation, and value shaping. Through case-based teaching, the classroom not only illustrates the practical significance of mathematics in national development and scientific progress but also cultivates students’ logical reasoning, scientific spirit, and patriotic awareness.

The findings confirm that advanced mathematics can serve as an effective carrier of course ideology, with its abstract and logical features providing a natural entry point for value education. By adhering to outcome-oriented course design, teachers can foster the coordinated growth of students’ academic learning and character building.

4.2. Challenges and future prospects

Despite these achievements, several challenges remain: some teachers’ understanding of OBE and course ideology is still superficial, with limited capacity for systematic instructional design; the construction of case repositories and

teaching resources remains insufficient, hindering large-scale implementation; and students' diverse backgrounds lead to varying levels of acceptance of ideological content. Future work should therefore focus on:

(1) Strengthening teacher training to transform OBE principles into practical instructional competence; (2) Building standardized, shareable case repositories to support broader adoption; (3) Advancing interdisciplinary integration so that mathematical knowledge and humanistic education mutually reinforce each other, creating a holistic framework for talent cultivation.

Through these measures, advanced mathematics can not only consolidate its role as a foundational discipline in science and engineering but also contribute more profoundly to the realization of all-round education.

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Disclosure statement

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