Reform of Ideological and Political Education in Higher Mathematics Courses under the Background of Vocational Education

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Abstract

This paper focuses on the characteristics of vocational education types and takes Shenzhen Polytechnic as an example to carry out the practice of ideological and political teaching reform in higher mathematics courses. In response to the problem of "emphasizing knowledge over morality" in traditional teaching, construct a three-dimensional education system of "knowledge – ability – quality": innovate the three-layer integration model of "mathematical principles – philosophical thoughts – professional ethics" in teaching design and develop a localized case library; In teaching implementation, the "BOPPPS+ ideological and political" model is employed, combined with PBL and intelligent grouping strategies to resolve the predicament of large-class teaching; The evaluation reform pioneered the digital portrait of ideological and political literacy, integrating behavioral data with growth and value-added analysis. Practice shows that students' recognition of ideological and political education is high, and their scientific spirit and professional qualities have improved significantly. Reflections propose deepening paths: Strengthen the cross-disciplinary "dual-teacher, dual-case" collaborative mechanism, build a "three-stage, four-dimensional" ability cultivation system for teachers, promote the transformation of ideological and political education from "label grafting" to "gene integration", and provide a reference for the construction of vocational mathematics courses in higher vocational education.

Keywords

Vocational ducation, Advanced mathematics, Curriculum-based ideological and political education, Reform of teaching practice

Introduction

In the context of deepening vocational education reform and implementing the fundamental task of fostering virtue and nurturing talent, national strategies and regional development demands have put forward clear requirements for the construction of ideological and political education in higher mathematics courses. Since the 18th National Congress of the Communist Party of China, the education sector has explicitly put forward "taking moral education as the fundamental task of education", requiring all kinds of courses to move in the same direction as ideological and political theory courses to form synergy effects. Documents such as the National Vocational Education Reform Implemehasion Plan and the Opinions on Promoting the High-End Development of Vocational Education in Shenzhen to Strive for World-Class Status have provided top-level design, and policy guarantees for the development of vocational education. Vocational education shoulders the responsibility of cultivating high-quality technical and skilled talents, master craftsmen, and great national artisans. Its talents need not only exquisite skills, but also firm ideals

and beliefs, noble professional ethics, deep patriotic feelings, and a strong sense of social responsibility. Higher mathematics, as a broad-based course with profound thinking training in vocational education, is a natural career and strategic position for ideological and political education. At present, traditional higher vocational mathematics teaching often falls into the trap of "emphasizing tools over humanities, emphasizing skills over qualities", and the teaching content is disconnected from students' actual thinking. There is an urgent need to solve this predicament through the reform of ideological and political education in courses. Especially in the context of Shenzhen's construction of the pilot demonstration area of socialism with Chinese characteristics and the Guangdong-Hong Kong-Macao Greater Bay Area, cultivating high-end technical talents with both craftsmanship spirit and innovation ability has become a core proposition to support regional industrial upgrading.

Teaching the design of ideological and political education in courses

Update teaching design concepts

In the new era, we should abandon the previous teaching inertia of "valuing knowledge over morality" and establish the integrated teaching design concept of "student-centered, ideological and political-led, ability-oriented". Deeply recognize that advanced mathematics is not only an instrumental discipline, but also an important vehicle for cultivating students' scientific worldview, methodology, and professional quality. Instructional design emphasizes that while imparting mathematical knowledge and developing arithmetic and logical reasoning abilities, it deeply explores and naturally integrates ideological and political elements to achieve the effect of ideological and political education, "like salt in water", and to achieve the effect of nurturing people imperceptibly. Expand the curriculum objective from a single "problem-solving" to a multi-dimensional goal of "understanding the reasoning, comprehending the ideas, strengthening the beliefs, and emphasizing the application".

