

## Principles and methods of mathematical modeling activities

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**Abstract:** Mathematical modeling education should follow the principle of purpose, the principle of acceptability, the principle of inspiration, the principle of incentive and the principle of creativity. In the mathematical modeling activities, it is necessary to highlight the student's subjective status, attach importance to the analysis of the thinking process, infiltrate the mathematical thinking, pay attention to the students' individual differences, and pay attention to the development of students' non-intellectual factors.

### 1. Introduction

Mathematical modeling education is conducive to the comprehensive cultivation of students' knowledge and quality, and enhances practical hands-on skills and operational skills. It is embodied in the ability to train students:

1) It can improve the ability of logical thinking and Abstract thinking.

Mathematical modeling is the process of building models, solving and analyzing. The establishment of the model is a specific to Abstract cognitive process. For example, the speed of the variable linear motion is the derivative model of the displacement. Through the analysis of thinking, the perceptual knowledge is raised to the rational understanding. This process helps to improve the students' Abstract thinking ability.

2) It can enhance the adaptability of college students.

Through learning mathematical modeling and training for competition, they not only receive the edification of modern mathematical thinking and methods, more importantly, know how to analyze, reason, generalize and use mathematical methods and computer knowledge for different practical problems.

3) It can help to increase self-learning ability. Due to the extensiveness of practical problems, many of the knowledge that students use in modeling practice are not learned before, and there is no time for teachers to explain in detail to make up the lessons. So the teachers have to talk about the main methods of thinking. The students further master through self-study and mutual discussion, which cultivated students' self-learning ability and analytical comprehensive ability.

4) It can help to improve the ability of college students to collaborate with others. In the process of mathematical modeling learning, there are a large number of mathematical models that can not be solved by mathematical knowledge alone. It requires interdisciplinary and cross-specialty knowledge to be integrated, which requires people with different knowledge structures to study with each other, uniting and cooperating, and solving problems together. It will make the knowledge structure complement each other and learn from each other's strengths.

5) It can cultivate the ability of college students to analyze, integrate and solve practical problems. The establishment of mathematical models is a positive thinking activity. The modeling process generally has to undergo stages of analysis and synthesis, Abstraction and generalization, comparison and analogy, systematization and concrete. It is required for university students to combine the mathematics knowledge and computer knowledge with other aspects of knowledge, and solve problems by hand, and make reasonable explanation according to the calculation result.

Through practice and learning, it improves the ability to analyze, synthesize and solve practical problems.

6) It can help to improve the creative ability of college students. Mathematical modeling stimulates students' interest and enthusiasm through a large number of vivid and interesting examples, guides students to continuously acquire new knowledge and use new methods and new technologies, and cultivates students' innovative awareness and abilities in the process of analyzing problems. Mathematical modeling is very beneficial to the creative cultivation of college students.

## **2. The basic principles of mathematical modeling education should be followed.**

### **2.1 Principle of purpose**

Mathematical modeling education should have a clear purpose. One is to promote the overall development of students and to provide further study for students. The second is to cultivate students' social practice ability so that students can be good at turning practical problems into mathematics problems. By establishing a model, analyzing and solving mathematical models, it lays the foundation for cultivating practical talents and achieves the goal of improving the quality of workers.

### **2.2 Acceptability principle**

The content and method of mathematical modeling teaching should be suitable for the specific situations of schools and students. First, it is necessary to adapt to local conditions. Mathematical modeling activities should be based on the teaching resources of the school, and appropriate selection of relevant content for activities. Second, the content and method of carrying out modeling activities should conform to the age characteristics, intellectual development level and cognitive level of the students. Third, the questions and models should be close to life and contact with the actual situation, and the content of the textbook should be kept close, so that students are interested and capable of solving problems.

### **2.3 Inspiring principle**

In carrying out mathematical modeling activities, we must adhere to the principle of inspiration. Teachers should adhere to the enlightening teaching as the main body to carry out teaching activities, fully mobilize the initiative of students' learning, inspire students to think independently, guide students to use brain, mouth, hands, and learn creatively. Learning, giving students a certain space of thinking, paying attention to students' independence and autonomy, guiding students to question, investigate, explore and learn during practicing, and promoting students to actively and personally solve problems under the enlightenment and guidance of teachers.

### **2.4 Activity principle**

As a kind of mathematics activity teaching, mathematics modeling teaching breaks through the way of classroom teaching. Classroom teaching should stay open, promote space and time flexibility, create a relaxed atmosphere for student activities, and enable students to learn to innovate during the process of using hands, mouth and brain and vigorously promote students' "independent exploration", "cooperation and communication," and "innovative thinking."

### **2.5 Incentive principle**

Mathematical modeling education should implement the principle of motivation from beginning to end. First, in the organization of modeling teaching, efforts should be made to create an atmosphere that encourages students to actively participate in activities through appreciating mainly, and improves their interest in learning and training to make them participate actively. Second, we must pay attention to mobilizing the enthusiasm of teachers to participate. Mathematical modeling teaching requires more energy than general classroom teaching to collect information, design problems, research models, design organization and guidance methods, etc. So it needs teachers to have dedication.

## **2.6 Creative principle**

Mathematical modeling activities have a greater impact on improving students' innovative quality. Mathematical modeling education should take the cultivation of students' innovative ability as an important goal, insist on developing and promoting students' creative thinking, and improve students' sense of innovation. At the same time, teachers should creatively carry out teaching design in teaching, making the whole modeling teaching more Innovative.

