The Exploration of Integrating the Thought of Mathematical Modeling under the New Engineering Disciplines

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Abstract. With the proposal of new engineering construction, engineering education has also put forward new requirements for the teaching of Higher Mathematics courses. Advanced mathematics is a compulsory basic course for various engineering majors in application-oriented undergraduate colleges. However, due to various reasons, it is still difficult to meet the new requirements of Higher Mathematics courses in the talent cultivation process under the background of new engineering courses in actual teaching. Based on the above issues, in the context of the new engineering discipline, the necessity of integrating mathematical modeling ideas into the Higher Mathematics curriculum of public basic courses in universities was analyzed. This paper elaborates on the characteristics of Higher Mathematics teaching that integrates mathematical modeling ideas from four perspectives: studying knowledge as a topic, emphasizing scientific thinking methods, combining theory with practice, and cultivating mathematical appreciation, and explored the teaching method of integrating mathematical modeling ideas into Higher Mathematics courses. Explain how to practice in teaching from six aspects. Through specific practice, improve the current situation of Higher Mathematics teaching, enhance the quality of Higher Mathematics teaching, and cultivate students to use various divergent thinking methods to solve problems, transform Higher Mathematics from a knowledge-based teaching of "what" to a competence-based teaching of "why", in order to better serve the professional needs of new engineering construction.

Keywords: New engineering disciplines; Mathematical modeling; Higher mathematics

1. Introduction

With the advancement of the construction of new engineering disciplines centered on the Internet and industrial intelligence, many universities are gradually realizing that strengthening basic education in science and engineering is an important measure to cultivate new engineering talents in the process of exploring and researching innovative talent cultivation models. At present, Higher Mathematics for engineering majors mainly consists of calculus, spatial analytic geometry, differential equations, vector algebra and spatial analytic geometry, infinite series, etc. As a compulsory basic course for engineering majors in application-oriented undergraduate colleges, the importance of Higher Mathematics is self-evident. However, research shows that the traditional college mathematics teaching, including Higher Mathematics courses, can no longer meet the needs of new engineering personnel training. In order to give full play to the basic and service functions of Higher Mathematics courses in the follow-up courses of engineering majors, promote the creative work of engineering students at a higher level and realm, and improve the teaching effect of Higher Mathematics courses is particularly important and urgent. The classroom is the main venue for teaching activities, and classroom quality is the decisive factor in teaching quality. The purpose of this paper is to combine the author's teaching experience in Higher Mathematics for many years, explore the teaching method of integrating mathematical modeling into Higher Mathematics under the background of new engineering disciplines, so as to improve the effectiveness of teaching [1].

2. The Necessity of Integrating Mathematical Modeling Thought into Higher Mathematics Teaching

In the traditional Higher Mathematics teaching class, more emphasis is placed on the explanation of theoretical knowledge, but for students' mathematical application ability and insufficient cultivation

of innovation awareness. Mathematical modeling is different, as it can transform mathematical expertise into practical solutions ability to ask questions [2]. Mathematical modeling is actually creating mathematical models, specifically, mathematical models are aimed at a certain phenomenon, in order to achieve the goal, the construction is based on the objective laws of this phenomenon, and the number is obtained by corresponding to the relevant Mathematical notation learn structure. In short, it is the process of using mathematical language to explain a certain phenomenon. It is very necessary to integrate mathematical modeling into Higher Mathematics teaching.

First of all, the teaching method of Higher Mathematics is single and the knowledge expansion is insufficient. Integrating mathematical modeling into Higher Mathematics teaching can stimulate students' interest in mathematical knowledge. The teaching content of Higher Mathematics is very much, and the teaching hours are also very tense. Most teachers try their best to catch up with the schedule. In class, they mainly teach by teaching methods, and only talk about the concepts, theorems and calculation methods in the mathematics textbook. They ignore the penetration and introduction of mathematical culture such as mathematical background, history of mathematics, mathematicians, and cannot learn deeper and more comprehensive knowledge. Modeling ideas can concretize abstract knowledge and enhance students' mathematical inspiration, promoting their ability to use mathematical knowledge to solve practical problems.

Secondly, students are passive learners and lack enthusiasm for learning. Integrating mathematical modeling can enrich the teaching means of Higher Mathematics. Most students tend to learn Higher Mathematics passively and mechanically, and will not actively use the high-quality teaching resources provided by platforms such as Learning Connect to consolidate their knowledge and expand their knowledge. Few students actively consult relevant cutting-edge literature to understand the latest developments and research results of their knowledge, and also lack the mastery and application of commonly used mathematical software. For most students, the purpose of learning Higher Mathematics is just to pass the exam and not fail the exam. So, the initiative and enthusiasm for learning are naturally not high. Mathematical modeling itself is also a kind of teaching means. Integrating it into the Higher Mathematics classroom can enrich the classroom teaching process. Compared with the way of case explanation, the integration of modeling ideas enables students to have a deeper understanding of Higher Mathematics, and also expands the means of students' mathematical learning, which is very helpful to the improvement of mathematical discipline literacy.

