

Research on Curriculum Ideological and Political Practice of Advanced Mathematics Based on Classroom Teaching

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Abstract: Taking advanced mathematics course an example, this paper discusses the concrete practice of the construction of ideological and political education in colleges and universities, and gives the concrete research ideas and methods of the integration of ideological and political education into advanced mathematics. Finally, taking the definition of the limit of sequence in advanced mathematics as an example, the article elaborates the ideological and political integration of this section.

1. Introduction

At the National Conference on Ideological and Political Work in Colleges and Universities on December 7-8, 2016, leaders pointed out that: "We should make good use of classroom teaching as the main channel, and ideological and political theory courses should be strengthened in the process of improvement to enhance the affinity and pertinency of ideological and political education, so as to meet the needs and expectations of students' growth and development. Other courses should keep a good channel and cultivate a good field of responsibility, so that all kinds of courses and ideological and political theory courses can walk in the same direction and form a synergistic effect". Mathematics is a discipline that studies quantitative relations and spatial forms. It has experienced the research and demonstration of countless mathematicians at all times and at home and abroad, and has accumulated a rich history and culture of mathematics. The exploration, truth, rigor, simplicity and beauty contained in it are all worthy of in-depth study and thinking. At the same time, mathematics is widely used in engineering, economics, medicine and other fields. It reveals the universal law, and the hidden philosophical thoughts are often universal, which can guide students to establish a correct outlook on life. According to the teaching content, timely integration of excellent deeds of mathematicians, mathematical allusions, mathematical culture, scientific spirit and other materials into the teaching of advanced mathematics can not only stimulate students' interest in learning advanced mathematics, but also improve students' learning efficiency. Moreover, it can realize the function of ideological and political education, which is also a major strategy of national talent education. As mathematics teachers in colleges and universities, we have the responsibility and obligation to integrate the philosophical value of mathematics, humanistic feelings, typical application cases and other ideological and political elements into

classroom teaching, cultivate students' spirit of assiduous study, inspire students' patriotic feelings and national pride, and guide students to establish correct socialist core values. Enhance students' cultural confidence and social responsibility ^[1].

2. Explore ideological and political elements

All courses contain educational resources ^[2], and advanced mathematics courses are no exception. Therefore, teachers should fully explore the ideological and political elements in advanced mathematics curriculum, including mathematical culture, philosophical value and humanistic feelings, typical application cases and so on. Only with the accumulation of certain ideological and political elements can the realization of ideological and political curriculum become possible. As the saying goes, "One can't make bricks without straw." This is the truth.

2.1 Mathematical Culture

2.1.1 Mathematical beauty

The main characteristics of mathematical beauty include: simplicity of concept, universality and unity of theorem and formula, coordination of theorem structure, symmetry of formula structure, ingenuity of method, etc. ^[3]. For example, when studying the area surrounding isogonal spiral and polar axis in definite integral application, multimedia is used to introduce some isogonal spiral existing in objective nature to students, such as the shell of nautilus is like isogonal spiral, the seed of chrysanthemum is arranged into isogonal spiral and the insect approaches the light source in the way of isogonal spiral. By the way, the mathematical principle of moths to fire is mentioned, so as to feel the beauty of mathematical charm and enhance mathematical literacy. Another example shows the beauty of mathematics Euler's identity: $e^{i\pi} + 1 = 0$, it perfectly connects several different elements including natural base number e , imaginary number i , circular constant π , the numbers 0 and 1, its simplicity is self-evident, its geometric explanation and origin is also very beautiful.

2.1.2 Mathematical thinking methods

There are abundant mathematical thoughts in the course of advanced mathematics, which is the limit thought throughout advanced mathematics. When learning the limit of sequence, we can introduce the circle cutting technique of Liu Hui, an ancient Chinese mathematician, and explore the process of approximating the circumference of a circle by connecting the circumference of a regular polygon inside the circle, so as to understand the limit thought contained in it. At the same time, it introduces Zu Chongzhi in the Southern and Northern Dynasties, who used the method of circle cutting to calculate PI accurately to 7 decimal places, which was more than a thousand years earlier than Europeans, so as to inspire students' national pride and patriotism. In addition, the advanced mathematics course also reflects other mathematical thoughts, such as the theory of transformation, the calculation of the advanced order derivative of a function into the lower order derivative; the homogeneous differential equation is transformed into separable differential equation by variable substitution. The convergence and divergence of infinite series is converted to the convergence and divergence of partial sum sequence. The calculation of double integral and line integral into definite integral, etc.