Revise the teaching objectives

At the level of teaching objectives, this study systematically revised the traditional higher mathematics curriculum objectives that focus on knowledge imparting and ability development, clearly integrating the dimension of ideological and political education, and constructed a "trinity" curriculum objective system of knowledge, ability, and quality. Specifically, the ideological and political goals aim to guide students to: understand the spirit of science and the consciousness of exploration; Cultivate dialectical thinking and philosophical literacy; Cultivate a sense of patriotism and responsibility; Cultivate professional spirit and moral character; Enhance cultural confidence and aesthetic edification. The revision of this goal aims to achieve a deep integration of value guidance with knowledge imparting and ability development, laying a solid mathematical literacy and ideological foundation for the cultivation of high-quality technical and skilled talents who are both virtuous and skilled.

Dig into ideological and political elements

At the level of ideological and political element mining, this study systematically sorted out the key integration points based on the bidirectional mapping of the advanced mathematics knowledge system and ideological and political education goals to ensure that ideological and political education is precisely integrated and naturally permeated. The specific approaches include: in the concept introduction stage, such as limits and derivatives, skillfully associate values like the spirit of striving and seizing opportunities; In the process of proving theorems, emphasize logical rigor to cultivate rational thinking, and use the story of mathematicians seeking truth to demonstrate the power of holding on to beliefs; In the method application stage, such as integrating for volume and optimization problems, incorporate the concept of sustainable development and systems thinking, and emphasize rigorous and precise professional qualities; Through the history and figures of

mathematics, especially the achievements of ancient China and the deeds of modern and contemporary patriotic mathematicians, cultivate cultural confidence and a sense of patriotism; Carefully designed case studies, combined with contemporary hotspots and local resources such as technological breakthroughs in Shenzhen high-tech enterprises and data modeling for special economic zone development, explain the value of mathematics in serving national strategies and solving real-world problems, and inspire the aspiration to serve the country through science and technology and a sense of social responsibility [1]. This excavation process focuses on the intrinsic logical connection between elements and knowledge, aiming to achieve an organic integration like "salt dissolving in water".

Implementation of ideological and political education in the curriculum

Overview of the course offered

This course is currently based on the "Advanced Mathematics" course (usually 160 class hours and two semesters) offered to science and engineering (such as electronic information and communication engineering) and economics and management (such as Financial Technology and Cross-border e-commerce) majors at Shenzhen Polytechnic [2]. The course covers modules such as functions, limits and continuity, derivatives and differentials, integrals and their applications, differential equations, series, etc. Before the reform, the traditional lecture plus exercise practice mode was mainly adopted. After the reform, the above-mentioned ideological and political elements were systematically integrated while maintaining the integrity of the knowledge system, and the teaching content and methods were optimized.

Teaching staff

Strengthening the teaching staff is key to improving the quality of course-based ideological and political education. To this end, a course-based ideological and political teaching team was formed, consisting of mathematics teachers, ideological and political course teachers (serving as advisors), and relevant professional course teachers (providing application cases). The team currently has 3 professors, 3 associate professors, and 7 lecturers, among whom 9 have doctoral degrees and 2 have master's degrees. The ideological and political education awareness and ability of the team members are enhanced through regular collective lesson preparation, special ideological and political training, such as studying the Ministry of Education guidelines, excellent case discussions, teaching salons, and other forms. Encourage teachers to participate in teaching competitions and research projects related to ideological and political education in courses to facilitate experience exchange and improvement. Emphasize that teachers should lead by example and influence students with a rigorous academic attitude, a deep sense of patriotism, and a positive outlook on life.

Teaching models and methods

(1) A blended online and offline teaching model based on the SPOC concept

Based on the Guangdong Provincial Quality Engineering Project, the teaching team successfully developed the MOOC course of Higher Mathematics and ran it on the Learning Pass platform. Based on the MOOC course, the team implemented blended online and offline (SPOC) teaching. Teachers post teaching tasks in advance on the Learning Pass platform, and students learn by watching teaching videos, participating in interactive discussions, and completing test questions [3]. Teachers use the data on students' learning and feedback obtained through the platform to provide targeted guidance in offline teaching. At the same time, the team delves into the moral education content of professional knowledge in teaching practice, enriches platform resources through various forms such as cases, videos, and literature, and integrates ideological and political education, which not only imparts knowledge but also plays a role in value guidance.

