

# Analysis and Reform Strategies of Teaching Advanced Mathematics in Local Colleges and Universities

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**Abstract:** In recent years, with the emergence of the "Internet +" concept and the rapid development of the education industry, "new teaching methods" with characteristics such as open teaching resources, flexible teaching methods, and strong self-directed learning have emerged. This article analyzes the main problems of advanced mathematics education in traditional classroom teaching from the aspects of school management, textbook knowledge updates, teacher teaching methods, and student innovation ability. Furthermore, it discusses the impact of "new teaching methods" on higher mathematics education based on the existing problems. Finally, it provides corresponding suggestions from the perspectives of schools, teachers, and students on how to leverage the advantages of new teaching methods and improve the quality of higher mathematics education.

**Keywords:** new teaching methods, traditional classroom teaching, advanced mathematics, teaching quality

## 1. Introduction

Classroom teaching is not only one of the important ways for students to acquire knowledge, but also a platform for presenting the crystallization of educational theory refined through long-term practice. However, traditional classroom teaching often emphasizes the perfection and compactness of the teaching process, while neglecting the focus on students' experiences and exploration in teaching. In order to deepen educational reform, and greatly enhance the level of talent cultivation, the "Opinions of the Ministry of Education and the Ministry of Finance on the Implementation of the 'Twelfth Five-Year Plan' for the Quality and Teaching Reform Project of Undergraduate Education in Higher Education Institutions" (Jiaogao [2011] No. 6) clearly stated in 2011<sup>[1]</sup>: "Utilize modern information technology, give full play to the advantages of university talents and the role of innovation in knowledge and cultural inheritance, organize universities to build a number of high-quality video open courses, to achieve the popularization and free availability of teaching resources, enabling university teachers and students, as well as the general public, to enjoy these high-quality online video teaching resources." In 2015, the "Opinions of the Ministry of Education on Strengthening the Application and Management of Online Open Course Construction in Higher Education Institutions" (Jiaogao [2015] No. 3) emphasized<sup>[2]</sup>: "Constructing a group of high-quality online open courses, represented by massive open online courses (MOOCs), which integrate course application and teaching services." From these documents, it can be seen that not only has China incorporated online course education into the new educational plan system, but also places a high emphasis and great innovation on the construction of online educational courses.

## 2. Literature Review

In recent years, with the concept of "Internet+", open educational resources have gained a broader development space. Particularly, the rapid development of new types of online open courses, represented by Massive Open Online Courses (MOOCs), has brought a significant impact on traditional higher education models. Stanford University President John Hennessy likened this impact to a "digital tsunami" in the history of education. The New York Times dubbed 2012 as the "Year of the MOOC," and subsequently, MOOCs became popular worldwide. In 2013, the domestic education sector also saw a "hurricane" of MOOCs. This year also became the first year of MOOCs in China<sup>[3]</sup>. According to data

collected by Class Central <sup>[4]</sup>, as of January 22, 2018, the global number of MOOC learners had reached 81 million. In China, Peking University began offering 15 MOOC courses in the fall of 2013, with 150,000 people registering for the courses, 6,000 taking exams<sup>[5]</sup>. After several years of development, the new teaching format has been actively promoted and is beginning to show results in Chinese higher education. On June 22, 2018, the Ministry of Education convened the "National Undergraduate Education Conference in the New Era" in Chengdu <sup>[6]</sup>. Wu Yan, Director of the Department of Higher Education of the Ministry of Education, stated, "In order to continuously promote the deep integration of modern information technology and education, the Ministry of Education will vigorously promote the application of modern technologies such as the Internet, big data, artificial intelligence, and virtual reality in teaching and management." With the increasing prominence of public foundational courses in higher education, reforming and innovating public foundational courses has become a key issue in the current educational and teaching reforms in universities.