2.1.3 Mathematical thinking training

In the course of advanced mathematics teaching, it is important to train students' logical thinking ability, analogical thinking ability, inductive thinking ability, divergent thinking ability and reverse

thinking ability. Analogy between the properties of the limit of sequence and the properties of the limit of function; Analogies of several mean value theorems; An analogy between the convergence and divergence of generalized integral and the convergence and divergence of infinite series; The analogy between one variable calculus and multiple variable calculus. Multiple solutions of limit, indefinite integral and definite integral cultivate students' divergent thinking. There are many contents in advanced mathematics that can cultivate students' reverse thinking, such as the relationship between indefinite integral and definite integral, using the definition of definite integral to find the sum of infinite series, using the convergence of infinite series to find the limit of series, constructing auxiliary functions to prove the mean value theorem and so on.

2.1.4 History of Mathematics and stories of mathematicians

Focus on introducing the historical background of mathematical knowledge to stimulate students' interest in learning. For example, the historical background of function definitions; the cognitive process of infinitesimally small quantities; the development of limit definition; the historical background of calculus. The story of a mathematician, such as Liu Hui, Zu Chongzhi, Zu Geng, Hua Luogeng, Chen jingrun, Newton, Leibniz, Cauchy, Weierstrass, Euler, Gaussian, etc. The story of a mathematician.

2.2 Philosophical value and humanistic feelings.

Excavate the philosophical value implied in the ideological and political elements of the course, and promote students to form a positive outlook on learning and life. For example, in the introduction class, we can introduce the experience of Anna, an Austrian mountain biker in the 2020 Tokyo Olympic Games, and extract a few sentences that can inspire students: "She competed without a team, without a coach, trained all by herself, then went to the competition alone, and finally left as an Olympic champion. She just rides intently, being a lone Wolf, riding purely, selflessly, with all her might." As freshmen are susceptible to the influence of various cultures, we can help them establish a correct outlook on life, values and world outlook.

2.3 Typical application cases

Combined with the knowledge points, from some classic application cases, show the application of advanced mathematics in practice. Through the establishment of mathematical models to solve practical problems, to stimulate students' interest in learning, to cultivate students' ability to analyze and solve problems. For example, when explaining directional derivatives and gradients, an ant escape case can be designed. A rectangular metal plate is heated by a flame not far away from it. In what direction should the ant crawl to reach a cooler place the fastest? Through the analysis of the mathematical model established from a mathematical point of view to verify that ants should crawl in the opposite direction of the gradient to reach the cooler place the fastest. For example, when we talk about generalized integrals, we can use this video to talk about the amazing Torricelli trumpet, which has a finite volume but an infinite surface area, and we can calculate that. For example, when explaining differential equations, a video can be used to show how the public prosecutor determines the time of death by measuring the body temperature. The differential equation model is established and solved, and the time of death can be determined by measuring body temperature from a mathematical point of view, thus greatly stimulating the enthusiasm of students to learn mathematics.

3. Integration into teaching design

In the design of advanced mathematics curriculum, we take moral cultivation as the starting point, centering on the course goal of combining knowledge content and value guidance, and infiltrate ideological and political content into the whole process of teaching "moisten things silently". It can take many forms.

3.1 Micro video method that students enjoy

For example, the circle cutting technique proposed by Liu Hui, an ancient Chinese mathematician, uses micro-video to show the scene process of circle cutting. Another example is the understanding of infinitesimal can also play micro video way; The love story between Descartes and Princess Glistin leads to the heart-shaped line. Television films are shown to determine the time of death of the body; And the magic Torricelli trumpet and so on.

