Practice and Innovation in Advanced Mathematics (Science and Engineering) Under the "Morality and Humanism"

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Abstract. "Casting root and cultivating soul" is one of the teaching objectives of the higher mathematics curriculum. It organically integrates political and ideological education elements, "implants" mathematical thought roots, and tries to stimulate students' interest in learning and exploration in the process of professional ethics infiltration and mathematical culture nourishment, so as to continuously improve their comprehensive scientific literacy.

Keywords: Advanced Mathematics · scientific literacy · humanistic spirit · Curriculum ideological and Political Education

1 Introduction

Every course has the educational function of "ideological and political education", and every teacher shoulders the sacred responsibility of "ideological and political education". Higher Mathematics is a basic theoretical course offered by all majors of science and engineering in colleges and universities. It has always been famous for its charm, application and dialectical thinking, and its educational status is the most important. Engels, the revolutionary tutor, was very interested in calculus and even solved related problems in his dreams. In his works such as "Anti-Durin" and "Dialectics of Nature", Engels praised calculus as "Among all theoretical achievements, there is not necessarily the invention of calculus in the second half of the 17th century as the highest victory of the human spirit" [1]. Therefore, how to transform the subject resources of Higher Mathematics into educational resources, and combine "knowledge imparts" and "value guidance", has become one of the problems that need to be discussed urgently in current mathematics education.

1.1 Teaching Objectives -- Focus on Teaching Objectives and Aim at Learning

Present Situation

Marx profoundly revealed the historical inevitability of the evolution of differential calculus. He pointed out that differential calculus had experienced three different historical

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development stages from its founding in the second half of the 17th century to the beginning of the 19th century, namely the "mysterious differential calculus" represented by Newton and Leibniz; The "Rational differential calculus" represented by D 'Alembert and Euler; "Pure algebraic differential calculus" represented by Lagrange.

In the part of differential calculus, the three mean value theorems (Rolle theorem, Lagrange mean value theorem, Cauchy mean value theorem) fully demonstrate the rules from simple to complex, from special to general, and the proof process reflects the logic relationship of the latter with the help of the former.

The integral part can be divided into line integral (definite integral, first type curve integral, second type curve integral), area integral (double integral, first type surface integral, second type surface integral) and volume integral (triple integral) according to its dimension [2, 3].

Teaching Objectives

Through the study of this course, on the one hand, students can master the basic knowledge of functions and limits, single variable function calculus, multiple variable function calculus, infinite series and differential equations, and can skillfully use them to analyze and solve some practical problems; On the other hand, cultivate students' ability of abstract thinking, logical reasoning and space imagination. The teaching objectives of this course are:

Objective 1. Be able to skillfully use basic knowledge to analyze and solve some practical problems. At the same time, it emphasizes the infiltration of liberal arts and science, which is helpful to cultivate compound and innovative talents.
Objective 2. Cultivate students' ability of abstract thinking, logical reasoning and space imagination. Pay attention to cultivating students' scientific thinking mode, sense of mission and responsibility of scientific exploration, pursuit of truth and climbing the peak forever.
Objective 3. Try to improve students' comprehensive scientific literacy and stimulate their interest in scientific inquiry in the process of infiltration and nourishment of mathematical culture. Stimulate students' interest in scientific inquiry. Foster the craftsman spirit of a great country that strives for perfection.

As mathematics teachers in colleges and universities, we should actively carry out the analysis and discussion of the reform of ideological and political education in the curriculum of "combining knowledge teaching with value guidance" [4]. On the one hand, we should focus on cultivating students' spirit of striving for excellence as a craftsman of a great country, and stimulate students' feelings and mission of serving the country through science and technology; On the other hand, we should pay attention to cultivating students' scientific thinking mode and sense of mission and responsibility for scientific exploration, pursuit of truth and eternal climbing [5].

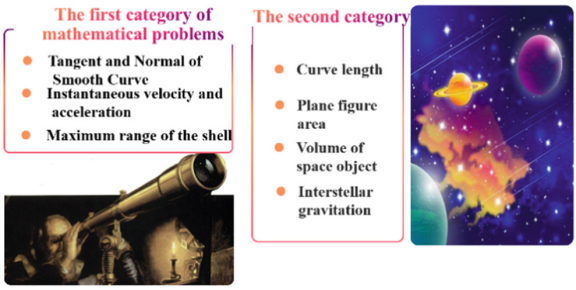

Fig. 1. Mathematical Problem

2 Teaching Content -- Select Appropriate Cases and Determine Ideological and Political Goals

In order to further demonstrate the ideological and political education system of mathematics curriculum constructed by us, and the unique advantages of integrating higher mathematics into ideological and political curriculum, only part of the curriculum content to explain the relevant teaching reform practice and innovation points (Fig. 1).

2.1 Concepts and Properties of Indefinite Integrals

In the 16th and 17th centuries, with the development of astronomy, navigation and other fields, the famous "the first class of mathematical problems" and "the second class of mathematical problems" were produced. Based on the development of mathematical history, the origin and function of indefinite integrals were clarified. Newton, a rigorous English mathematician, and Leibniz, a visionary German mathematician, realized that "differential" and "integral" were a pair of inverse operations on the basis of summing up the experience of predecessors, and established calculus respectively.

