# On the Teaching and Learning of Higher Mathematics

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**Abstract.** Advanced Mathematics is an important basic course in science and engineering colleges. It is widely used in many fields, such as natural science, engineering technology, life science, social science, economic management, etc. Because of its high abstraction and strict logic, students' learning enthusiasm is not high, their goals are unclear, and the teaching effect is not ideal. In view of the above situation, this paper analyzes the present situation of higher mathematics teaching from the perspective of college students' learning foundation, learning attitude, teaching material content and the significance of the research on higher mathematics teaching methods under the background of innovation and entrepreneurship education, and focuses on the different teaching concepts of the innovative mode of higher mathematics. In view of the existing problems, this article proposes that some countermeasures for the innovation of higher mathematics teaching so as to offer help and reference for educators in colleges and universities. It is mainly hoped that innovative teaching methods, means and ideas of higher mathematics can be integrated into it, which will help the sustainable development of higher education and make it more perfect and novel, thus helping to give full play to the leading role of teachers, mobilize students' enthusiasm and initiative in learning, and achieve the purpose of improving teaching effect and students' learning effect.

**Keywords:** Advanced mathematics; Teaching methods; Mathematical thinking; Innovative model; Learning effect

## 1. Introduction

In many colleges and universities, not only the original science and engineering majors continue to offer advanced mathematics courses, but more and more liberal arts majors also offer advanced mathematics courses to some extent. However, over the years, although many mathematics educators have made some efforts and made many attempts in higher mathematics education and teaching reform, they have achieved little, especially in some ordinary undergraduate schools, the old teaching content and traditional teaching methods have basically not changed, which is difficult to meet the needs of the progression of various disciplines and practice for mathematics.

It is indeed difficult for every student who has just entered the university to change from simple and basic mathematical thinking to the study of highly abstract and complex advanced mathematics, but it seems that the more difficult the subject is, the more unique it has, which makes you constantly take out your mind to learn it, understand it, understand it and appreciate it, so as to truly feel its inner beauty [2]. As an educator, how to impart knowledge to the educated, achieve the expected educational goal and improve the effectiveness of classroom teaching and learning?

(1) The current college students mainly have the following deficiencies: First, the basic knowledge of mathematics in middle schools is weak. Second, there is a sense of fear in learning advanced mathematics. Through understanding, a few students are afraid of learning advanced mathematics, feel difficult and pressured, and are not interested in learning advanced mathematics. They think it is boring, inattentive in class, absent-minded, and seem to understand what they have learned. There is a saying among the students: "There used to be a tree with many people hanging on it. The name of this tree is Gao Shu". Although this is a joke, it also reflects the students' fear of advanced mathematics from the side. In their minds, advanced mathematics is a very difficult course.

(2) From the analysis of the students' answers, it can be summarized as "no teaching, no new questions". That is to say. The knowledge involved in the topic is not taught by the teacher in class or is not fully taught. Students can't answer; if the questions are novel or the way of asking questions is different from the textbook questions, students will not answer them. The reason is that the work of our math teachers in cultivating students' learning ability and innovative thinking ability has not been implemented [6].

## 2. The Current Problems in Higher Mathematics Teaching

(1) Course content as a course system, advanced mathematics pays attention to the systematization of knowledge and the rigor of theory in the arrangement of teaching materials. However, the requirements of mathematics in various majors are different, and with the deepening of educational reform in China, the curriculum and teaching content of various majors have been adjusted accordingly, so the requirements for teaching have also changed accordingly. However, in actual teaching, many teachers teach mathematics indiscriminately for the rigor of mathematical knowledge system, and some teachers only prefer to deduce formulas and prove conclusions, and carry out theoretical deduction and mathematical calculation in pure mathematics, which is bound to disconnect what they have learned from reality and increase the difficulty of students' learning to a certain extent.

(2) In terms of teaching methods, the phenomenon of "cramming" is still outstanding in the current classroom teaching of advanced mathematics. The teaching process is dull, the explanation is boring, and there is a lack of exploration and students' active participation, and there is a lack of mutual cooperation and communication. The teaching method adopted is still the traditional mode of chalk and blackboard, and the modern teaching methods are not fully utilized [3]. In addition, in terms of homework, the traditional model is still followed, that is, the teacher assigns fixed topics after class → the students complete the assigned topics and hand in the written homework → the teacher gives them to the students and comments on the homework after correcting them. This kind of homework certainly has certain benefits, but because of the long cycle and the limited number of questions, it is difficult for students to get timely information feedback from homework, and it is impossible to comprehensively consolidate what students have learned, which will inevitably affect students' learning effect, thus affecting the next stage of learning, and thus leading to the poor learning effect.

