

Integrating Modeling Idea into the Teaching of Higher Mathematics

Xiaobo Liu

School of information engineering, Nanjing Xiaozhuang University, Nanjing, China

Keywords: Higher mathematics teaching, modeling ideas.

Abstract: Mathematical Modeling can interweave mathematical knowledge with mathematical application, which can not only enhance students' application awareness, but also play a great role in filling the gap between mathematical theory and application. The application of mathematical modeling thought in the teaching process of higher mathematics can get twice the result with half the effort in cultivating students' ability. The infiltration of mathematical modeling thought into the teaching of higher mathematics is also beneficial to the further study of the subsequent mathematical model courses.

1. Introduction

Although the mathematical modeling contest for Chinese college students develops rapidly, the contestants are a small number of students after all, and it must be combined with the daily teaching activities to make it play a greater role. In fact, Mathematical Modeling can interweave mathematical knowledge with mathematical application, which can not only enhance the purpose of mathematical knowledge and enhance students' application awareness, but also play a great role in filling the gap between mathematical theory and application. In the past, the teaching of Higher Mathematics was often disconnected from the outside world and failed to fully show the value of calculus. If the idea of Mathematical Modeling can be fully reflected in the teaching of Higher Mathematics, and the relevant content can be organically combined with the corresponding mathematical model, students' ability cultivation can get twice the result with half the effort. In addition, since the Mathematical Model of Calculus has been taught, the thought of Mathematical Modeling has been infiltrated into the teaching of Higher Mathematics, which is conducive to the further study of subsequent mathematical model courses. Therefore, it is necessary to infiltrate the preliminary training of modeling thought in the teaching of higher mathematics.

2. Feasibility of infiltrating Mathematical Modeling ideas into Higher mathematics teaching

The purpose of infiltrating modeling thoughts into Higher Mathematics teaching is to let students know that mathematics is useful and how to apply mathematical thoughts. Calculus is the crystallization of two thousand years of human wisdom, and its formation and development directly benefit from the progress and breakthroughs in physics, astronomy, geometry and other research fields. From Kepler's three laws of planetary motion to Newton's universal gravitation, to the planetary motion Kepler found the phenomenon of tangential acceleration is zero, to the Fermat study of extreme value, and then to the formation of the calculus mean value theorem, the equation of motion speed and rocket calculus export and so on, which is full of very profound mathematical ideas and excellent mathematical applications, mathematical model is also a rich subject matter. In addition, as an example of practical application of calculus, it is also possible to establish simple planetary motion model, population model, public resource model, economic problem model and so on by analyzing the relationship between many quantitative changes in physics, biology, sociology, economics and natural phenomena. The addition of these contents increases the information content of the course, broadens the students' vision, stimulates their interest in learning, and is conducive to improving the students' basic mathematical quality. In teaching, by introducing the thinking and methods of modeling contest, teachers can give full play to students' initiative and autonomy, and focus on case analysis. Under the premise of not damaging the knowledge system, we should take

"use" as the standard, "topic" as the center to organize basic knowledge teaching, and "practice" as the means to choose flexible and diverse teaching methods, to highlight the key points, to explain the difficult points, to elaborate and practice more, so that students can find their knowledge defects in "practice" and stimulate their thirst for knowledge.

3. Methods of integrating mathematical modeling into Higher mathematics teaching

Proper infiltration of Mathematical Modeling thought in Higher Mathematics can make students' study enter into the virtuous cycle that theory is connected with practice, and practice promotes theory.

3.1 Clarifying the meaning of the concept

Mathematical concepts are generated by practical needs, so we should pay attention to the process of Abstracted concepts from practical problems in mathematics teaching, so as to cultivate students' interest in applied mathematics. In Higher Mathematics, the concepts of Derivative and Definite Integral are two important concepts, so we should make clear their meaning in teaching. Description is derivated from the concept of derivative curve tangent slope geometry, physics of variable speed linear motion speed and intensity of alternating circuit of current practical problems such as Abstract, has a wide range of practical significance, so it has wide significance. Meaning of derivative is the instantaneous rate of change which function relative to the independent variables, it is basis of solving the practical problems of all rate, which is the basis of the mathematical model was established based on differential equation, in order to solve the area of the curved trapezoid, variable speed linear motion displacement, we introduce the concept of definite integral. The basic idea of definite integral is to get approximation by breaking the integral into zero, and to find limit by gathering zero. The key to the establishment of the concept of definite integral is to take the local approximation to directly substitute the curve, and to replace the variable Abstractly with a constant. In all applications of definite integrals, the analysis of the infinitesimal is the key, and the establishment of the infinitesimal embodies this significance.

3.2 Promotion and application

There are many problems in the application of higher mathematics, and there are three typical problems:

3.2.1 The most value problem

Extreme value is the first problem in using higher mathematics to solve practical problems. In the teaching, the solving steps of extreme value problem have reflected the primary mathematical modeling thought, in the teaching it should increase the number of questions, expand the thinking of students, make students master the method to solve extreme value problem, and experience extreme value problem application of the extensive through a variety of types of exercises.

3.2.2 Application of definite integrals

The idea of infinitesimal method has a wide range of applications. This idea is rooted in the concept of definite integral, in the teaching we must analyze the concept of definite integral, make students understand the meaning of definite integral concept to establish, when solving practical problems using infinitesimal method, we should clear the ideas of differential first, we also should strengthen the instance of application problem in the choice of sample and the arrangement of homework.

