

Mathematical Modeling Course Teaching Reform: Strategy and Practice

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Abstract

This paper discusses the direction of mathematical modeling course teaching reform, aiming at improving teaching quality and students' practical application ability. The reform direction includes integrating the idea of mathematical modeling into the teaching syllabus, innovating the teaching mode to stimulate the learning interest, strengthening the teaching of mathematical experiment course and building the mathematical modeling network platform to improve the evaluation system. The specific teaching methods include the combination of theory teaching and case analysis, class discussion and group cooperation, experiment simulation and software application, competition participation and project practice, as well as paper writing and achievement presentation. Finally, some suggestions are put forward to combine theory with practice, cultivate students' self-learning ability, strengthen the construction of teachers and improve the teaching evaluation system, so as to comprehensively improve the teaching effect of mathematical modeling course.

Keywords

Mathematical Modeling; Network Platform; Practical Ability; Evaluation System.

1. Introduction

As an important bridge between mathematical theory and practical application, mathematical modeling can not only help students deeply understand mathematical concepts and methods, but also cultivate their ability to solve practical problems. Through the practice of mathematical modeling, students can transform abstract mathematical knowledge into a tool to solve specific problems, thus enhancing the interest and practicality of learning. By participating in mathematical contests in modeling or projects, students need to face complex problems in a limited time, collect, process and analyze information, and finally propose solutions. This process not only exercises students' professional skills, but also cultivates their psychological quality, communication ability and anti-pressure ability, which is of great significance for improving students' comprehensive quality. Teachers also need to improve their own professional quality and teaching ability to better guide students to carry out mathematical modeling practice.

Sun Shudong [1] discussed how to integrate mathematical modeling into the teaching of university mathematics courses, and proposed a series of effective teaching strategies and methods aimed at improving the quality and effect of mathematics teaching. Chen Huayou [2] emphasized the role of mathematical modeling in improving students' comprehensive quality. He believes that mathematical modeling not only helps improve students' mathematical literacy and logical thinking ability, but also cultivates their innovative spirit, teamwork spirit and problem-solving ability. Yan Peisheng [3] further discussed the relationship between mathematical modeling and university mathematics education. He pointed out that mathematical modeling is an indispensable part of mathematics education in universities,

which can not only enrich the content of mathematics courses, but also promote the reform and innovation of teaching methods.

2. Problems in the Teaching of Mathematical Modeling Course

2.1. The Course Content is Simple and Lacks Practicability

At present, many colleges and universities use paper teaching materials, the content is monotonous, can not record the learning process, interaction is not strong.

2.2. Rigid Teaching Mode and Lack of Innovation

The traditional teaching mode is mainly taught by teachers, and students passively accept knowledge, lacking the opportunity of active exploration and practice. This kind of "cramming" teaching mode inhibits the cultivation of students' innovative thinking and ability.

2.3. The Evaluation System is Single, Ignoring the Process Evaluation

The traditional mathematics evaluation system mainly relies on the scores of the big homework at the end of the semester and the scores of the small homework at the end of the semester. The small homework at the end of the semester focuses on the investigation of theoretical knowledge, and the big homework at the end of the semester focuses on the comprehensive ability of students, especially the ability of applying mathematics to solve practical problems. In the process of learning, preview, quick answer, group discussion, classroom student explanation, etc., are not included in the evaluation.

3. Reform of Teaching Strategy of Mathematical Modeling Course

3.1. Integrate the Thinking and Politics of Mathematical Modeling Course into the Teaching Syllabus

Integrating the ideological and political thoughts of mathematical modeling course into the teaching syllabus is an important way to improve the teaching quality of the course and cultivate the comprehensive quality of students. The establishment of the ideological and political resource library of the course: collecting cases, videos, pictures and other materials related to the ideological and political thoughts of the course, establishing the ideological and political resource library of the course, providing convenience for teachers to prepare lessons and students to study by themselves.