(2) Diversified teaching methods

In terms of innovative teaching models and methods,

this study breaks through the traditional lecture model and builds a multi-collaborative, technology-enabled system of ideological and political teaching methods for courses, including the "BOPPPS+ ideological and political" teaching model, situational creation and case-driven, problem-oriented, and inquiry-based learning (PBL), information technology-enabled, flipped classroom, and blended teaching. Using the "BOPPPS ideological and political" teaching model, ideological and political elements are ingeniously embedded in various links such as introduction, goal setting, participatory learning, and summary. For example, when explaining the concept of calculus, Shenzhen landmarks are used to introduce the concept in the introduction stage, and discussions on the role of mathematics in the construction of the "dual zone" are organized in the participatory learning stage. Vigorously promote context creation and case-driven, relying on real occupational scenarios and social hot issues, naturally incorporate value concepts such as efficiency awareness, sustainable development, and professional ethics, such as using the problem of logistics distribution route optimization to explain the application of maximum value, integrating the occupational concepts of efficiency first and cost savings, and using the financial compound interest model to explain the exponential function, Incorporate awareness of rational investment and risk prevention [4-6]. Implement Problem-based and inquiry-based learning (PBL), design open-ended questions with ideological and political connotations to guide students to explore and understand responsibility, such as "Using mathematical models to evaluate the effect of an environmental protection policy" to guide students to understand the importance of green development through inquiry. Actively empower information technology, push micro-lessons on the history of mathematics and application case videos through online platforms, and use visualization tools such as MWORKS and GeoGebra to present abstract concepts and ideological and political connotations intuitively. Explore flipped classrooms and blended teaching by pushing ideological and political self-study materials before class, deepening value guidance during class, and assigning homework that integrates reflection, such as writing learning reflections, to achieve the synergy of knowledge internalization and value shaping. These methodological innovations aim to enhance the appeal and impact of teaching and ensure that ideological and political education is "like salt in water" and imperceptible.

Teaching evaluation

At the level of teaching evaluation reform, this study constructs a three-dimensional integrated curriculum ideological and political evaluation system of "knowledge – ability – literacy", breaking the traditional single examination evaluation. The specific approaches include: strengthening process evaluation, accounting for 40%, recording thinking quality and teamwork spirit through classroom observation, analyzing professional quality and social responsibility awareness through assignment/project reports, tracking participation in ideological and political resources through online learning data, and assessing the degree of internalization of value through regular learning reflection; Optimize terminal evaluation, 60%, and incorporate ideological and political elements into traditional test questions, such as the philosophical implications of Liu Hui's "circle cutting technique" in short-answer questions and the social significance of the Shenzhen enterprise optimization model in application questions; Introduce value-added evaluation, and dynamically monitor students' growth in ideological and political literacy dimensions such as scientific spirit and patriotism through before-and-after comparative questionnaires and interviews [7].

The system provides a scientific and comprehensive assessment of the effectiveness of ideological and political education through a combination of quantitative and qualitative methods, as well as results and processes.

The implementation of ideological and political education in the curriculum

Teaching practice of ideological and political education in advanced mathematics courses was conducted with undergraduate students majoring in electronic information Engineering, communication Engineering, artificial intelligence, and software Engineering of the class of 2024 as the research subjects. After the course ended, one class was randomly selected from each major, and a questionnaire survey was conducted. A total of 152 questionnaires were distributed, and 149 valid questionnaires were retrieved, with a response rate of 98.03%.

Students' recognition of the implementation of ideological and political education in the curriculum

85.91 percent of students were very interested in the advanced mathematics course, 96.64 percent were satisfied with the overall teaching of advanced mathematics, considering the teachers well-prepared, the content rich, and the thinking clear, among which 71.14 percent were very satisfied. 93.28 percent of students think public course teachers must carry out ideological and political education in combination with the course, and 95.30 percent of students say they are willing to cooperate with teachers to carry out the teaching reform of ideological and political education in the course. Most students hold a positive and affirmative attitude towards the implementation of ideological and political education in advanced mathematics courses.

