

## On Reform and Practice of Advanced Mathematics Teaching for International Students

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### Abstract

Along with the promotion of China international influence, the number of students abroad is increasing obviously. Therefore, more and more attention has been paid to the teaching method of international class. There are many difficulties and challenges to teach the students from various countries. Taking the course of advanced mathematics for international students as an example, this paper discusses the reforms mainly from four aspects, including the selection of teaching materials, online course, classroom management and teaching methods.

### Keywords

International students; Advanced mathematics; Reform.

### 1. Introduction

Since the 18th National Congress, the scale of studying in China has continued to grow. China has become the largest destination for studying in Asia, and the attractiveness of studying in China has been further enhanced in match with the country's economic and comprehensive strength. At the same time, more and more international students come to China to study academic courses, and the proportion of academic students and graduate students has achieved double growth. The University adheres to the principle of open education and carries out international cooperation and exchanges. The university has established cooperative relations with more than 100 universities and enterprises in more than 30 countries and regions, such as the United States, Britain, France, Canada, Australia, New Zealand, Japan and South Korea. Our school cooperates with the University of Southampton, one of the top 100 schools in the world, to hold a Sino-foreign cooperative education project. The school has received and trained international students from more than 40 countries and regions, such as France, Italy, Canada, Japan, South Korea, Singapore, Russia, Mongolia, Sweden and Thailand. At present, about 500 foreign students are enrolled every year. International student education has become an important development content of colleges and universities in China, including our university. Among them, "advanced mathematics", as a public compulsory course in physiology and engineering, is the most significant part of the assurance to foreign students' education. It plays an important role in the enrollment of foreign students in the future.

The "one belt, one road" initiative is a major measure to raise the level of opening up to the outside world [1]. With the implementation of China's Belt and Road Initiative and the continuous improvement of international influence, the number of international students studying in China has been increasing year by year. And most of them from the Belt and Road Initiative and other developing countries choose to study engineering management. As a basic course for all majors in engineering colleges, higher mathematics is not only a necessary

guarantee to learn professional courses well, but also plays a key role in the basic education for international students in China.

## **2. Research of the Current Situation Between Domestic and International**

### **2.1. Analysis of the Current Situation of Higher Mathematics Study**

Through investigation, interview and classroom feedback, this paper makes an in-depth survey about the higher mathematics teaching of foreign students in the school. It is found that foreign students mainly face several problems in learning higher mathematics, such as weak mathematical foundation, poor Chinese understanding level, and differences in learning habits between foreign students and domestic students [2].

First, the mathematical basis is weak. International students come from different countries. Most of the international students are influenced by the original cultural and educational background, their mathematics foundation is relatively weak, which is about the same as that of high school students and even junior high school students in China. A number of international students with weak mathematical foundation are not very good at self-study, and there are great differences in learning ability. This has a great negative impact on the arrangement of higher mathematics teaching content and classroom implementation design.

Secondly, the Chinese language is not proficient. International students are mainly taught in Chinese and English, and a few majors are taught in English. However, for teachers and most international students, English is a third country language. Most international students have a poor foundation in Chinese. It is difficult for both sides to communicate in Chinese or English. So, the effect of classroom teaching will be affected.

Third, the learning habits are different. Due to cultural differences, some foreign students are late for class and do not listen carefully; some international students who are more active in the classroom will interrupt the teacher's normal teaching at any time to ask questions. All these will affect the progress of teachers' classroom teaching and the presentation of teaching content.

### **2.2. Analysis of the Current Situation of Higher Mathematics Teaching**

On the one hand, there are great differences in teaching methods at home and abroad [3]. From elementary mathematics to advanced mathematics, domestic mathematics education focuses on the integrality of mathematical theory system, the accuracy of mathematical calculation and the cultivation of problem-solving ability. While foreign mathematics education generally focuses on application and ignores system. Relatively speaking, after the training of high school education, domestic students have strict mathematical thinking, solid basic knowledge and complete knowledge system. While international students' knowledge foundation is relatively weak and the system of knowledge is poor. Therefore, the teaching and training methods used for domestic students are not suitable for the international students.