Therefore, in the context of the new engineering discipline, if teaching is still carried out according to the previous traditional education model, it lacks inspiration for students, neglects the encouragement of students' exploration spirit, and makes students only obtain knowledge in the classroom without practical verification, only leaning towards problem-solving training for difficult and biased questions, which stifles students' creativity and makes it difficult to improve the quality of education. With the development of teaching and social needs, new educational methods should be closely linked to life. Teaching that incorporates modeling ideas advocates for students to actively construct problem models, rather than simply solving difficult problems and unilaterally improving grades. Teachers of Higher Mathematics are teachers of basic courses in universities. If they can expand the depth and breadth of knowledge in teaching, try to show the unique vitality and charm of Higher Mathematics, encourage students to creatively analyze and solve problems from the beginning of basic disciplines, accumulate and develop correct learning habits step by step, this can affect their development in other aspects, It is also possible to cultivate leading talents with innovative abilities.

3. Characteristics of Higher Mathematics Teaching with the Idea of Mathematical Modeling

3.1 Using Knowledge as a Research Topic. Some concepts of Higher Mathematics, such as limit, derivative and integral, have been studied by students in high school, but the learning content is limited to calculating and using them as formulas, without discussing the generation, development and summary of these knowledge concepts. Now let students re-examine the mathematical concepts

they have already learned, organically integrating history, teaching methods, and theoretical ideas into the teaching process, changing their passive learning status, and guiding students to think, such as the origin of concepts, the transformation process of mathematical forms, the limitations of existing methods, and key links. Teachers treat classroom content as a research topic and lead students to examine the entire process of knowledge discovery and research. Students can relearn the mathematical concepts they have learned in a brand new way. Not only can they comprehend the essence of mathematical concepts, but the research process also gives them the courage to explore problems tenaciously, and they will not feel discouraged due to the setbacks in the process. It is necessary for teachers to explain strict logical reasoning in theorem proving, but the process of discovering, summarizing, and inducing theorems can better stimulate students' active desire to explore deeper knowledge.

3.2 Emphasizing Scientific Thinking Methods. At the stage of learning Higher Mathematics, students should keep in mind the formulas and conclusions, but should constantly remind them to pay attention to the spirit, ideas and methods of mathematics, and never "don't know why". Because various formulas or theories will gradually be forgotten over time and environment, while scientific thinking methods can be preserved, making people open-minded and good at association. Standardized thinking will improve learning and work efficiency, thereby benefiting the whole life. In the classroom, analyze the teaching and research phenomenon that the actual mathematical modeling idea is integrated into Higher Mathematics, find out the factor relationship from it, transform it into abstract symbolic representation, repeatedly summarize and deduce with various examples, and discuss various possibilities, finally get the axiomatic conclusion. This kind of mathematical knowledge obtained through the process of abstract symbolization, optimal decision-making and axiomatic summary will effectively improve students' insight and sensitivity to problems. Students not only learn Higher Mathematics knowledge, but also learn scientific thinking methods, which is also the requirement of information age for Higher Mathematics teaching [3].

3.3 Integrating Theory with Practice. The basic concepts of Higher Mathematics come from various typical problems in history. Analyzing the process makes it easier for students to understand why they learn this knowledge. In this era of information explosion, various disciplines are showing a trend of intersection, and mathematics has become an attractive subject for students in various majors. Emphasize the discussion of practical problems, allowing students to see mathematics and natural sciences the connection and promotion of social sciences and philosophy, ranging from small events in life to the mysteries of the natural universe, and the diversity of mathematics in other disciplines, bring students a new perspective - mathematics is around us, and the joy of research and discovery drives students to develop interest and courage in discussing problems, achieving practical problems and mathematical models, mathematical models and interpretations a natural interaction mode.

3.4 Developing Mathematical Appreciation. Mathematics learning emphasizes unity and harmony, with characteristics such as simplicity, symmetry, and evolution. Only with a profound understanding and correct extraction of the essence of things can different things and phenomena with common characteristics be unified and abstracted into one, and internal objective laws can be explained in a concise way, while exploring the symmetry and evolutionary laws of problems. This is the beauty of mathematical theory. There are many concepts and formulas to learn, and often comparing and summarizing mathematical knowledge, identifying good and bad, important and unimportant, basic and non basic, are important things for students in the learning process, and are also methods to cultivate mathematical appreciation. Students with mathematical discrimination know how to distinguish between primary and secondary things, and can grasp the essence of things. Naturally, Higher Mathematics is also good.