Regarding the effect of ideological and political education in courses, most students believe that it helps to form correct worldviews, values, professional ethics, and professional qualities, enhance patriotic feelings, improve social responsibility, enhance cultural confidence, cultivate scientific research thinking, and increase learning interest. Only 4.03% of students think it has no effect. See Figure 1 for specific results.

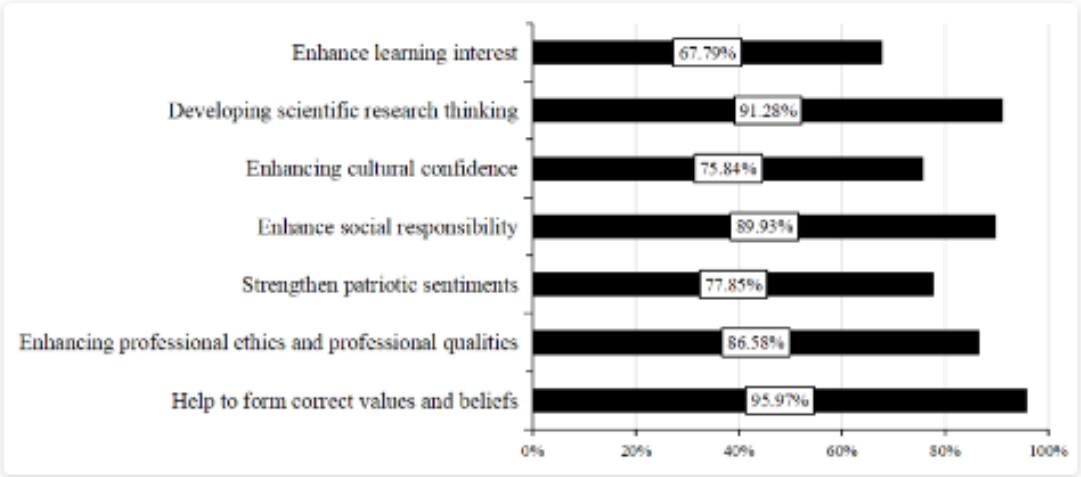

Figure 1. Student feedback on improving teaching in ideological courses.

Students' suggestions on implementing ideological and political education in the curriculum

Formally, students are calling for more video animations, field visits and interactive discussions and debates to enhance the learning experience; In terms of content, there is a strong demand for enhanced professional relevance, such as combining cases in the fields of artificial intelligence and communication technology, and integrating with social hotspots, such as big data privacy and technology ethics, to make ideological and political education more in line with professional needs and real life; In terms of the depth of implementation, some students are concerned about the excessive impact on the systematicness of knowledge and suggest a precise grasp of the "degree" of integration of ideological and political elements to ensure a balance between

knowledge imparting and value guidance; In terms of the evaluation mechanism, it is proposed that the scientific nature of the assessment of ideological and political literacy should be enhanced. Subjective evaluations, such as classroom performance and reflection, should have clearer and more transparent standards to enhance the credibility and guiding role of the evaluation. These suggestions provide an optimized direction that focuses on practicality, professionalism, and scientificity for subsequent reforms.

Teaching summary and reflection

Practice shows that the systematic promotion of ideological and political teaching reform in advanced mathematics courses has effectively enhanced the educational effectiveness of the courses. Students have a high recognition of the integration of ideological and political education, and positive results have been achieved in stimulating learning interest, cultivating scientific spirit, nurturing patriotism, shaping professional quality, and initially achieving the coordinated advancement of knowledge imparting, ability cultivation, and value guidance [8]. However, the reform practice is still in the exploratory stage, and many aspects need to be deepened and reflected upon.