On the other hand, there are no suitable teaching materials and teachers have no experience to learn from. In recent years, the number of international students has increased sharply, and their learning progress of higher mathematics can't keep up with Chinese students. Therefore, most colleges and universities have set up independent higher mathematics courses for international students in recent years. But there are great limitations, on the one hand, the history of teaching international students is short, and we have not formed a classic higher mathematics textbook. On the other hand, the source of international students recruited by colleges and universities is relatively different, and there is no suitable targeted higher mathematics textbook. Third, teachers have no mature experience to learn from in the arrangement of teaching content, classroom teaching organization, and communication with students.

### 3. The Main Problems in the Teaching of International Students

First, most international students have Chinese language barriers. International students in our university basically have no systematic Chinese learning in the original country. But they only receive centralized Chinese training for about one year after arriving in China. In the process of Chinese training, most of them take the basic daily language as the main learning content. Although many foreign students' Chinese test scores meet the requirements of the school, their actual Chinese level and understanding can't guarantee the comprehension when they learn mathematics [4].

Second, the mathematical foundation is uneven and the overall foundation is weak. Because foreign students come from different countries and regions and they are affected by social structure, cultural background and educational foundation, most foreign students in Asia and Africa have weak mathematical foundation. They are not familiar enough with the knowledge points of elementary mathematics, such as the judgment of the value domain and definition domain of basic elementary functions, the understanding of compound functions, and the basic formulas of trigonometric functions. Therefore, the teaching of higher mathematics has dealt a heavy blow to students' learning enthusiasm at the beginning.

Third, there are differences in learning habits. In the teaching process, it will be found that there are great differences in learning habits between international students and Chinese students. First of all, due to the obstacles of Chinese, many international students give up learning textbooks. They don't read the designated teaching materials or recommended reading materials basically, but only focus on the teachers' courseware. Secondly, some students do not have the habit of taking notes in class. If the teacher arranges exercises for practice in class, they also record or practice casually, and do not sort out and summarize after class. Because there are many teaching contents and linked knowledge points in higher mathematics, if they don't have habit of recording and sorting out notes, and read learning materials after class, they can't learn smoothly at all.

Finally, the online learning is difficult. Some international students don't form the habits about online learning, and self-management ability is lacking. According to the online survey, 60% of teachers think that the main reason for the impact of online teaching effect is that students are not self-discipline, lack of independent learning ability. During the epidemic period, they lack learning environment, learning atmosphere and external supervision at home. These factors will affect the state of learning.

### 4. The Content of the Reform

The teaching of an international student course is very different from that of undergraduate teaching in China, because the teaching target is more special. International students come from all over the world, and their cultural background, education level, living environment and language exchange are very different. Because of this particularity, it is impossible to follow the arrangement and design of undergraduate teaching courses in China. So it is necessary to adjust and reform curriculum teaching in a targeted way [5].

#### 4.1. The Selection of Teaching Materials

For international students who have just arrived in China, their advanced mathematics courses are usually taught in English, and the teaching materials used need to be in English. Choosing the original English textbooks of overseas higher mathematics as a reference, we will find that overseas mathematics textbooks have many descriptive languages when introducing the definition. They focus on using simple and vivid language to help students get an intuitive impression, and then give a strict and abstract definition to deepen their understanding. It is different from domestic textbooks which are concise and mainly based on formula derivation.

These differences bring great challenges to teachers. It is not enough to master professional vocabulary. We need to use correct and appropriate vocabulary and sentences to describe problems fluently in class.