The emergence and development of the new teaching format have brought more innovative opportunities to the teaching of advanced mathematics, while also presenting significant challenges. Against this backdrop, this article, based on an analysis of the problems in traditional classroom teaching of advanced mathematics and the impact of the new teaching format on the teaching of advanced mathematics, provides some suggestions on how to combine the advantages of traditional classroom teaching and the "new teaching format." It aims to guide universities in transforming traditional educational concepts, promoting the reform of outdated teaching methods among teachers, encouraging students to unleash their inherent innovative abilities, and ultimately improving the teaching quality of advanced mathematics.

### **3. The traditional classroom teaching of higher mathematics presents several key issues.**

As a crucial foundational course, the quality of its teaching directly impacts the subsequent learning outcomes of related professional students. From the 1950s to the present, the development of higher mathematics education in China has gone through seven important stages<sup>[7]</sup>, showing a trend towards an increasingly refined teaching system, an expanding student body, and widespread personalized teaching. However, traditional higher mathematics education is facing evident challenges in teaching materials, teaching methods of instructors, and students' innovative abilities, due to the impact of new teaching forms.

#### ***3.1. Outdated Knowledge in Textbooks***

As the carrier of teaching content, textbooks are essential for both teachers and students. Furthermore, many local universities seldom consider and balance the cultivation of mathematical thinking for students in different majors during the development of advanced mathematics textbooks. Authors of these textbooks often struggle to effectively integrate relevant professional backgrounds due to the lack of knowledge in other disciplines. This has led to a clear disconnect between courses and a serious hindrance to the updating of knowledge in advanced mathematics, which is one of the important reasons for the lack of interest in advanced mathematics classes among students.

#### ***3.2. Outdated Teaching Methods of Instructors***

As a highly applicable course, the purpose of teaching advanced mathematics is to cultivate applied and innovative talents. However, due to the tight schedule and heavy workload of advanced mathematics teaching, the traditional teaching method mainly consists of "teachers lecturing while students listen, occasionally asking questions and doing exercises". There are very few instances where traditional classroom teaching methods, such as "blackboard + chalk," are organically combined with modern information technology, or where practical teaching of "advanced mathematics + major" is conducted for students in different majors. This overlooks students' professional needs and the emphasis on exploratory teaching, directly impacting students' enthusiasm and initiative in learning advanced mathematics.

#### ***3.3. Lack of student innovation skills***

Traditional higher mathematics education can help students systematically master the basic knowledge of the course, and cultivate students' thinking and methods in higher mathematics. It is also beneficial for helping students learn professional knowledge and promoting their comprehensive

development. However, the current situation, where the abstract and difficult nature of traditional higher mathematics textbooks, and the limited time for interactive discussions between teachers and students, has led to a lack of interest and low efficiency in students' learning. Over time, students have complained about the difficulty of the course. Especially when faced with practical problems related to higher mathematics, traditional classroom teaching focuses more on the imparting of theoretical knowledge, lacking in cultivating students' innovative consciousness and innovative thinking. This leaves students unsure of how to correctly apply what they have learned and further explore innovation.

#### **4. The Impact of New Teaching Methods on Advanced Mathematics Education**

In recent years, the modernization of higher education has become a new direction for the development of higher education in the 21st century. Many frontline university teachers have begun to use new teaching methods in their daily teaching. At the same time, university students with strong subject consciousness and innovation consciousness have quickly adapted to these new teaching methods. However, for the highly abstract, rigorous, and widely applicable nature of higher mathematics courses, how to effectively carry out teaching and learning under new teaching methods is the biggest challenge facing current mathematics teachers and students. MOOCs, micro-lessons, and flipped classrooms, as representatives of current new teaching methods, have had a significant impact on teaching, especially in higher mathematics education, despite their short time of appearance and application.

##### ***4.1. These new teaching methods have broken the constraints of traditional management models***

As stated in "Learning: The Treasure Within" published by the UNESCO Education Commission for the 21st Century, "Human society is in transition, and lifelong education and a learning society are the only answer. All universities should be open and promote open education."<sup>[8]</sup> In the past, the teaching of higher mathematics was only targeted at specific groups in school. Under the traditional education management system, those who failed in the college entrance examination, working professionals, and people with a strong interest in higher mathematics but older in age had no chance to study higher mathematics. However, with the emergence of new teaching methods, learners who want to study and are interested in studying are no longer limited by factors such as environment, major, or age. Additionally, the transformation of traditional "classroom" teaching into "offline classrooms and online spaces" through new teaching methods has broken the traditional structure, avoiding the impact of objective factors on teaching effectiveness. Furthermore, this change allows students to fast-forward, pause, or review teaching content according to their own situation, making it easier for them to learn and to some extent compensating for the shortcomings of traditional higher mathematics classroom teaching.