The concept of indefinite integral shows the idea of reciprocal inversion, which inspires students not only from the front of the problem but also from the opposite side of the problem to seek solutions. Higher mathematics is full of dialectical ideas, such as "part" and "whole", "line" and "curve", "constant" and "variable", "finite" and "infinite", "approximate" and "exact", we can train students to learn to use the correct way of scientific thinking to analyze problems and solve problems (Fig. 2).

2.2 Concepts and Properties of Differential Equations

Differential equation is a subject closely related to actual production and life and technology. It is reflected in the concise and precise mathematical language to describe the problems and phenomena in the real world, and also depicts the outstanding spirit of mathematicians who are not afraid of hardships and brave to climb mountains.

Application of tacoma, Washington, us in 1947 the collapse of the tacoma Narrows bridge incident, to address the issue of practical problems spring vibration relations with second order differential equation, on the one hand, shows the combination of theory

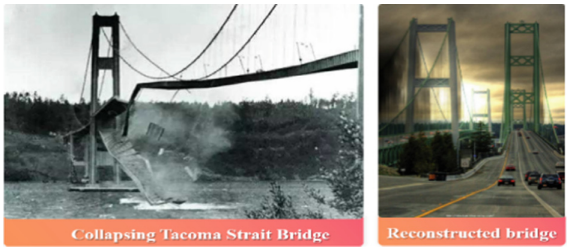

Fig. 2. Differential equation problem

and practice of scientific charm, on the other hand can spark "lit" students' innovation, spawns innovation motive power, raises the student spirit power.

Although the resonance phenomenon of the spring vibration problem caused the collapse of the bridge, this "double-edged sword" also provides favorable support for Musical Instruments and oscillators used in the building. From this, we can show the excellent architectural works of our country such as Shanghai Center Building, Hong Kong-Zhuhai-Macao cross-sea bridge and so on.

In addition, differential equations are also widely used in infectious disease models [7], such as

$$\begin{cases} S' = -\lambda I^p S^q + b - \mu S \\ E' = \lambda I^p S^q - (\varepsilon + \mu)E \\ I' = \varepsilon E - (\gamma + \mu)I \\ R' = \gamma I - \mu R \end{cases} \tag{1}$$

where S, E, I, R represents the susceptible, the latent, the infected and the recovered respectively, b is birth rate, μ is natural mortality, ε denotes transfer rate from latent disease to infected disease and γ defines removal rate of patients from the infected to the recovered.

Meanwhile, it can be applied in nonlinear Schrödinger equation [8], such as

$$-\Delta_p u + |u|^{p-2}u - \Delta_p(|u|^{2\alpha})|u|^{2\alpha-2}u = h(u), x \in R^N, \tag{2}$$

It derives from classical Schrödinger equation

$$iz_t = -\Delta z + W(x)z - h_1(|z|^2)z - \kappa \Delta g(|z|^2)g'(|z|^2)z, x \in R^N. \tag{3}$$

3 Course Evaluation System

The curriculum evaluation system provides the necessary evaluation standards for teaching effects and students' learning achievements, forming process assessment and timely data feedback, which can not only stimulate students' awareness of active learning, but also form evaluation materials [6] (Table 1).

Table 1. Evaluation system

Composition of evaluation system	Evaluation mean	Evaluation purpose
Process evaluation	Classroom performance (classroom discussion, questions, random questions)	Improve students' learning initiative; Cultivate students' ability of random thinking; Give teaching feedback to a certain knowledge point
Outcome evaluation	After class homework	Overall evaluation of the teaching effect of this teaching design

Table 2. Classroom performance scoring standard.

Assessment content	A (about 90 points)	B(about 75 points)	C (below 60 points)
The initiative to participate in the discussion; The initiative to answer questions; The correctness of analysis and induction	Proactive discussion, positive answer, clear logic, correct argument	Actively discuss, actively answer, and be able to express basic views	Low enthusiasm to participate in discussion and answer
Random questions	High correlation with teaching content	Average relevance to the teaching content	Low correlation with teaching content

Table 3. Scoring standard.

Assessment content	90–100 points	75–89 points	60–75 points	below 60 points
Assessment content	90–100 points	75–89 points	60–75 points	below 60 points
Clear views, clear ideas and complete structure (weight 0.4)	Above 80%	Above60%	Above 40%	Below 40%
Selection of "contrast mode" (Weight 0.4)	Reasonable selection of contrast mode, clear context layout	The layout of contrast mode is basically clear	The contrast mode is mixed and the structure is acceptable	Without the use of contrast mode, the content is disorderly

4 Conclusion

The ideological and political education and mathematics teaching of the course complement each other and integrate into one (Table 2). With the help of typical cases, the ideological and political elements are implanted, so that students can fully understand the concepts, properties, formulas, theorems, etc. contained in mathematics, and understand that mathematical knowledge comes from real life, and also serves real life in turn (Table 3).

The improvement of teachers' concept of curriculum ideological and political needs to make corresponding adjustments to the original educational concept in teaching objectives, we should pay attention to contact; in terms of educational concept, we should pay attention to renewal; in terms of professional ethics, we should pay attention to responsibility and so on.

The coordinated development of "ideological and political curriculum" and "ideological and political curriculum" complement each other is concerned with the future of college students' own development and is an indispensable part of the future of higher education in our country [9, 10]. For the ideological and political education of higher mathematics, although it has set out, it is not mature. We still need to explore and advance in the organizational process, evaluation system, curriculum resources and other aspects. Mathematics curriculum education is always on the way.

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