#### **4.2. Course Teaching Aspects**

International students come from different countries. English may also be their second language. They are not as familiar as their mother tongue. And different regions have different pronunciation habits, which may cause difficulties in communicating with each other although they all speak English. Then, if teachers want to grasp such a class and achieve the effect of unimpeded communion between teachers and students, they need to have a certain level of English and have great patience with students. Sometimes, a simple word or phrase will play a better role in communication. If foreign students come to China to study and are interested in Chinese language and culture, the teachers can try to insert some simple Chinese in classroom teaching to adjust the classroom atmosphere. In addition, for the teaching of foreign students' higher mathematics courses, the mathematical foundation is uneven due to the different educational environment of foreign students. It is difficult for teachers to keep up with the teaching progress in a short time, if they want to unify teaching in the classroom and ensure that each student master the knowledge points. Then, it is suggested that at the beginning of the course, teachers should make a test for foreign students, for example, teachers use the exercise test to master the mathematical knowledge stored by students. And then teachers can teach the knowledge selectively that most students lack as a preparatory chapter. In addition, Chinese students can tutor foreign students' mathematics knowledge in advance after class. Through this process, Chinese students can also improve their oral English ability, which is a kind of mutual assistance and cooperative learning [6].

#### **4.3. Classroom Management Aspects**

The different living environment and learning styles of international students make them not adapt to the strict classroom discipline of Chinese education. In classroom teaching, international students sometimes arrive late and leave early for various reasons. During the teacher's lecture, some foreign students go in and out of the classroom at will. During important festivals abroad, a large number of students are absent from work. These phenomena have caused great trouble to teachers' teaching. To improve the phenomena, teachers need to be serious about classroom discipline. In addition, teachers can teach students to use network chat software in teaching, which is convenient for teachers to answer questions and guide them after class, so as to promote the communication between teachers and students.

#### **4.4. Teaching Methods Aspects**

During the COVID-19 prevention and control period, the online and offline teaching methods have been accelerated. Teachers need to invest more time and energy in building teaching platforms and resource sharing platforms for their students. The collection and production of online course resources are mainly formulated according to the basis and needs of students. In particular, the recording of teaching videos requires small clips. Small videos recorded in the unit of knowledge points are easier to be accepted by students. In addition, online resources can add more documents and videos about mathematics history, mathematics culture, examples of mathematics application in life, except the knowledge points themselves. These may not have time to teach in class, but they can be used as preview content to require students to read in advance. Moreover these can deepen students' understanding of the course and improve students' interest in learning.

## 5. Reform Features and Innovation

Based on the idea of solid teaching in "offline" classroom and classroom extension in "on-line" classroom, this project constructs the "teaching mode of higher mathematics course for international students on-line and offline". The mode includes five elements, such as curriculum convergence, optimization of teaching content, teaching implementation mode, curriculum evaluation mode, and classroom teaching extension [7].

### 5.1. Curriculum Connection

Preparatory teaching should be carried out. We should take the preparation for course content and teaching language well, and solve the problems of weak mathematical foundation and language barriers of international students. First, the mathematical knowledge should be connected with basic knowledge. We should investigate the mathematical basis of international students and carry out graded teaching according to the specific situation of basic mathematical knowledge. Before teaching higher mathematics courses, teachers can teach the contents of elementary mathematics as the basis of college mathematics learning, and strengthen the remediation of international students' mathematics. The teaching form can be the combination of teachers' face-to-face teaching and online video courses. Secondly, teaching language should be learned in advance. School can set up a course of "Chinese for mathematics major" for foreign students, and help foreign students adapt to the way of teaching Advanced Mathematics in Chinese as soon as possible.

### 5.2. Refining and Optimizing Teaching Content

In order to meet the current situation and needs of international students' teaching, teachers can teach students according to their aptitude in the meantime, we must refine the content of higher mathematics and optimize the presentation of teaching content [8]. First, the teaching materials should be chosen carefully. Because most international students have clear learning objectives, they pay more attention to practical knowledge. Therefore, the selection of higher mathematics textbooks for international students should not only consider the mathematical knowledge system, but also consider the practicability of the content. Secondly, the arrangement of teaching content should be adjusted. Teachers can arrange the teaching contents according to the characteristics of international students.

### 5.3. Teaching Implementation Mode

Classroom teaching creates a "double subject" model, which emphasizes the leading role of teachers and the dominant position of international students. To give full play to the "dual subjectivity" of teachers and students, the first thing is to stimulate the interest of international students in learning mathematics. In teaching, teachers can start from two aspects: the integration of mathematics history and the exploration of problems. First, mathematics history can increase the interest of the classmates. Teachers can better help international students understand the essence of mathematics knowledge by properly integrating mathematics history into the process of explaining mathematics knowledge. The second is to guide international students to explore learning and take the initiative to learn, so as to form an interactive learning environment between teachers and students.