4. Integrating the Thought of Mathematical Modeling into the Teaching Method of Higher Mathematics

4.1 Optimize Teaching Design. Adequate pre class design can enable teachers to more freely apply mathematical modeling ideas during the teaching process, which is also an important method to improve classroom efficiency and optimize teaching content. In the early stage of course design, teachers can try different introduction and explanation methods, such as case driven and problem setting, to fully stimulate students' learning interest while integrating teaching content and modeling ideas, providing a good foundation and guidance for subsequent education and teaching. In addition, the infiltration of mathematical modeling ideas is a long-term process that requires teachers to analyze and design teaching content in advance before forming a scientific teaching plan. By combining different focuses such as explaining modeling steps, strengthening modeling thinking, and optimizing model methods, students can better grasp mathematical modeling ideas; Combine the mathematical laws and knowledge points in the Higher Mathematics course content to carry out more scientific and simple model design and optimization, so that students can use mathematical modeling knowledge more flexibly in subsequent learning.

4.2 Divide Teaching Segments. The three stages of problem generation, rule inference, and practical application are the thinking processes that students must go through when accepting and understanding new knowledge. In the process of strengthening the infiltration of modeling ideas, it is also necessary to respect the "three stage" rule to divide classroom teaching stages, in order to better ensure the effectiveness of teaching content and the understanding of modeling ideas. Firstly, it is triggered by real-life issues students' thinking about mathematical knowledge can better stimulate their interest in learning and keep up with the teacher's teaching thinking. For example, when learning the concept of definite integral courses, teachers can provide irregular graphics to guide students in solving the area. Many basic calculation methods have complex processes and cannot guarantee accuracy, and the advantages of integral calculation are prominent. Secondly, the introduction of integral calculation is not an overnight process, but rather a process of thinking development from limits, differentiation, and then integration (Fig.1). This has a certain test on students' computational and inference abilities, which can help them better understand the basic ideas and principles of integral [4]. Finally, the teaching content for implementing applications is more extensive, and teachers should give students a certain degree of autonomy when planning this part of the curriculum to explore and verify the learning effect of students on Higher Mathematics knowledge and modeling ideas.

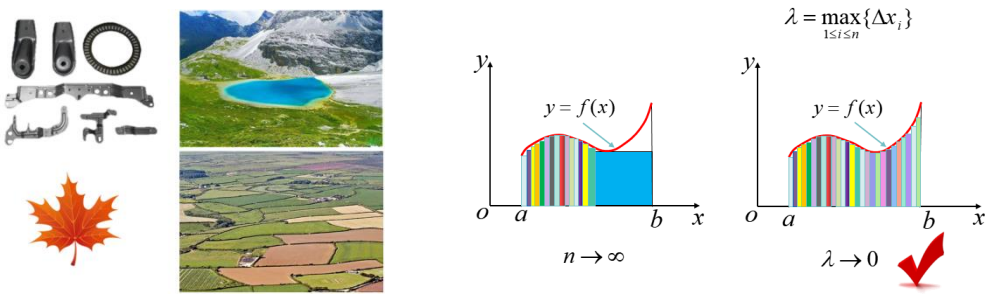

Figure1. The Concept of Definite Integral

4.3 Clear Modeling Steps. In order to better cultivate students' mathematical modeling ability and permeate modeling ideas, teachers need to help students master the correct modeling steps in the teaching process, ensuring that students can solve practical problems in a more standardized manner. Firstly, there are certain differences in parameter quantities and mathematical characteristics among different practical problems. Teachers can lead students to jointly explore and analyze the problem they are studying. After fully clarifying the known quantity, solution quantity, and data parameters, precise model assumptions can be made. Secondly, in the process of model design, some complex practical problems need to be Abstraction and simplified. In this process, the model characteristics should be retained, and the primary and secondary relations of the research

objects should be clear, so that the mathematical model can have the practical value of linearization and homogenization [5]. Thirdly, the application of Mathematical structure and tools is an important method to analyze the internal relationship of quantity, such as Algebraic equation, image analysis, logical inference, etc., which can be used as analysis ideas. However, different methods have differences in convenience and accuracy, and personalized analysis needs to be carried out according to the characteristics of actual problems. Finally, to verify the accuracy and effectiveness of the model, software such as MATLAB can be used to solve and analyze the model, and repeated corrections and optimizations can be made based on the problems that exist during the program testing process. The model results can be verified by inputting different data types to ensure the universality and authenticity of the final model establishment.

