Higher mathematics teaching design based on military problem

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Abstract. Integrating military cases into the teaching of higher mathematics can stimulate students' interest in learning and lay a good foundation for students to consciously apply mathematical knowledge and methods to solve military problems they will face in the future. Therefore, this paper first expounds the significance of integrating military problems into higher mathematics, then expounds the selection principles of integrating military problems into higher mathematics, and finally combines part of the teaching content of higher mathematics with practical problems with military background, and uses the "problem solving" of military problems to design the classroom content. Demonstrate the use of mathematical methods in solving practical problems.

1. Introduction

In order to win the war, the army needs to improve the level of practical teaching, so the training process of colleges and universities should be more aimed at actual combat. Advanced mathematics, as a basic course for all majors in engineering and technology colleges, is also a compulsory scientific and cultural course suitable for growing officers in military colleges and universities, laying the foundation for students to further study. Therefore, in order to train advanced military talents, it is urgent to update the teaching concept of higher mathematics, emphasize the teaching concept of taking students as the main body[1], and pay more attention to the practical application of the knowledge in the process of knowledge transmission, especially the application of the knowledge in military cases. Therefore, it is necessary to integrate military cases into the teaching design of higher mathematics[2], Thus effectively combine them with the knowledge points to improve the students' ability.

2. The significance of integrating military cases into higher mathematics

2.1. The needs of students' learning interests

Because of the abstractness of the advanced mathematics course itself. Most students are not interested in learning advanced mathematics. In this case, some interesting military cases should be used to introduce various knowledge points in the teaching process, Thus enhance students' learning interest. Citing military cases is the main way to mobilize students' learning motivation[7].

2.2. The need of training team consciousness in military mathematical Contest in Modeling

Military Mathematical Contest in Modeling is an extension of advanced mathematics class and an effective platform for students to apply the mathematical knowledge they have learned[3]. The questions of military mathematical modeling generally come from practical problems. In the process of participating in military Mathematical Contest in modeling, students must master the methods and steps of solving the problems in modeling if they want to solve the problems raised in modeling[4]. The methods and steps to solve these problems can be explained through the integration of military cases in the learning process of advanced mathematics[8]. Through the establishment of mathematical models to transform boring knowledge into classic problems or hot issues to solve, exercise the students' ability to analyze and solve problems, more importantly, cultivate the students' team spirit.

2.3. The need to cultivate students' fighting consciousness

The working environment of cadets in the future is closely related to the military, so it is necessary to conduct quantitative analysis in order to achieve the command of battles, from the small to the combat plan, and establish mathematical models with the mathematical knowledge learned. In order to better integrate with the future work[9],

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it is essential to add military cases in the daily teaching process.

3. The selection principle of relevant military cases should be incorporated into higher mathematics

Proper integration of military cases in the teaching process is one of the important methods to realize the practical teaching reform of higher mathematics courses. However, there are still some problems in the current research on the integration of advanced mathematics into military cases, which are mainly manifested in the fol-lowing aspects:

3.1. The number of actual combat military cases is small

At present, the number of cases that can be directly applied to practical theory teaching is small, which cannot meet the needs of basic courses for cases. Some practical cases are relatively old and lack timeliness. And actual combat military case operability is not strong. Lack of comprehensive, targeted cases.

3.2. The effect of practical teaching is low

The purpose of practical teaching of military cases is to adapt to the needs of military struggle preparation and improve the students' ability to integrate theoretical knowledge, analyze and solve the problems of preparing for war. However, there is still a phenomenon of low teaching effect in case teaching. The selection of case content does not fit closely with the actual needs of students. This requires scientific and rigorous design, which is not only a difficult problem to be solved in military case teaching, but also an important aspect to enhance the effect of case teaching.

In short, actual combat plays an important role in the personnel training process of military academies. Mathematics is the basic discipline of subject education, the necessary mathematical theory and calculation basis for students to learn follow-up courses and engage in scientific research and command in the future, and the im-portant medium for training students' ability to raise, analyze and solve problems[10]. In a sense, it is a key issue that needs to be considered whether appropriate military cases can be effectively combined with knowledge points related to higher mathematics and applied to teaching, and whether students can truly and effectively absorb what they have learned and cultivate their ability to analyze and solve practical problems. It is an important measure to enhance the teaching effect of basic courses, strengthen re-search for war, research for teaching direction, and look forward to explore new ideas and new ideas for education and education to meet the needs of future war.