### 5.4. Curriculum Evaluation Method

The purpose of the evaluation is to test the learning effect of international students and to measure whether teaching activities meet the basic requirements of the syllabus. Combined with the characteristics of international students, the content of the course examination and the method of grade evaluation should pay attention to the process evaluation. Furthermore, the evaluation should use diversified and multi-level performance evaluation methods [9]. The examination method should weaken the big difference due to the weak foundation, and protect

their learning enthusiasm. Therefore, this method can take the combination of open, half-open and closed. The scores evaluation of higher mathematics should highlight the assessment of international students' learning ability and attitude, and truly reflect the study situation of international students' advanced mathematics. This evaluation can maximize their subjective initiative. And besides, the evaluation can be considered comprehensively from attendance and after-school assignments, classroom discussions and classroom notes, unit tests and final examinations.

### 5.5. Classroom Teaching Extension

First of all, teachers can use the network course teaching platform to strengthen the "online" higher mathematics course construction. And then this can realize the extension of higher mathematics classroom teaching, and assist international students in higher mathematics learning. Secondly, teachers can establish cooperative learning groups to encourage international students to carry out mutual learning. We can set up a cooperative learning group to overcome the sense of powerlessness in learning and avoid copying and perfunctory homework. Meanwhile we can arrange for domestic students to study in pairs with international students after class. In view of the advantage of the good mathematical foundation of domestic students, we can establish a "good with poor" mutual aid group. Further, the group can help international students improve their Chinese ability and mathematical level, so as to learn from each other.

## 6. Implementation of the Reform

### 6.1. Strengthening Curriculum Teaching

1. Through various ways such as going out for investigation and exchange, we can understand the situation of universities setting up the course, and absorb their successful experience and good practices. Then we can conduct teaching research in combination with the actual situation of setting up the course in our university, so as to make the course more adapt to the needs of the times and fully mobilize the learning enthusiasm of students. At the same time, school should pay attention to strengthening the training of teachers, and improve their language expression ability, teaching ability and so on.

2. Regular lectures and training should be held to raise awareness of the course among teachers and international students. It can be divided into basic lectures and advanced lectures. Basic lectures are mainly aimed at international students with weak foundation, which can help them to master basic knowledge, expand the knowledge of international students, and stimulate the interest and exploration spirit of international students. Advanced lectures are mainly aimed at students who have a deeper study of the higher mathematics, in line with the needs of the study of engineering, to train international students to further learn the ability of the higher mathematics.

3. The scope of Chinese learning can be expanded appropriately and simple professional Chinese should be supplied. During Chinese training, international students usually pay attention to the basic Chinese for daily communication. If they can properly learn some professional Chinese such as mathematics during this period, it will not only be conducive to the study of higher mathematics courses, but also be helpful to the study and understanding of other professional courses.

4. The teaching content should be optimized and corresponding teaching materials should be compiled. Most international students have clear learning objectives and pay more attention to the practicability of their knowledge. Therefore, based on the comprehensive consideration of the practicability of the teaching content, and the acceptance ability of international students, we can use the combination of intensive and brief lectures to appropriately reduce the teaching

content and difficulty. For example, during the teaching of definite integral, teacher can mainly introduce the main idea, basic calculation and application problems. For the integral of some complex functions, it is realized by consulting the integral table after appropriate deformation.

## 6.2. Adjust Teaching Content

1. Teachers should strengthen communication with international students. Paying attention to communication with international students is a prerequisite for a good international student course. African students are influenced by culture and customs, so they have strong self-esteem, straightforward personality, and easily excited emotion. Therefore, in the teaching process, our teachers are required to have a good cultivation, and they should pay attention to ways and means, can't use any sensitive words. After class time teachers can communicate with international students to exercise their English language communication skills with students. Meanwhile teachers can understand the characteristics of international students and master the needs of international students on the content of the course. Finally this can enhance mutual understanding between teachers and international students.