3.1.1. Cultivate Patriotism and Sense of Responsibility

Through the practical cases in the course, such as the application of differential equation mathematical model to explain the spread of the novel coronavirus epidemic, in the face of the severe situation of the epidemic, the Chinese people patriotic fight against the epidemic, showing great strength, and inspiring students' patriotic feelings and social responsibility.

3.1.2. Establish a Correct World Outlook, Outlook on Life and Values:

While explaining the ideas and methods of mathematical modeling, it guides students to realize the value of mathematics in solving practical problems, and cultivates their scientific attitude of seeking truth from facts and the spirit of pursuing truth.

3.2. Innovate Teaching Mode to Stimulate Learning Interest

Case teaching and problem-oriented teaching model are adopted to guide students to actively participate in class discussions and explore ways to solve problems. Through group cooperation, group discussion and other ways to cultivate students' teamwork spirit and innovation ability. At the same time, the use of multimedia teaching means to enhance the classroom interaction and interest, stimulate students' interest in learning.

Students are encouraged to use mathematical modeling ideas and methods to solve practical problems, cultivate their innovative thinking and practical ability, and lay a solid foundation for future scientific research and social practice.

Teachers should also actively participate in visits and exchanges, increase practical experience, so that they can be more skilled in using various mathematical modeling methods and tools for teaching.

3.3. Strengthen Mathematics Experiment Teaching

The mathematics experiment course is an important way to improve students' mathematical modeling ability and practical ability. By offering mathematical experiment courses, students are guided to use mathematical software for mathematical modeling and data analysis, so as to deepen their understanding and application of mathematical knowledge. At the same time, students are encouraged to participate in mathematical contests in modeling and scientific research project competitions to improve students' ability to solve practical problems.

3.4. Establish a Mathematical Modeling Network Teaching Platform and Improve the Evaluation System

The campus mathematical modeling network teaching platform is established to provide abundant mathematical modeling resources and cases, which is convenient for students to learn independently, communicate and record learning effects. Through the online teaching platform, students can obtain the latest mathematical modeling information, share learning experiences, participate in online discussions, thereby broadening the scope of knowledge and improving the learning effect.

The establishment of a scientific and reasonable teaching evaluation system can evaluate students' learning effect comprehensively and objectively. Post feedback and improvement after each class: collect feedback from students in time, continuously improve and optimize the teaching content, teaching methods and teaching evaluation, so as to improve the teaching quality and education effect of the course.

3.4.1. Evaluation Methods Combining Formative Evaluation and Summative Evaluation

It not only pays attention to the formative evaluation of students, but also pays attention to the summary evaluation of students' learning outcomes. Through observation, record, feedback and other ways, timely understanding of students' learning situation, adjust the teaching strategy. Evaluate students' learning outcomes through examinations, tests, and project presentations.

3.4.2. Develop Differentiated Evaluation Criteria

Basic level students, master basic knowledge and basic skills as the main evaluation criteria. Development level students, on the basis of mastering basic knowledge, pay attention to the evaluation of their thinking ability and the effectiveness of learning methods. Excellent level students, with comprehensive quality and innovation ability as the main evaluation criteria, encourage their pursuit of excellence.

3.4.3. Evaluation of Introducing Ideological and Political Elements

In the evaluation process, ideological and political elements are introduced, such as students' patriotic feelings, social responsibility, and innovative spirit, so as to promote students' all-round development.

4. Reform of Teaching Methods of Mathematical Modeling Course

Mathematical modeling courses are interdisciplinary disciplines that study how to combine mathematical methods with computer knowledge to solve real-life problems. Its goal is to make students master the basic ideas, methods and types of mathematical modeling through the

introduction of specific examples, understand the general process of scientific research, and enter the practical operation state.

4.1. Combine Theoretical Teaching with Case Analysis

4.1.1. Theoretical Teaching

First of all, teachers need to systematically introduce the basic concepts, principles and methods of mathematical modeling to lay a solid theoretical foundation for students. In the teaching process, we should pay attention to the combination of teaching and discussion, so as to facilitate students to carry out independent research on the basis of understanding theories. In the teaching process, students should be encouraged to learn independently, think independently and solve problems. Compile rich media teaching materials, increase the introduction of practical application cases of video and narration, so as to make the content of teaching materials more suitable for students' research.