3.2 Present ideological and political materials of the course in the form of two-dimensional code.

Push the two-dimensional code containing the course ideology and politics into the courseware, let the students use the mobile phone to scan the code and directly read the material content prepared by the teacher, and organize the students to read it immediately. The interesting and valuable content in the document can be mainly displayed in the courseware, through the teacher or students' narration, focus on learning together. Learn the stories of outstanding mathematicians, inspiring young people, and excellent sentences. For example, in the introduction to advanced mathematics mentioned the Olympic champion Anna's legendary story. For example, when introducing the definition of limit, we will mention the lives of the French mathematician Cauchy and the German mathematician Weierstrath. By scanning the two-dimensional code prepared by the teacher in advance, we can learn about Cauchy's brilliant achievements and his life. There is a letter between him and his mother worth learning: "If Christians could become mental patients, the madhouse would have been filled with philosophers. Dear mother, your child is like a windmill in the field, with math and faith as his wings. When the wind blows, the windmill rotates in a balanced way, generating the power to help others." From which we can learn their tireless learning spirit and noble character.

3.3 Integration of ideological and political content and professional knowledge

According to the major of the students, some knowledge close to their major can be incorporated. For example, students majoring in big data and artificial intelligence can find some functions close to their major when introducing the limits of functions in class teaching, such as the output function Sigmoid function, which is often encountered in machine learning. By programming with Python software, they can make the image of the function and intuitively see the change trend of the function. The application of this function in machine learning is also introduced. This is conducive to students' understanding of professional knowledge and stimulate students' interest in learning mathematics. For example, marginal function and its economic significance can be introduced when teaching derivatives to economics students.

3.4 Show the ideological and political thinking of the course with exquisite pictures or physical models.

For example, download the physical pictures of the isogonal spiral, beautiful concave and convex curves, heart-shaped lines and other exquisite pictures in the courseware to improve students' mathematical literacy and aesthetic feeling; Another example is "Mouhe square cover" when teaching volume calculation. Teachers can shop online or make their own Mouhe square cover model to enhance students' sensory understanding and stimulate their learning enthusiasm.

4. Teaching throughout the classroom

Classroom teaching is the main channel and front to implement curriculum ideology and politics. Firmly grasping classroom teaching is the "last mile" to realize curriculum ideology and politics. The course of ideological and political science is not only a simple supplement to the course of ideological and political science, but also allows the explicit ideological and political content to be deeply perceived and implicitly carried out in other courses, which is a further deepening of the course of ideological and political science. Therefore, ideological and political construction of professional courses is the inevitable requirement of the development of The Times. The following two things should be done:

4.1 Find out the alignment of ideological and political content and professional knowledge.

Teachers should, based on the ideological and political elements in the curriculum, follow the principle of "ideological and political" and "professional", clarify the entry point of each ideological and political element in the curriculum, and clarify the relationship between ideological and political elements and professional content. Send some ideological and political content related to the course content to students timely through learning platforms such as Learning Tong and Rain Classroom, such as the background of knowledge generation, the history of mathematics, and inspirational stories of outstanding mathematicians.

4.2 Take the practical problems concerned by students as the entry point.

We should encourage students to do extended study or research by individual or team, and organize students to take an active part in the National College Students Mathematics Contest and Mathematical Contest in Modeling. Combine classroom teaching content with real life cases, cultivate students' ability to analyze and solve problems in daily life, and promote the improvement of students' mathematical application ability and innovation ability. Promote "ideological and political" and professional integration, to achieve the effect of education.