2. Preparation for lessons is a necessary preparation for a teacher before teaching. In the aspect of lesson preparation, we should strengthen lesson preparation and improve the quality of lesson preparation. How to complete the teaching task according to the teaching plan is the first problem to be solved for teachers. When preparing lessons, the teachers should pay special attention to the selection of contents, highlight the key points, achieve less and better, and abandon the contents that are not suitable for international students' teaching. When preparing lessons, teachers should first read and memorize the contents, and try to be proficient in unscripted explanation during teaching. In the process of making courseware, the content should not be too much, the text narrative part should be reduced as much as possible, and some pictures should be drawn as much as possible to visualize the teaching and help students understand.

3. In the course of teaching, heuristic teaching is the method used in the teaching of international students in our school, which can greatly mobilize students' enthusiasm to participate in teaching compared with the traditional "perfusion" teaching method. We take a form of discussion class teaching, students can ask questions at any time, can also be on stage to explain their views. Teachers guide students to think, encourage discussion, and finally teacher can focus on summary and explanation. Through classroom questions, students' answers and discussion conversations, students fully understand their math skills. However, in the course of teaching, an important problem faced by teachers is how to describe the complex mathematical problems clearly [10].

4. The pre-test grading work should be carried out. Students are tested for the basics of mathematics before formal class, and then according to different levels to give targeted teaching. Because the higher mathematics course has heavy learning tasks and a large number of people, if it needs to spend a lot of time and energy explaining many elementary mathematics knowledge at the same time, it will not only pose an obstacle to students' understanding of new concepts, but also make their priorities unclear and key points vague. Accordingly, this will virtually increase the difficulty of learning. Therefore, the graded examination will not only strengthen the learning efficiency of foreign students, but also solve the problem of uneven mathematical foundation.

5. The teaching methods should be reformed. International students are encouraged to form study groups, whether from the same country or not. But the group are not over-large and generally do not exceed 5 people. They can assign group learning tasks flexibly. Through after-school group discussion, it not only helps to master mathematics knowledge, but also enhances the exchange between students. At the same time, we can arrange for tutors to answer questions for international students after class. Teachers should answer questions regularly for

international students, so that students can be answered in time. In this way, it can not only enhance teacher-student exchanges, better access to teaching feedback, but also strengthen the enthusiasm of international students to learn. In addition, the assessment method should be updated. The purpose of curriculum assessment is to test the learning effect and measure whether students meet the basic requirements. However, the general undergraduate higher mathematics use the closed examination method and the difficulty of the test are very disproportionate to international students. Therefore, it is necessary to combine the characteristics of international students, and then we can reform the examination content and evaluation methods.

6. The online video teaching should be developed. The basic content and key content will be recorded into a video. International students can watch the video repeatedly through the school's online curriculum teaching platform, deepen understanding and solve problems.

## 7. Practical Effect

The implementation of higher mathematics teaching reform for foreign students will bring a win-win effect for colleges and students. Firstly, for colleges, the implementation of teaching reform will update the knowledge and improve the professional ability of teachers, and promote the quality of teaching. Secondly, for students, the reform of higher mathematics education has stimulated students' interest in learning, improved students' initiative consciousness and thinking ability, and cultivated students' awareness of self-study and mutual assistance. It can not only enable students to learn advanced mathematics knowledge, but also make them feel the unique Chinese learning model. It enhances students' learning ability, broadens their way of thinking, and has a positive impact on other disciplines.

## 8. Conclusion

At present, the research on the teaching mode of higher mathematics courses for international students is not carried out for a long time, and the group of international students is not very large. In the context of promoting the Belt and Road, it is the time for us to carry out teaching reform, explore and accumulate teaching experience. Through several years of teaching of international students, we should make useful attempts in teaching content, methods, classroom management and teaching evaluation. And we have accumulated some experience. The continuous exploration and practice of these problems will also improve the international level of the teaching of higher mathematics courses and provide valuable experience for the internationalization of other engineering courses.

## Acknowledgments

Authors thank for the financial support by Education and Teaching Reform project of Dalian Polytechnic University (Grant: JGLX2021108) and would like to express many thanks to the support of the school of International Education, Dalian Polytechnic University.

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