4.4 Contact Practical Application. Because the value of Higher Mathematics course is very strong in tool and practicality, teachers can properly combine with different professional directions such as physics, finance, aerospace, etc. in the learning process, so that students can form a preliminary understanding of their own majors while learning Higher Mathematics knowledge, and lay a good foundation for subsequent course learning. For example, for students majoring in automation, in the design process of production models, it is necessary to consider the relationship between appearance features and force characteristics, so that they can better maintain stability and accuracy during machine tool processing and cutting processing. Students can make comprehensive comparison through mathematical modeling, especially in the design process of some arc processing tools, they need to introduce knowledge such as radius of curvature, which tests students' ability to apply Higher Mathematics knowledge (Fig.2). Higher Mathematics is closely related to life and production practice, which requires teachers to carry out integration and exploration from students' learning majors, stimulate students' learning interest, and at the same time, make students have more interest in professional direction [6].

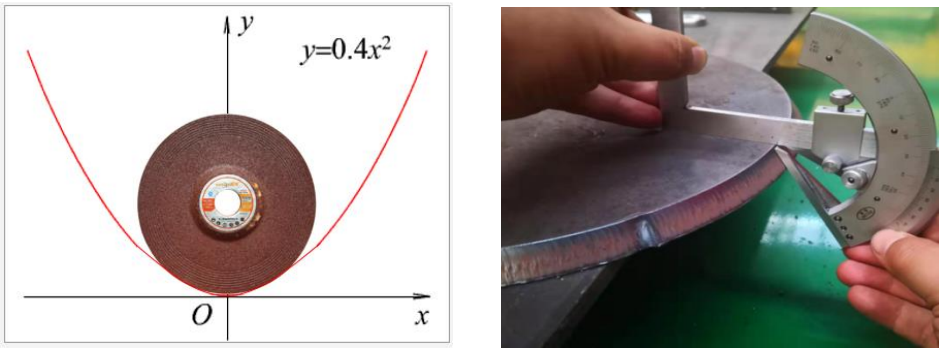

Figure 2. Curvature and Radius of Curvature

4.5 Conducting Mathematical Experiments. At present, Higher Mathematics courses in many colleges and universities lack mathematical experiment content, and the interaction between teachers and students and the correctness of mathematical models cannot be improved. Teachers need to pay attention to it and integrate it properly. There are certain differences between the content of mathematical experimental courses and other conventional experimental courses, mainly achieved through computer simulation and model testing. For example, for some more complex sequence class models, teachers can design different sequence lengths and parameter types through software program experiments, leading students to identify current modeling deficiencies during the testing process and improve and optimize them [7]. In the process of concept teaching in some Higher Mathematics, teachers can also use mathematical experiments to help students master basic knowledge. For example, in extreme thinking, the use of sequence models can continuously expand n values, allowing students to more intuitively observe the final value tendency during the process of sequence convergence, and help students understand the role and significance of modeling through a dynamic process.

4.6 Assign Group Topics. The method of mathematical modeling design is very flexible, which puts forward certain requirements for the designer's thinking logic and computational ability. There

are also specialized mathematical modeling competitions in universities to test students' mathematical thinking and basic abilities. In the teaching of Higher Mathematics, teachers can consciously assign modeling research topics to students, which are completed by students in groups, to achieve a breakthrough from simple to complex model building. In the process of designing a project, students need to conduct extensive data review of the studied problem, clarify the basic mathematical and logical relationships, and then proceed with the initial construction of the model. In the process of arranging Higher Mathematics modeling topics, teachers should start from relatively simple practical and applied topics, gradually transition to more complex or theoretical model research and Higher enrich students' modeling thinking [8]. In addition, students can recognize some Mathematical physics models in the process of solving problems, and higher strengthen the understanding and application of calculus, derivatives and other knowledge.

5. Conclusion

This paper analyzes the characteristics of Higher Mathematics teaching that incorporates mathematical modeling ideas from four perspectives in the context of the new engineering discipline, and explored the teaching method of integrating mathematical modeling ideas into Higher Mathematics courses, explaining how to practice in teaching from six aspects. Through concrete practice, effectively improve the current situation of Higher Mathematics teaching, enhance the quality of Higher Mathematics teaching, and cultivate students to use various divergent thinking methods to solve problems. The times are developing, the mode of cultivating talents is changing, and the methods of higher education are constantly innovating and reforming. In the context of new engineering, in the teaching process of Higher Mathematics, teachers should not treat knowledge as dogma and the application of knowledge as mechanical imitation behavior. Instead, they should change their educational concepts, integrate mathematical modeling ideas, explore the origin and application of mathematical concepts, explain the depth and breadth of mathematical thinking, subtly stimulate students' innovation enthusiasm and improve their innovation ability, in order to achieve the cultivation of innovative talents.

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