

Teaching Reform of Mathematical Model Course Based on the Cultivation of Innovative Talents

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Abstract: Based on the competition of mathematical model in colleges and universities, we aim at cultivating the formation of mathematical modeling consciousness, developing the ability of mathematical model and cultivating innovative thinking, in order to enhance the ability to solve practical problems for undergraduate students and graduate students. The paper firstly introduces positive effects on cultivating innovative talents based on mathematical model. Then some characteristics of the mathematical model competition are given. Finally some suggestions on the teaching reform of mathematical model course are proposed. The reform achievement on the mathematical model course supports suggestions in the reform positively.

1. Introduction

The national medium and long-term educational reform and development program(2010-2020) pointed out: Cultivating high-quality talents and innovative talents is the first thing for colleges and universities. For enhancing the cultivation of talents' quality, the acceleration of cultivating innovative talents is a long-term and strategic significance thing. As mathematical model provides students with the innovative environment and condition, engaging in the mathematical model activity plays an important role in cultivating students' personality and their innovative ability in the current teaching reform and quality-oriented education [1]. Based on the talent cultivation model of deepening foundation, widening caliber and extending capability, by the mathematical model competition and relative courses as mathematical model and mathematical experiment, and so on, we focus on training students' performing ability and practical ability, the spirit of innovation, unity and hard working, which is the basis of cultivating high-quality talents and innovative talents.

As mathematical courses in colleges and universities have the positive effects in cultivating

students' scientific spirit of exploration and creative thinking, the mathematical model course plays the foundation role of cultivating the application of using mathematics and innovative ability for undergraduate students and graduate students. Since 1992, the mathematical model competition for undergraduate students began, aiming at pushing the implement of mathematics theory and methods to practical problems and realizing the transform of mathematics application [2]. In 2004 the mathematical model competition for graduate students began in colleges and universities, aiming at strengthening the ability of innovative thinking and the practical ability [3]. For the positive meaning of the mathematical model competition in teaching reform and cultivating students' innovative ability, Zhu and Fang [4] propose the multi-level innovative talents cultivation mode and have analyzed the results of this feasible and effective mode. Based on the mathematical model activity, Zhang, Bi and Wang [5] construct the multi-dimensional cultivation system of dual creative type in order to enhance students' ability in innovation and entrepreneurship in colleges and universities. There are a large number of literatures about the teaching reform of the mathematical model course, such as [6] and so on. In the recent 20 years, the quality of undergraduate students and graduate students has a great improvement.

2. Characteristics of the Mathematical Model Competition

The mathematical model competition reflects a good command of mathematics knowledge, in which some practical problems are solved by the specific knowledge we learned and the mathematical software. The competition is open, comprehensive and practical, mainly checking the way of thinking and the ability of using mathematics knowledge rather than the learning ability of mathematical methods [2].

After learning the basic mathematical courses such as advanced mathematics, linear algebra and mathematical statistics, students have grasp some basic mathematics theory, and have the logical thinking ability and the ability to analyze and solve problems. In order to enhancing students' ability of using mathematics knowledge to solve practical problems, the mathematical model course is arranged as one of the main courses in colleges and universities, pushing the further development of the mathematical model teaching. Different from the principle of more theory and less practice for traditional mathematical courses, the mathematical model course focus on the ability of application and the ability of innovation and practice. Figure 1 demonstrates the whole process of mathematical model [7].

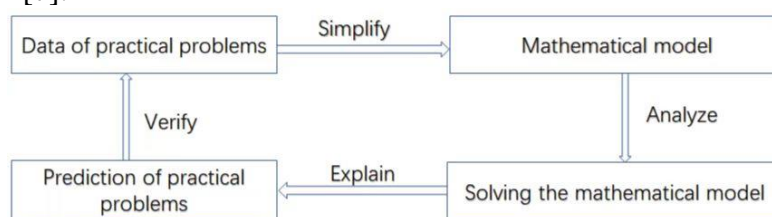


Figure 1. Process of mathematical model

As the mathematical model competition is a contest with strong profession, it investigates not only the ability of using mathematics knowledge to solve practical problems, but also the cooperation of the team members and the ability of searching relative information. Usually a team in the mathematical model competition is established by three members. In the competition process, teachers establish the team by students' character and arrange the task for the members of the team in order to strengthening the spirit of cooperation. Figure 2 shows the execution route of the mathematical model competition [8].