5. Case Introduction

This paper takes the teaching design of the unit "The Definition of the Limit of Sequence" as an example to integrate the curriculum ideology and politics into the classroom teaching. The details are as follows:

5.1 Teaching Content: Definition of Limit of Sequence. Teaching Objectives: See Table 1

Table 1: Teaching objectives

Objective of knowledge	Objective of competence	Goal of moral education
<p>(1) Understand the historical background of the generation of limit thought; Can understand the concept of sequence limit from the trend of sequence change;</p> <p>(2) Understand the precise definition of sequence limit.</p>	<p>(1) The process of Liu Hui's circle cutting is shown by micro-video and animation, so that students can observe the process of connecting regular polygons within a circle to approximate a circle and experience the ideological method of limit;</p> <p>(2) Enhance students' ability of observation, analysis and induction and realize the rigor of mathematics subject through the intuitive definition of sequence limit and the rigorous exploration activities.</p>	<p>(1) The ancient Chinese mathematician Liu Hui's circle cutting method was used to calculate PI. Later, Zu Chongzhi followed this idea and calculated PI accurately to seven decimal places, more than 1,000 years earlier than Europe at that time. To stimulate students' national pride and patriotism education,</p> <p>(2) Through the introduction of the inspirational stories of mathematicians Cauchy and Weierstrath, to help students establish a correct view of learning and life.</p>

5.2 Teaching design: See Table 2

Table 2: Instructional design fragments

Teaching and Learning	Teaching Content	Teacher-student interaction and design intent
Introduction of situation (1 minute)	In ancient times, people did not derive the formula to calculate the circumference of a circle. How did they calculate the circumference of a circle?	Teacher: How do you calculate the circumference of a circle? [Design intention] Create a situation, introduce new knowledge and stimulate students' thirst for knowledge.
The introduction of (4 minutes)	There is a saying "Wednesday path one". That is, the circumference of a circle is approximately replaced by three times the diameter of a circle. In order to reduce the error, Liu Hui, an ancient Chinese mathematician, created the "circle cutting technique". If you cut and cut again, so that you cannot cut, then you have nothing to lose by joining the circumference."	[Design intention] Guide the students to experience the limit thought from the ancient Chinese "cutting the circle", let the students realize the great wisdom of the Chinese nation. Inspire students' strong national confidence and pride.
Find out something new (5 minutes)	By using python programming software to make the scatter diagram of sequence, observe the trend of specific sequence, intuitively perceive what is the concept of the limit of sequence, so as to naturally depict the descriptive definition of the limit of sequence.	Introduction to Python programming software drawing. [Design intention] to stimulate students' learning enthusiasm through program drawing; Enhance students' intuitive understanding of the changing trend of the series.
Make something new (3 minutes)	Descriptive definition of the limit of a sequence: For an infinite sequence, it is said to be the limit of a sequence if, as infinity increases, infinity approaches a certain constant.	Teacher: How to describe "infinite proximity" with mathematical language? [Design intention] Guide and inspire students to think about the strict definition of sequence limit.

Find out something new (7minutes)	Introduction to the process of discussing the precise definition of sequence limit: using absolute value to describe distance, introducing the description of arbitrary small, introducing the description of sufficient large. Give a definition of the limit. The arbitrariness, the correspondence, the existence of attention. Using the concept of neighborhood, the limit of sequence is described on the number line.	How to understand the precise definition of sequence limit? [Design Intention] Exercise students' meticulous logical thinking ability. Add the corresponding knowledge point two-dimensional code, convenient for students to quickly access the information.
Curriculum Ideology and Politics: Stories of Mathematicians (6 minutes)	Cauchy and Weierstrass, two mathematicians who made important contributions to the definition of limits, enhance students' understanding of mathematicians and learn about their spirit of scientific research.	Through the two mathematicians' scientific spirit of seeking truth and exploring, and their indomitable attitude of pursuing truth, students are encouraged to fear hardship and pursue excellence in study and life.
Class extension (2 minutes)	Thoughts after Class: From the point of view of mathematics to understand the "one foot hammer, the day takes its half, eternal" this saying.	[Design intention] Deepen students' understanding of the limit of series, and cultivate students' self-learning and practical application ability.

6. Conclusion

Advanced mathematics course is a public basic compulsory course set up in science and technology colleges, which contains abundant ideological and political elements. From digging ideological and political materials, integrating into teaching design, penetrating through teaching class and analyzing specific cases, this paper completely introduces the strategies and methods of how to integrate ideological and political ideas into the teaching of advanced mathematics. It provides some references for teachers to integrate ideological and political teaching into the curriculum.

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