Enhance the precision and depth of the exploration and integration of ideological and political elements

At present, there is a tendency for the mining of ideological and political elements to be superficial and labeled, and there is an urgent need to enhance the accuracy and depth of integration. Specifically, at the level of knowledge principles, the essential connection between mathematical concepts and philosophical thoughts has not been fully revealed, such as in the application of derivatives, the "power-performance" contradiction model in chip design has not been deeply analyzed; At the case design level, the materials of the history of mathematics mostly remain at the level of common sense introduction, such as Zu Chongzhi's PI, lacking the deep deconstruction of the core idea of the limit of Eastern mathematical wisdom, such as Liu Hui's "circle cutting technique". In the future, efforts should be made to build a three-tier mapping model of "mathematical principles – philosophical thoughts – professional ethics", such as cultivating systems engineering thinking through the "local/global" relationship of Fourier transform, and jointly develop "Case records of Mathematical Breakthrough 'Bottleneck' Technologies" with Shenzhen high-tech enterprises, such as the optimization model in Huawei's 5G algorithm, To achieve a gene-like integration of ideological and political elements with professional knowledge.

Teaching model innovation faces challenges for large-scale applications

PBL and flipped classroom teaching in large classes of more than 80 students present "three lows" problems: The deep participation rate of students is less than 30%, and some groups have "free-riding" phenomena. The pre-class self-study completion rate is only 65%, and the ideological and political connection is stiff, such as the extreme concept being directly switched to the "perseverance" lecture after self-study. The solution requires a two-track approach: One is to implement the "intelligent grouping – role empowerment" mechanism, relying on the Learning Pass platform to dynamically group by professional direction and ability level, and set up mandatory rotation roles such as "algorithm engineer" and "ethics assessor"; Reengineering the three-stage process of "micro-ideological and political education, precise teaching, in-depth exploration", such as presenting the unified beauty of Maxwell's equations with a 5-minute animated micro-lesson before class, elaborating on the Fourier transform and deconstructing the 5G signal interference model in groups during class, and completing the interdisciplinary task of "chip heat dissipation optimization modeling science and technology ethics risk report" after class.

There is an "island effect" in the cross-disciplinary collaboration mechanis

The current team collaboration shows a structural disconnection: the differential equation model

provided by mathematics teachers lacks the application scenario of "millimeter-wave radar signal processing" supported by teachers majoring in electronic information. The ethical issue of "big data privacy" designed by ideological and political teachers is detached from the carrier of probability and statistics knowledge. Institutional innovation is urgently needed: Establish "Collaborative innovation studios for Course-based ideological and political education", hold monthly "mathematics electronic information ideological and political Education" tripartite teaching and research meetings, and produce "Guidelines for the Development of Interdisciplinary Ideological and Political Elements"; Implement the "dual-teacher, dual-case" system – professional teachers provide the original problem of the "autonomous driving perception system" – mathematics teachers establish the filtering algorithm model – ideological and political teachers design the reflection module of "ethical boundaries for setting collision probability thresholds" to form a closed-loop education chain.

There is a lack of a quantitative yardstick for evaluating ideological and political literacy

The current evaluation system is in a double predicament of strong subjectivity and formalism: the rate of subjective differences among teachers in classroom performance scores is 40%, and 82% of students mechanically repeat the conclusions of textbooks in terminal evaluations, failing to truly reflect the growth of literacy. This problem can be addressed by using a multimodal data aggregation "digital portrait" evaluation model, which integrates online platform behavior data (such as keyword analysis in discussion forums), project report innovation index (CNKI system plagiarism rate lower than 15%), and the difference between the pre-test questionnaires (the dimension of patriotism increased by ≥20%) to form a "digital portrait of ideological and political literacy growth" [9,10]. The model relies on empirical scales to achieve a paradigm shift in ideological and political literacy from "unmeasurable" to "quantifiable".

The deepening of curriculum-based ideological and political education reform needs to confront the dual challenges of vocational education characteristics and the discipline of mathematics. In the future, the principle of "precise integration, intelligent collaboration, scientific evaluation, and capability leap" should be followed to transform the cutting-edge demands of Shenzhen's industries into ideological and political teaching resources, build a new educational ecosystem, and provide a reference for the ideological and political education construction of vocational mathematics courses in higher vocational education.

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