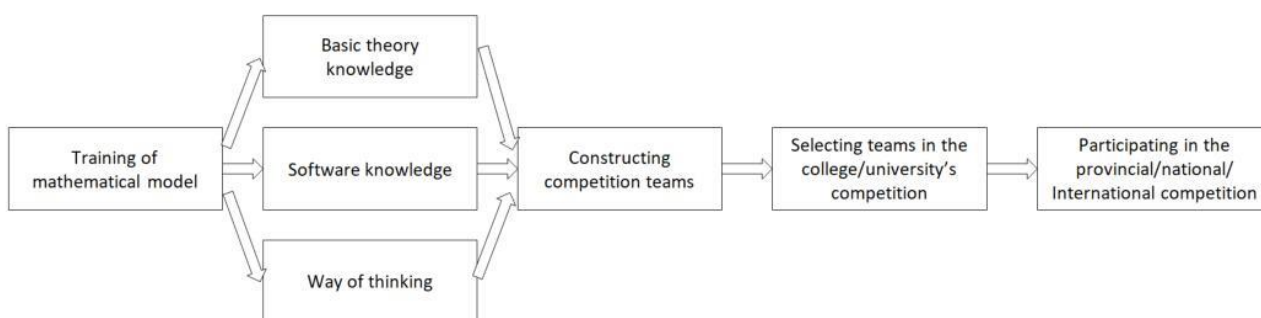


Figure 2. Execution route of the mathematical model competition

3. Some Suggestions to Reform the Mathematical Model Course

3.1. Enrich Professional Knowledge and Broader Thinking

Searching the database of China National Knowledge Internet (CNKI) with the keywords “mathematical model”, the papers published of specific mathematical models are shown in Figure 3. In the process of solving problems in the mathematical models competition, there are some mathematical models frequently used, such as neural network, genetic algorithm and cluster analysis. Besides, the analytic hierarchy process, fuzzy comprehensive evaluation, linear regression, logistic regression and decision tree are usually used. These mathematical models are mainly widely used in the fields of economic statistics, biomedical and applied mathematics and so on, which reflect the importance of the mathematical model knowledge in storage and broaden the students’ way of thinking [9].

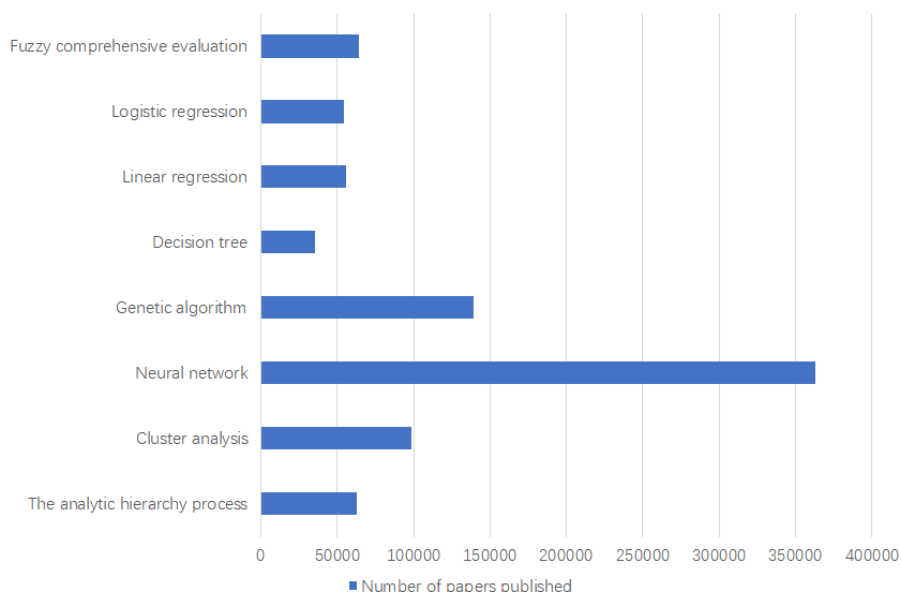


Figure 3. Number of papers published on mathematical models related to China National Knowledge Internet up to September of 2022

3.2. Update Teaching Methods and Implement the Organic Linkage of the First Classroom and the Second Classroom

Usually the learning of the mathematical model is in the computer labs. Most teachers use all kinds of modern teaching tools in teaching, such as computer aided instruction and multimedia

teaching, and so on. Especially when teachers introduce some kind of computer software, students could keep on learning by training in the computer labs, which will improve the teaching efficiency. On the other hand, using modern communication tools like Internet build up the close contact between teachers and a student, which makes the communication become easier.

The first classroom focuses on the interaction between teachers and students, which makes teachers could understand the thinking of students and the profession knowledge they have learned. In the teaching process of the first classroom, teaches prepare the contents of the course and give lectures with typical cases by the case-teaching method according to the teaching progress, and encourage and guide students to learn new knowledge. Then teachers ask some questions in the classroom discussion, which emphasize the application of mathematics knowledge. Combining the mathematics theory with the practical application improves the students' interest of learning greatly. During the process, teachers need to follow the hot problems in recent research and apply the new research achievement in teaching, which makes the contents of teaching keeping forward.

The second classroom relative to the first classroom closely focuses on the interaction between students. In the second classroom, students contact with each other by the network teaching platform, establish the mathematical model and use modern computing methods to solve practical problems. In the process, teachers assist students to accomplish projects and carry out some incentive measures to promote the interest of attending the practical activity in the second classroom, in order to cultivate the performing ability and ability of innovation and cooperation.

By the mathematical model competition platform and the case-teaching method, the teaching in the first classroom strengthens students' ability in using mathematics theory and computer software to solve practical problems, while the establish of the second classroom emphasizes students' ability in founding problems, analyzing problems and solving more practical problems creatively. Thus combing the first classroom with the second classroom organically enhances the scientific exploration spirit and the spirit of cooperation, resulting in cultivating the innovative talents with theoretical knowledge and the practical ability [10].