##### ***4.2. Promoted the innovation of traditional teaching methods***

The teaching process under the new teaching format will inevitably introduce modern and information-based teaching methods, and utilize computer and internet technologies to assist teaching. When teachers record teaching videos, they can timely incorporate some hot issues related to students' majors and real-time cases, which helps students recognize the importance and application value of higher mathematics in their respective fields of study. They can use computer software and mathematical software to intuitively and vividly present the teaching content of higher mathematics combined with relevant knowledge of students' majors, allowing students to feel the beauty of mathematics and stimulate their interest in learning higher mathematics. For specific teaching content such as spatial analytic geometry and multivariable calculus, using the new teaching format not only avoids the troubles brought to teachers by heavy course tasks and limited teaching time in traditional teaching, but also creates vivid and easy-to-understand teaching scenarios, helping students overcome their fear of learning abstract concepts in higher mathematics.

##### ***4.3. Promoted the enhancement of college students' innovation ability***

The cultivation of innovation ability is inseparable from independent thinking. Traditional higher mathematics teaching involves explaining in class and problem-solving outside of class. Students in the classroom complete their learning of knowledge guided by specific questions raised by the teacher, easily lacking time and opportunities for independent thinking. After class, they only mechanically

complete assignments. The new teaching format can provide course videos, allowing students to independently choose and arrange their learning time, content, and progress according to their actual learning situation, and communicate online or offline, enabling students from different regions and majors to openly discuss thoughts and freely discuss around a certain doubt or practical application problem. This not only gives students a deeper understanding of their own doubts but also greatly promotes their innovation awareness and ability through the collision of different viewpoints.

Certainly, the new teaching format compensates for the shortcomings of traditional classroom teaching in higher mathematics education. However, the new teaching format also presents some issues: Firstly, although the new teaching format allows teaching in fragmented time, it demands high self-control and information processing capabilities from students. Secondly, under the new teaching format, students engage with instructional equipment, lacking communication with teachers and collaboration with peers, which hinders the development of students' emotional attitudes.

Additionally, the article's statistical analysis of research papers related to "new teaching methods" retrieved from the CNKI Core Journal Database since 2015 (as shown in Figure 1) reveals a significant increase in domestic experts' and scholars' research on the new teaching format, stabilizing after 2019 and even showing a decline in attention. This reflects the development pattern of the new teaching format in China. This raises concerns about the future development of higher mathematics education under the new teaching format. The author believes that the emergence of the new teaching format is not a replacement for traditional classroom teaching but a supplement, coexisting with traditional classroom teaching.

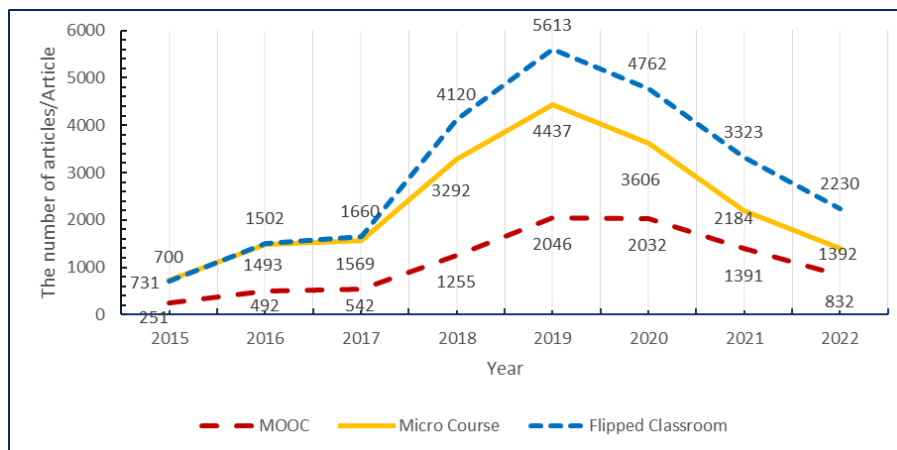


Figure 1: The trend of the number of articles on "new teaching methods" in the CNKI core journal paper database, 2015-2022<sup>①</sup>