## **3. The method of mathematical modeling education**

### **3.1 Highlight the subjective status of students**

The student's subject status means that the student should be the center of teaching activities. All the teaching methods should serve the students' learning. Students should actively participate in the teaching activities and act as the protagonist of the teaching activities. The characteristics of mathematical modeling determine that each part of the teaching should put the prominent student's subject position in the first place. Teachers should encourage students to try boldly, not afraid of failure, and must think more, read more, discuss more, and practice more so that students are always in the position of active exploration.

### **3.2 Promote at different levels**

In the teaching of mathematical modeling, teachers should pay attention to the differences of students' individuality, require separate requirements for students, and set different teaching requirements and development goals for different students. It is necessary to give more guidance to eugenics, propose higher mathematical modeling goals, encourage the use of modern educational technology, give them the opportunity to independently model, and independently complete high-quality modeling papers. For students of intermediate level, teachers should give more inspiration and more enlightenment, improve the level of modeling, and strive to make students complete the modeling of small papers independently. For poor students, teachers should grant more tutoring. The main point is on the idea of infiltrating mathematical modeling, with it students only need to complete less difficult modeling exercises. When students encounter difficulties, teachers should encourage students in a more encouraging way to help students enhance their confidence, overcome difficulties, and achieve success of modeling through emotional communication between teachers and students.

### **3.3 Infiltration of mathematical thinking methods**

Mathematical thinking method is the essence of mathematics knowledge, and it is the bridge of turning knowledge and skill into ability. Because modeling mathematics is faced with ever-changing practical problems, the modeling process should be the process of infiltrating the mathematical thinking method. Firstly, it is the method of returning to the thought. It can also infiltrate the idea of the function, the idea of the equation, the idea of combining numbers and shapes, logic dividing thoughts, equivalent transformation thoughts, analogical regressions, analogical association thoughts and exploration thoughts. We can also introduce students mathematical methods such as elimination method, meta-element method, undetermined coefficient method, matching method, counter-evidence method, analytical method, inductive method, etc. As long as we focus on the all-round penetration of mathematical thinking methods in modeling teaching, we can let students understand the idea of mathematical modeling in essence.

### **3.4 "Deferred judgment"**

The so-called "deferred judgment" is to delay the time when the result appears. The essence is that the teacher should not throw the result to the student too early. Delaying the judgment should focus on two aspects: first, the mathematical concept, theorem, and the problem solving should all be carried out as a process; second, teachers should be patient when listening to students answering questions, especially answering wrong. They should not be judged immediately. They should calm

down and inspire students to think positively, organize students to have heated discussions. And then the problems will gradually become clear, and finally they will get satisfying modular solution.

### **3.5 Attach importance to the analysis of thinking process**

Students feel that mathematics modeling is difficult. The main reason is that the thinking mode of mathematical modeling is different from the students' long-term learning of mathematics knowledge. It is necessary to analyze the mathematical thinking process of modeling, and to discover valuable thinking training factors, Abstractly summarize the mathematical ideas and methods contained in the modeling process, develop students' multi-faceted mathematical thinking ability, cultivate students' innovative consciousness, and let each student do their best and have their own achievements, through the emergence, development and application process of modeling.

### **3.6 Emphasize the application**

1) Guide students to pay attention to daily life problems and organically integrate the problems encountered in real life into modeling teaching.

2) During the modeling teaching, teachers should pay attention to the process of recreating the formation of mathematical models. Students can first experience the general thinking methods of mathematical modeling. And then let students learn the actual problems and construct their own mathematical models.

3) It is necessary to strengthen the connection with other disciplines, spread the science, engineering and other different disciplines and expand the source of student modeling problems.

4) Emphasis on the use of computers. Since building, seeking, and verify model in mathematical modeling require special value attempts, mathematical collection and processing, function simulation, construction of images, and even a large number of calculations. Computers will become the most powerful mathematical modeling aids.

5) Focus on the development of students' non-intellectual factors

Non-intellectual factors include motivation, interest, emotion, will, attitude, etc. The non-intellectual factors in cultivating students in mathematics teaching are to make students have a strong desire for mathematics, broad interest, positive emotions, good motivation, strong will, firm belief, and the aggressive psychological quality. In the teaching, teachers can combine the mathematical modeling content according to the students' psychological development level and specific conditions and adopt flexible and diverse forms to explain the wide application of mathematical modeling paradigms, stimulate students' strong interest in participating in mathematical modeling activities, and promote forming and strengthening motivation. We can introduce a competitive mechanism, allowing students to encourage each other and achieve success through mutual discussion or competition and let students fully appreciate the practicality, fun and unique charm of mathematical modeling.

## **4. Conclusion**

Mathematical modeling is not only the application and sublimation of mathematical knowledge, but also the expression and teaching method of mathematical thoughts. In fact, basic concepts, formulas and theorems are all mathematical models. Therefore, the essence of mathematics teaching is mathematics model teaching. During the process of teaching, we should pay attention to the following points. A. the topic selection of the model should be popularized. The content of mathematical modeling which is easy to accept, interesting and practical should be selected. B. design creative examples to inspire students to think positively, step by step, and find rules. C. examples should be fewer but better, avoid large and extensive, and to dilute the learning of higher mathematics theory knowledge. D. students should start from the original form of reality and gradually train and guide them to observe, analyze, summarize and Abstract the mathematical model from simple to complex.

## References

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