3.3. Encourage Students to Participate In Scientific Research Projects and Cultivate the Achievement Transformation

By the learning of theory and the practical training in the mathematical model course, students basically grasp the thinking and methods of mathematical model and have some ability in application. In the process of solving problems, teachers guide students to think systematically and comprehensively in the exploration of mathematics, find out new elements, change the original strategies in time and propose effective treatments to solve new problems, which reflects the ability of using mathematics knowledge to solve more practical problems. By selecting excellent teams through school competitions, these teams are instructed and trained patiently by tutors and finally attend the international/national/provincial mathematical model competition.

In order to enhance students' the mathematical model level and scientific research level further, we could establish some scientific research projects about the mathematical model for students, and encourage students positively participate in and apply projects, which will make the teams in mathematical model grow constantly. The topic of projects could be the titles in the mathematical model competition in past years, or the scientific research projects of teachers, or the national/provincial entrepreneurship and innovative programs and so on. After a series of practical training in mathematical model, the students' ability in using mathematics knowledge to solve practical problems is greatly improved, and the innovative achievements would be generated by innovation to serve the society. Especially for the undergraduate students having been awarded in the mathematical model competition, they usually have the priority to become postgraduate students

and participate in the tutors’ projects much easier. Figure 4 shows the cultivation of innovative talents system frame.

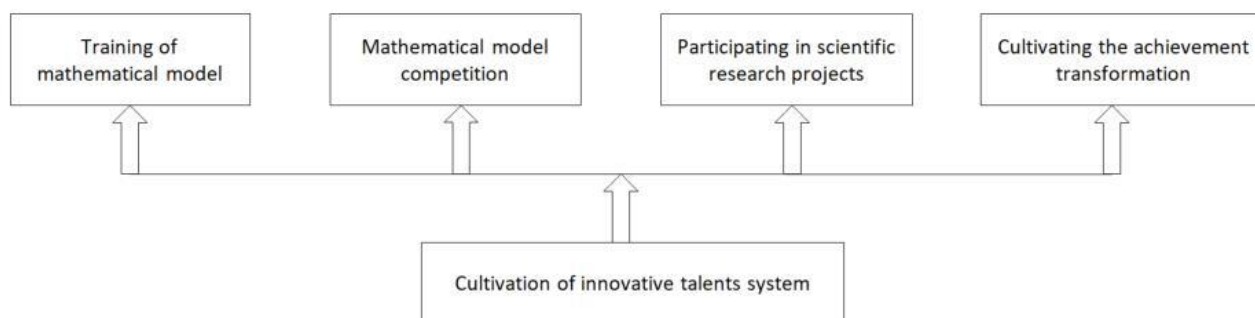


Figure 4. Cultivation of innovative talents system frame

4. Achievements after Reforming the Mathematical Model Course

Since we have carried out the teaching reform of the mathematical model in Hunan institute of science and technology in 2020, we have gained good results in cultivating the quality of talents and enhanced the students’ applicable ability and the ability of application and innovation. Table 1 shows numbers of the mathematical model competition awards in Hunan Institute of Science and Technology in recent five years, from which we observe that the teams participating in the competition and the numbers of awards are much more than before. In the following part, we just analyze the data and inspect the effect of the teaching reform of the school of mathematics in Hunan Institute of Science, In recent two years, the teams participating in the national mathematical model competition has enlarged to two times that of teams in the past years, and the teams being rewarded have been increasing correspondingly with the award ratio up to 60% percentage. From the year 2020 to 2021, we have 1 team gaining the national first prize, 5 teams gaining the national second prize and nearly 20 teams gaining provincial prizes. In 2022, we have 1 team gaining the Finalist prize and 1 team gaining the Honorable Mention prize in the mathematical/interdisciplinary contest in modeling (MCM/ICM). What’s more, the graduate teams in school of mathematics have gained several awards, that is, 1 team gaining “HUAWEI Cup” the national second prize, 2 teams gaining “HUAWEI Cup” the national third prize and nearly 10 teams gaining provincial prizes.

Table 1. Numbers of the mathematical model competition awards in Hunan Institute of Science and Technology in recent five years

Year	Numbers of Provincial Awards	Numbers of National Awards	Numbers of International Awards
2018	9	2	13
2019	7	2	11
2020	23	2	11
2021	40	16	10
2022	60	17	7

Continuing the reform thinking of the mathematical model course is the first thing from now on, that is, strengthening and enriching the teaching team, designing and optimizing typical teaching cases relative to the teaching contents, optimizing the network platform and enlarging the common algorithms in the mathematical model and excellent papers relative to the national/provincial mathematical model competition for undergraduate and graduate students, and strengthening the students’ performing ability in the practice of mathematical model. We aim at making the reform of

the mathematical model course be one of the typical teaching reforming cases of mathematics courses, and applying the teaching reforming achievements of our course to other colleges and universities.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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