3.2.3 Modeling learning of differential equation

Solving differential equations is all about solving practical problems. There is no general rule method to establish mathematical model by differential equation. In general, the first step is to determine variables, analyze the relationship between these variables and their infinitesimals or rate of change, establish differential equations (including definite solution conditions) in accordance

with the theories in mathematics, physics, biology, chemistry, engineering and other disciplines or laws and theorems obtained through experiments, and then solve the equations and analyze and verify the results. The concept of differential equation is introduced by practice, and the solution of differential equation can solve many practical problems. For example, the discovery of the law of universal gravitation enables students to understand the important role of mathematics in the development of science.

3.3 Case teaching of mathematical models in higher mathematics

Case teaching is taking the concrete case as the teaching content in the teaching, and introducing the mathematical modeling thought method through the concrete question modeling example. After we had learned in each chapter, select and compile some practical application problems and guide the student to carry on the analysis, establish mathematical model and solve mathematical problems through the Abstraction, simplify, hypothesis, variables, parameters, to solve the actual problem, it enable students to master the method of mathematical modeling, and make students deeply understand the mathematics' role of solving practical problems, is beneficial to implement the principle of combining theory with practice in teaching, greatly improving the students' ability to analyze and solve problems, such as: when teaching the properties of continuous functions on closed interval, I enumerates two seemingly unrelated problems of the mean value theorem, However, the original problem is skillfully transformed into the existence of zero point of continuous function through association, so as to obtain the perfect proof.

4. Reform textbooks and integrate modeling ideas

Calculus has a wealth of mathematical model topics, but the current higher mathematics courses rarely involve mathematical models, which not only makes the purpose of learning mathematical knowledge unclear, but also makes it difficult for students to use the knowledge to solve practical problems.

4.1 Focusing on integration in the specific content

4.1.1 Paying attention to the integration of mathematical ideas and methods

In the introduction of concepts, principles and formulas, we should pay attention to the integration and penetration of mathematical ideas and methods. In elaborating concept of limit, derivative, integral and so on, it should introduce mathematician is how to deal with the actual question through the example, derivate definition after transforming the unknown question into the known question, it must highlight the transformation thought; It emphasizes the mathematical thought of changing by invariance, changing by quietness, changing by directness, recognizing the infinite from the finite. It pays attention to the introduction of mathematical methods such as differential method, integral method and infinitesimal method. It trains the students' application consciousness and ability to solve practical problems with mathematical thinking.

4.1.2 Attaching importance to the establishment of functional relations

In social practice, in addition to qualitative analysis, further research requires quantitative analysis to seek the dependence between variables. First of all, we must Abstract and simplify it, find out the main variables and parameters, and establish the functional relationship after analysis and reasoning, which will lay a good foundation for solving practical problems in the future. Therefore, we should pay attention to the examples of the establishment of functional relations and strengthen the training of relevant aspects.

4.1.3 Cultivating the ability of transforming

As for the practical problems in reality, how to grasp the essence of the problems, carry out certain Abstraction and simplification, and express them in mathematical language to make them Abstract and become the related problems of higher mathematics? We should develop students' ability to transform general problems into mathematical models and mathematical collections into

practical applications.

4.1.4 Cultivating the thinking mode of combining theory with practice

We should introduce theories and examples of data design, collection and analysis. In each chapter, I will arrange specific assignments, collect and seek data in reality, sort out and analyze them, and use relevant mathematical knowledge to ask questions and give answers. I will develop the habit of observing the society and understanding the reality with mathematical knowledge, and develop a way of thinking that combines theory with practice.

4.2 Structural reform and innovation

The compilation order of the contents should refer to the traditional teaching materials, and integrate and adjust the contents as a whole according to the spirit of teaching reform.

4.2.1 Adding elementary mathematical models at the end of the chapter on function knowledge

Elementary mathematical model is to use elementary mathematical knowledge to solve practical problems with the characteristics of the model. Such problems exist in real life in large quantities. By solving these problems, we can enhance the intimacy of mathematics and increase the enthusiasm of learning mathematics.

4.2.2 Arranging a section of the application examples content at the end of each chapter of mathematical knowledge

It is to apply relevant mathematical knowledge to directly solve some simple practical problems around students, so that students can intuitively experience the application value of mathematics.

4.2.3 Increasing simple mathematical application models of derivative, definite integral, extreme and maximum value, ordinary differential equation, and other aspects

We should choose to solve some simple but practical problems with the characteristics of modeling, and consciously guide students to understand the process of mathematical modeling. Teaching materials should focus on the design of the problem, guide students to establish the corresponding model, so that students feel that the application of mathematics has prospects and interesting, so as to consciously observe the society, put forward problems, establish mathematical models, solve problems, and give play to their talents.

4.2.4 Adding a chapter of mathematical modeling knowledge introduction content

By introducing the basic concepts, methods and main steps of mathematical modeling, this course enables students to have a certain understanding of the basic knowledge of mathematical modeling, deepen their understanding of mathematical modeling, cultivate students' awareness of applying mathematics in social practice, and develop the habit of building mathematical models consciously to solve practical problems.

5. Conclusion

Teaching practice has proved that mathematical modeling is an effective means to cultivate students' thinking quality and improve their ability to apply mathematical tools to solve practical problems. Therefore, universities should actively create conditions, and strive to build the advanced mathematics curriculum integrated with the idea of mathematical modeling into a strong position to cultivate students' creative thinking and improve their comprehensive quality.

References

[1] Ma Zuliang, Zhang Yici, On mathematics modeling which is the important link of mathematics education reform, Journal of Mathematics Education, vol.11, 1995.

[2] Li Daqian, Mathematical modeling and quality education, China Undergraduate Mathematical Contest in Modelling Newsletter, vol.9, 2002.