(3) Effect test at present, China's higher education is essentially exam-oriented education, although it doesn't aim at entrance examinations like primary and secondary schools. Because academic performance will dominate students' whole four-year study life and even their whole life, and the only way to determine students' academic performance is examination, which also leads many teachers to take passing the examination as the starting point in teaching, without being hooked up with the practical application of students' majors, not to mention the cultivation of students' innovative thinking ability and mathematical rational thinking ability, so it is impossible to realize quality education and cultivate high-level compound talents needed in the new century[5].

## 3. The Strategies of Higher Mathematics Teaching and Learning to Deal with Problems

(1) Teachers should teach selectively, First, to meet the actual needs of various majors, Second, to infiltrate some modern mathematical thinking methods. For physics, chemistry and other majors, explanations and examples can be linked to reality; In the teaching of engineering mathematics, some too complicated reasoning can be deleted and can be used completely by computers. Instead of calculation, some concepts and methods that are relatively old and have no development prospect in the development of modern science, compress some discussions, and the narrative of some mathematical concepts can be replaced by simple and accurate language; For the teaching of liberal arts advanced mathematics, we should introduce the knowledge system of advanced mathematics, and at the same time, properly infiltrate mathematical thinking methods and mathematical aesthetics,

create an environment for them to accept the influence of mathematical thinking and improve their mathematical quality.

The integration of mathematical modeling ideas in advanced mathematics teaching is an important link in college mathematics education, which can arouse students' interest in exploring the knowledge and application of advanced mathematics, improve students' ability to combine mathematics with application, and enhance the comprehensive quality of modern college students' advanced mathematics [4]. For example, when learning differential equations, we should combine infectious disease model, economic growth model, regular warfare and guerrilla warfare model, drug distribution exclusion model in the body, population prediction and control model, smog diffusion and disappearance model and so on. When learning the difference equation, we should combine learning deposit model, product supply and demand model, consumption model, Samuelson multiplier-acceleration model and so on. Mathematical modeling is the embodiment of using the knowledge of advanced mathematics to solve the actual problems.

In the traditional teaching mode, the rigid way of "teachers giving lectures, students attending lectures and finishing homework after class" is often adopted, and the classroom atmosphere is gloomy, the teaching process is boring, and students lack the enthusiasm for mathematics learning. Integrating the ideological education of mathematical modeling into the classroom of higher mathematics education requires teachers to adopt a brand-new way of homework practice, make homework content break through the limitation of course content, use group thinking to practice homework, and create reasonable training content of mathematical modeling according to students' actual situation, which does not provide students with ready-made answers or limited methods, and provides students with broad space for creation and development [1]. According to the specific training requirements put forward by teachers, students can complete written reports or papers individually or in the form of group cooperation, strengthen the interaction between teachers and students, learn from each other and inspire each other in the discussion, and complete the common improvement of advanced mathematics skills.

(2) Approach to teaching, due to the contradiction between too much teaching content and a serious shortage of teaching hours, on the one hand, the traditional teaching mode leads to a small amount of classroom information, which makes teachers tired of catching up with the teaching progress in order to complete the teaching task, and some key contents that should be elaborated in detail cannot be fully developed, which affects the teaching quality and teaching effect; On the other hand, there is no better inquiry-based and participatory teaching. Therefore, in actual teaching, first of all, students' self-study ability should be cultivated vigorously, and teachers should mainly give guidance on methods and raise students' interest and enthusiasm in learning mathematics [7]. Secondly, multimedia technology can be applied to mathematics teaching. Through multimedia teaching, intuitive, vivid and vivid mathematics teaching scenes can be created, which can increase the amount of classroom information, improve teaching quality and teaching efficiency, such as the concepts of limit, Taylor formula, definite integral and multiple integral. When introducing the geometric meaning of tangent, through computer。The animation demonstration of the limit process in graphics can make students understand and accept it easily. For example, Taylor's formula

$$\sin x = x - \frac{1}{3!}x^3 + \frac{1}{5!}x^5 - \frac{1}{7!}x^7 + \frac{1}{9!}x^9 + \cdots + \frac{(-1)^{n-1}}{(2n-1)!}x^{2n-1} + o(x^{2n})$$

Approaching the sine function:

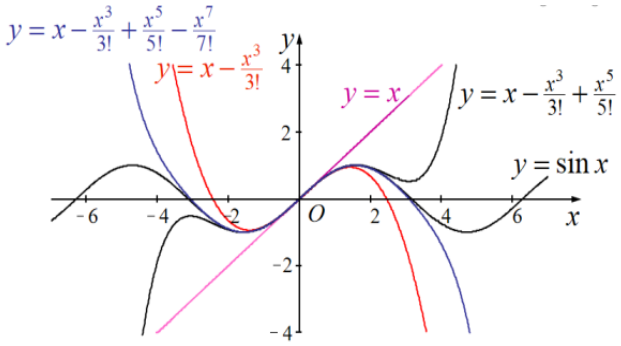


Figure1. Taylor's formula approaching the sine function

However, the application of modern educational technology does not mean that the traditional teaching methods are completely abandoned, because the blackboard is also an important media means, and the artistic appeal and charm displayed by teachers in lectures can not be completely replaced by multimedia. For example, the introduction of many mathematical concepts, the basic principles, methods and skills of mathematics and other mathematical training will be explained more clearly and concisely on the blackboard, which will better reflect the logical thinking ability of mathematics and be more conducive to students' understanding and mastery. Therefore, in practical teaching, we should reasonably combine modern educational technology with traditional teaching methods. In terms of homework, the topics covering the basic knowledge points of this lesson and reflecting the teaching objectives can be assigned to students before the teacher teaches, and students can complete their homework through self-study; You can also make use of the school's Internet, so that the arrangement, solution and handing in of students' homework can be realized through the campus network. Of course, the flexible application of various homework methods can give full play to the role of homework in higher mathematics teaching.

(3) Although the effect test is a way to measure students' learning level, overemphasizing the test will fall into a misunderstanding of learning for the test, forming exam-oriented education. When we criticize exam-oriented education, it doesn't mean that we totally deny exams. Exam scores are also a reflection of students' learning ability. However, exam scores can't be the only basis for students' grades. Students' grades should be composed of many factors, and the quality of homework completion and students' practical ability should be taken into account. For example, teachers can arrange some mathematical modeling topics that are closely related to real life, and let students report the process of mathematical modeling in groups within a specified time, including model hypothesis, model analysis, model solution, model test, etc. Teachers comprehensively grade students' reports, and grade students according to their actual performance. Students with excellent performance will be given extra points in peacetime, thus improving students' ability to solve practical problems with advanced mathematics knowledge and promoting their enthusiasm for learning advanced mathematics [8]. Applying what you have learned is the ultimate goal of learning, and it is also an important means to check the learning results.

Teachers should broaden the means and ways to test students' mastery of advanced mathematics knowledge, and assess students from multiple ways, angles and channels, instead of just taking the final exam as the only means of assessment. Each school can combine its own characteristics, and according to the requirements of society for majors, teachers of advanced mathematics courses should teach mathematical experiments and mathematical modeling alternately, and at the same time carry out related exercises, and combine the effect of exercises with the results [9]. On the one hand, it can arouse students' enthusiasm for learning, on the other hand, it can also cultivate students' innovative thinking mode, improve students' capacity to solve actual questions with mathematical tools, and finally liberate students from simple exam-oriented education.

## 4. Conclusions

To sum up, in the teaching of advanced mathematics, students need master enough mathematical knowledge. , the reform of teaching methods and assessment methods of advanced mathematics is an important topic faced by college teachers in the new times, which is an significant way and transport to improve teaching quality and cultivate high-quality and innovative talents. We should not only use the network platform to realize diversified teaching, but also pay attention to process assessment and proportion. Combining the joint efforts and mutual cooperation of schools, teachers and students, we should integrate various teaching methods and means into the teaching of advanced mathematics, infiltrate into students' real life, cultivate and improve students' mathematical logical thinking, strengthen students' application ability of advanced mathematics in combination with life, motivate the evolution of college students' creative thinking, and cultivate innovative talents needed by the future development of the country.

Higher mathematics teaching is an arduous and complicated project! As times changes, especially the arrival of the new engineering era, under the background of creativity and startups education, students' demand for mathematical knowledge is more urgent. Therefore, how to choose appropriate teaching means and methods to arouse students' learning motivation in advanced mathematics and combine mathematical knowledge with professional knowledge, especially with the talent demand under the construction of new engineering, is a subject that our higher mathematics teachers will continue to explore and study.

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