## 5. Countermeasures and Suggestions

In response to the main problems in higher mathematics education in traditional classroom teaching and the impact of the "new teaching format," the following are some suggestions for reform and innovation in higher mathematics education under the "new teaching format" from the perspectives of schools, teachers, and students<sup>[9][10]</sup>.

### 5.1. School Level

Local colleges and universities should continue to strengthen the in-depth exploration of the "new teaching format" platform, using this platform to closely integrate the dull teaching content in higher mathematics with practical courses within the major, expand the connection with students' professional knowledge, stimulate students' interest in learning, and make efforts to integrate the new teaching format into talent cultivation. Local colleges and universities should systematically promote the development of high-quality online courses for "Higher Mathematics" tailored to the characteristics of students in different majors. At the same time, local colleges and universities should establish an evaluation system for teachers' teaching quality and students' learning situation.

<sup>①</sup>CNKI Core Journal Papers Database: <http://www.cnki.net/>

### 5.2. Teacher level

As the implementers of the teaching process, teachers must strive to improve teaching quality while understanding the relationship between teaching quality and students' learning interests, motivation, and efficiency (as shown in Figure 2). This requires a rethinking and repositioning of their role in the "new teaching format". In the context of the "Internet+", teachers should leverage the advantages of the "new teaching format" to overcome the limitations of traditional classroom teaching, and shifting the focus from knowledge inheritance to knowledge creation. Teachers should enhance their digital literacy, cultivate information network thinking, and proficiently master modern educational teaching technologies. Mathematics instructors should strengthen communication and exchange with students' subject teachers, and develop tailored teaching plans for different professional students. Through these measures, teachers can effectively lead in the teaching process and maximize student motivation, thereby enhancing the teaching quality of higher mathematics.

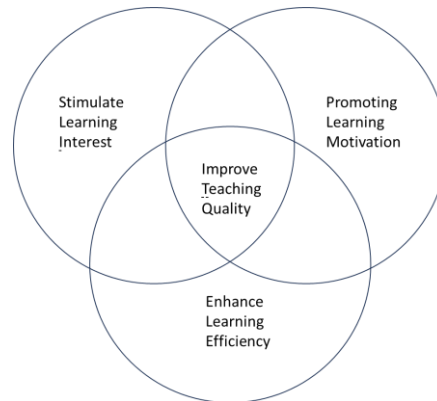


Figure 2: Relationship between teaching quality and students' interest in learning, motivation, and learning efficiency

### 5.3. Student Level

As the main participants in the teaching process, teachers should focus on how to make them curious, puzzled, and amazed by the knowledge of higher mathematics, which is conducive to the formation of students' learning motivation. Therefore, in the study of higher mathematics, students should not only be accustomed to the traditional classroom teaching model but also actively adapt to the "new teaching format." It is especially important to establish the correct concept of online learning, enhance autonomy, self-discipline, and integrity, complete the established learning curriculum efficiently and regularly, actively participate in discussions and examinations, exchange their understanding of knowledge in a timely manner, ultimately forming good habits of independent learning and innovative learning.

## 6. Conclusion

In the face of the impact and influence of the "new teaching format" on traditional classroom teaching, we should not blindly advocate for the "new teaching format" while denying the importance of traditional classroom teaching in the information age. Only by highly integrating the "new teaching format" with traditional classroom teaching, can teachers of higher mathematics break through the current barriers in higher mathematics teaching, explore more suitable teaching methods for contemporary university students, and create a new situation in higher mathematics teaching.

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