4.1.2. Case Analysis

Project-based teaching is introduced, and representative practical cases are selected as teaching projects to let students understand the application of mathematical modeling in practical problems. Examples should be representative, timely and interesting to stimulate students' interest and enthusiasm in learning. Students can deeply understand the basic steps and methods of mathematical modeling in the process of solving practical problems. Carry out school-enterprise cooperation to provide more practical opportunities for students. These practical links allow students to apply their knowledge to practical problems and improve their practical ability and innovation ability.

4.2. Class Discussion and Group Work

4.2.1. Classroom Discussion

Students are encouraged to actively participate in class discussion and express their views and opinions. Through the discussion, students' understanding of mathematical modeling concepts and methods is deepened, while students' oral expression skills and critical thinking are developed.

4.2.2. Group Cooperation

Students are divided into groups and each group is assigned a practical problem for mathematical modeling. Team members need to work together to complete the task. This helps develop students' teamwork and problem-solving skills.

4.3. Experimental Simulation and Software Application

Mathematical software and simulation tools are used to carry out experimental simulation to verify the correctness and effectiveness of mathematical modeling. Through the experimental simulation, students can intuitively see the results of the mathematical model and deepen the understanding and application of the model.

4.3.1. Selection of Tools

Select appropriate mathematical software and simulation tools according to modeling requirements, such as MATLAB, Python (with NumPy, SciPy and other libraries), etc.

4.3.2. Model Building

Build the corresponding simulation model according to the mathematical model in the software, including defining variables, setting parameters, writing equations, etc.

4.3.3. Run the Simulation

Run the simulation model with software, observe and record the output results of the model.

4.3.4. Data Comparison

Collect actual data or known results and compare them with the output results of the simulation model. The accuracy of the model can be evaluated by calculating similarity measures such as mean square error (MSE) and root mean square error (RMSE).

4.3.5. Result Analysis

Analyze the accuracy of the model according to the comparison results, and judge whether the model effectively represents the actual phenomenon or problem. If the model is biased, you need to adjust the model parameters or rebuild the model.

4.3.6. Model Optimization

According to the analysis results, the model is optimized to improve its accuracy and adaptability.

4.3.7. Validation Cycle

Repeat the above steps to continuously validate and optimize the model until it meets the actual requirements.

4.4. Competition Participation and Project Practice

4.4.1. Competition Participation

Students are encouraged to participate in various mathematical contests in modeling, such as the National Mathematical Contest in Modeling for College Students. By participating in the competition, students can not only exercise their mathematical modeling ability and teamwork spirit, but also have the chance to win honors and awards.

4.4.2. Project Practice

Cooperate with enterprises or scientific research institutions to carry out mathematical modeling for actual projects. This not only allows students to apply what they learn, but also improves their practical ability and innovation ability.

4.5. Paper Writing and Achievement Presentation

4.5.1. Paper Writing

Instruct students to write mathematical modeling papers, including problem background, model construction, solution process, result analysis and conclusion. Writing papers can exercise students' writing ability and expression ability.

4.5.2. Results Display

Organize students to show their results, and let students show their mathematical modeling results to the whole class or the whole school. This can not only enhance students' self-confidence and sense of achievement, but also promote academic exchange and mutual learning.

5. Summary and Prospect

This paper deeply discusses the application and importance of mathematical modeling in mathematics teaching, and puts forward feasible reform strategies and measures in view of the existing problems in mathematics teaching. Through the analysis of practical cases, we have witnessed the remarkable effect of mathematical modeling in cultivating students' innovative thinking, practical ability and problem-solving ability. In the future, we expect more educators to pay attention to and practice mathematical modeling teaching, constantly explore new teaching models and methods, and contribute to cultivating high-quality talents with innovative spirit and practical ability.

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