The military problems selected in this paper are real, and the students have a certain understanding of the background of the selected military problems. In the process of specific selection of military problems, they should avoid selecting too difficult cases, so as not to waste the teaching time, and they should not choose too simple cases that cannot achieve the teaching effect. At the same time, in order to obtain good teaching effect, The selection of interesting military issues is also a criterion for this article.

4. The specific case design of integrating military problems into higher mathematics

4.1. Take the physical application of definite integrals for example

4.1.1. Question raised

J-20 is the fifth generation stealth neutral J-fighter developed in China, on January 11, 2011, J-20 was born and successfully made its first flight. After that, the J-20 appeared in the Zhurihe parade, mounted the Air Force combat troops, flew over Tiananmen Square for review, soared in the blue sky, and defended the motherland. A very important breakthrough of the J-20 fighter is that its two engines are independently developed in China, the engine is the heart of the aircraft, providing power for the flight of the aircraft, we also know that the greater the work done by the engine, the more powerful the power of the aircraft[5], so how to find the work done by the aircraft engine is the problem we have to study.

4.1.2. Problem analysis

The engine is equipped with a piston, and the piston moves up and down in the cylinder. When the piston moves from the top to the bottom, the intake valve will be opened, so that the piston will absorb a certain amount of gas. When the piston moves upward, the gas will be compressed and ignited, and the gas will expand after being ignited by heat. This will push the piston down to do work, and finally the piston will move up to discharge the gas, so that the goal of converting heat into kinetic energy through the piston is achieved, and the amount of gas that can be inhaled by the piston depends on the cross-sectional area of the piston and the distance it moves from the top to the bottom, that is, the amount of work done by the piston[6]. The size of the work done by the piston directly affects the power of the engine, so how to find the work done by the piston movement? This involves the problem of variable forces doing work along a straight line.

4.1.3. The mathematical problem contained in this problem

it is known from physics that if the axis of an object moves from to under the action of a variable force, the direction of the force is parallel to the direction of motion, and the work done by the variable force takes a subinterval, on which the work element is $\mathrm{d}W = F(x)\,\mathrm{d}x$, So the work done by the variable force $F(x)$ over the interval $[a,b]$ is $W = \int_a^b F(x)\,\mathrm{d}x$. Because the pressure acting on the

piston changes with the change of the pressure of the piston, the work problem of the piston motion is a work problem of variable pressure.

4.1.4. Solution to this problem

As shown in Figure 1, there is a certain amount of gas in the cylindrical container with the bottom area S. Due to the expansion of the gas, a piston with the area of "" in the container" "is moved from the point a to the point b to find the work done by the gas pressure in the moving process.

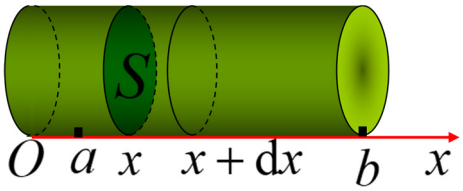

Fig. 1. Piston doing minor work.

The Boyle-Marius law tells us that pressure p is inversely proportional to volume V, i.e $p = \frac{k}{v} = \frac{k}{xS}$.So the force acting on the piston is $F = p \cdot S = \frac{k}{x}$,

Therefore, the work elements acting on the piston are:

$dW = Fdx = \frac{k}{x}dx$, The work expected is

$$W = \int_a^b \frac{k}{x}dx = k[\ln x]_a^b = k \ln \frac{b}{a}$$

4.1.5. Result analysis

The size of the work done by the piston is related to the distance the piston moves, that is, to the amount of air inhaled, and also to the inhaled medium. This conclusion has a guiding role for the design of high-power pistons.

4.2. Examples of Green's formula and its application

4.2.1. Question raising

First ask the students a basic common sense question: How big is our country? Many students may blurt out that 9.6 million square kilometers, which seems to be a standard answer, in fact, this is only the land area in the past textbooks, and China has a large amount of territorial sea area. The ocean plays an increasingly important role in national development and national security strategy, and the ocean has become a place for countries to compete and contest. China's maritime security issues are not only related to national sovereignty and security, but also related to the future development of the country. For example, the border dispute around the South China Sea has been very heated. How big is China's South China Sea? How can we calculate the area of our territorial sea? At present, the advanced measuring tool is the GPS area measuring instrument, so what is the mathematical principle of the GPS area measuring instrument?

4.2.2. Analysis of the problem

We know that to measure the area with the GPS area measuring instrument requires the handheld measuring instrument to go around the measuring area for a week, the instrument automatically records the coordinates of several points in the traveling closed route, and automatically calculates the area of the surrounding area as shown in the figure.

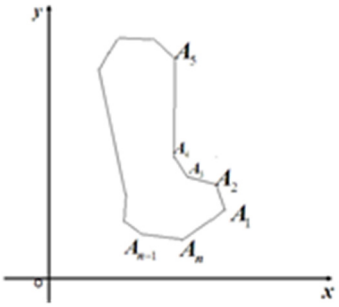

Fig. 2. GPS area map with coordinates

The question is how to find the area measured by the GPS area measuring instrument? How does it work? Newton's Leibniz formula is studied in the integral calculus of functions with one variable in order to understand the computational problems that determine integrals

$$\int_a^b F'(x)dx = F(b) - F(a)$$

The formula shows that the definite integral of a function on a closed interval can be expressed by the value of its original function at the end point of the interval, that is, the boundary point of a line segment. Does this method of converting an operation into a boundary operation extend to double integrals? Since the integral region of the double integral is a region on the plane, and the boundary of the region is a curve, does the double integral have a relationship with the curve integral on the boundary of the region in which it resides? Which brings us to Green's formula.

4.2.3. The mathematical problems contained in the problem

Because the boundary L of the desired graph can be expressed as:

$$L = A_1A_2A_3 \cdots A_nA_1 = A_1A_2 \cup A_2A_3 \cup A_3A_4 \cup \cdots \cup A_nA_1$$

$$A = \iint_D dxdy = \frac{1}{2}\oint_L -y\,\mathrm{d}x + x\,\mathrm{d}y$$

4.2.4. Solution to this problem

We focus on one of these arcs

$$\int_{A_1A_2} -y\,\mathrm{d}x + x\,\mathrm{d}y$$

The corresponding parametric equation is as follows:

$$\overline{A_1A_2}:\begin{cases} x = x_1 + t(x_2 - x_1) \\ y = y_1 + t(y_2 - y_1) \end{cases} \quad (0 \le t \le 1)$$

Then:

$$\int_{\overline{A_1A_2}} -y\,\mathrm{d}x + x\,\mathrm{d}y$$

$$= \int_0^1 \left[-(y_1 + t(y_2 - y_1))(x_2 - x_1) + (x_1 + t(x_2 - x_1))(y_2 - y_1)\right] dt$$

$$= \begin{vmatrix} x_1 & x_2 \\ y_1 & y_2 \end{vmatrix}$$

Similarly:

$$\int_{\overline{A_iA_{i+1}}} -y\,\mathrm{d}x + x\,\mathrm{d}y = \begin{vmatrix} x_i & x_{i+1} \\ y_i & y_{i+1} \end{vmatrix} \quad (1 \le i \le n, A_{n+1} = A_1)$$

Therefore, the desired area:

$$A = \iint_D \mathrm{d}x\mathrm{d}y = \frac{1}{2}\oint_L -y\,\mathrm{d}x + x\,\mathrm{d}y$$

$$= \frac{1}{2}\sum_{i=1}^{n} \begin{vmatrix} x_i & x_{i+1} \\ y_i & y_{i+1} \end{vmatrix}$$

4.2.5. Result analysis

According to Green's formula, if you want to find the area of the South China Sea, you only need to input the polygon vertex coordinates measured by the GPS area measuring instrument into the computer, and then convert them into rectangular coordinates through the coordinate conversion software, and then according to the above formula design program, you can calculate the area of the South China Sea, the same way that you can obtain the area of our territorial sea.

5 Summary of contents

In this paper, knowledge points in higher mathematics courses are selected from the perspectives of interest, depth and innovation, and the classroom teaching is carefully designed and properly arranged. Under the whole teaching mode of knowledge introduction, knowledge construction, knowledge understanding and knowledge improvement, military teaching cases are selected to explore the depth of teaching content and try to get rid of the boredom in the classroom. Increase students' intuitive understanding of concepts, stimulate students' interest in learning, improve students' awareness of applied mathematics related knowledge, let students experience the happiness of mathematics learning, and lay a good foundation for them to consciously apply mathematical knowledge and mathematical methods to solve military problems they will face in the future.

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