Preliminary Study on the Reform of Higher Mathematics Stratified Teaching in Private Colleges and Universities in Emerging Engineering Education Construction

Yupeng Sang

*Department of Information Engineering, Heilongjiang International University,
Harbin 150025, China
164821796@qq.com*

Abstract

Firstly, based on the emerging engineering education construction of private colleges and universities, the necessity and connotation of stratified teaching in higher mathematics are put forward. Secondly, examples of the reform of higher mathematics stratified teaching in our school are given. The specific content of the teaching reform is elaborated. The paper analyzes the effectiveness of teaching reform and concludes that the quality of teaching is obviously improved, which verifies the effectiveness and feasibility of stratified teaching.

Keywords: *Emerging engineering education, Higher mathematics, Reform of stratified teaching, Private colleges and universities*

1. Introduction

The concept of Emerging Engineering Education was first recognized by the Ministry of Education in June 2016. In February of the following year, the Ministry of Education held a seminar on the development of higher engineering education at Fudan University. At the meeting, the in-depth study on the connotation characteristics, construction and development of Emerging Engineering Education was carried out, and the “Fudan Consensus” was reached. After the exchanges and discussions between the Ministry of Education and the universities and experts from all walks of life, they formed the “Tianjin University Action” and the “Beijing Guide”, which led to a trilogy of the construction of Emerging Engineering Education [1][2]. The “Emerging” of Emerging Engineering Education is mainly manifested in the three aspects of new developing, new type and new born. The Ministry of Education strongly advocates the construction of Emerging Engineering Education in colleges and universities, with the aim of cultivating high-quality, comprehensive engineering talents with stronger practical ability, innovative ability and international core competitiveness. At the same time, it particularly emphasizes the ability of engineering students to integrate multidisciplinary, and requires students to develop their thinking and apply Emerging Engineering Education ideas to solve new problems. The idea of Emerging Engineering Education has subverted the training objectives of traditional engineering education,

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which requires great adjustment in the talent training program, and regards the new concept, new structure, new model, new quality and new system as the core content of the reform. The scale of engineering education in China is huge in the world, but the large scale is not the same as the high quality [3]. At present, the problem of traditional engineering education is that the boundary between engineering education and science education is vague, and the general education and engineering education are out of touch. Students do not realize the auxiliary role of general education in engineering education, even a small number of students simply have no idea whether their major is affiliated with engineering or science, resulting in a phenomenon of incomplete knowledge structure. The scale of engineering education in China is huge in the world, but the large scale is not the same as the high quality. At present, the problem of traditional engineering education is that the boundary between engineering education and science education is vague, and the general education and engineering education are out of touch. Students do not realize the auxiliary role of general education in engineering education. Even a small number of students simply have no idea whether their major is affiliated with engineering or science, resulting in a phenomenon of incomplete knowledge structure [4][5]. The "Higher Mathematics" course is an important part of the general education of Emerging Engineering Education talents and also the cornerstone of the training of Emerging Engineering Education talents. However, the teaching effect of this course in the field of engineering education is not ideal and needs to be reformed. This paper focuses on the teaching reform of the "Higher Mathematics" course in the field of engineering education in private colleges and universities under the background of Emerging Engineering Education, and provides some reference for the future teaching of such courses.

2. The necessity of “stratified” teaching

The traditional teaching model has the drawbacks of "popular education", which is contrary to the teaching principle of teaching students by their aptitude. Different students in the same class have great differences. To achieve the goal of improving the overall learning efficiency of students, it is not feasible to rely solely on the traditional teaching model, especially for the general course of "higher mathematics" as the cornerstone of engineering. Every qualified teacher has been thinking about how to top outstanding students based on ensuring that students with poor foundations can understand them in the same classroom. Although each student's learning ability, cognitive level, and self-qualify are different, there are both existing and potential levels for each individual. Those students who are in a famous school may end up being nothing; while those in a bad teaching environment can become adults. This is the result of two levels of mutual conversion. Therefore, the individual differences in these two levels must also be considered in the teaching process. The teacher should constantly stimulate the potential learning level of all kinds of students, encourage and believe the students' learning ability, from which the stratified teaching will be born.

The stratified teaching is to re-distribute the original natural class according to the students' basic quality and learning ability, then according to the understanding and needs of the students at different levels, re-define the stratified teaching syllabus, formulate different teaching tasks, choose different teaching methods and evaluation system to truly realize the teaching philosophy of teaching students by their aptitude. The stratified teaching is intended to consolidate the foundation of students with poor

learning ability, improve the quality of learning of ordinary students, and top the comprehensive quality of outstanding students so that all students just compare with themselves and improve the quality of teaching on a large scale. This is the true goal and significance of stratified teaching, and it is also the essence of educational pursuit.

In recent years, the number of students in ordinary colleges and universities has been increasing, and the expansion of enrolment has brought the phenomenon of uneven student quality to colleges and universities. The same is true for private colleges and universities. Under the impact of the wave of enrolment expansion, private colleges and universities have expanded the scope of student recruitment to all parts of the country, which has produced regional differences in student quality. In addition, the course "Higher Mathematics" is with string theory, and it is difficult for students with poor learning ability to understand and receive at the beginning. But to meet the needs of most students in the classroom teachers will not slow down the teaching progress to cater to students with poor ability. This will make these students lose their interest in learning and even give up the course. For students with strong learning abilities, the entry of "Higher Mathematics" is relatively easy. The knowledge points taught by teachers in the classroom cannot meet the needs of these students, which greatly wastes teaching resources. It can be seen that "Higher Mathematics" is very necessary to teach in a private college and universities with a stratified teaching model. Of course, it is not easy to achieve stratified teaching in "Higher Mathematics". It requires a long-term reform and exploration process. If there is no clear stratification principle and various aspects of stratified teaching reform, nor scientific implementation plan, it may be counterproductive, which will reduce the quality of teaching, hinder the implementation of the talent development plan, and even have a strong negative psychological impact on some students.

Our school is mainly liberal arts, supplemented by engineering. The teachers who were responsible for the "Higher Mathematics" course in the Basic Teaching and Research Department did not fully consider the actual situation. The same version of the syllabus, teaching programs, and teaching plans was used to teach all the students in all majors, resulting in the high failure rate of this course within the whole school. This affected the quality of personnel training and the student's graduation and employment. Later, the school and the frontline teachers discovered this problem at the same time. Under the requirements and guidance of the talent training plan of Emerging Engineering Education, the school boldly innovated and vigorously reformed, and clarified the reform plan of "Higher Mathematics" teaching in a stratified teaching model in our school. After continuous exploration and improvement, the student's failure rate was finally returned to the normal distribution state. The specific implementation process of this model is as follows: Firstly, re-establish the syllabus based on the needs of the curriculum in different majors. Secondly, different majors are assigned different amounts of class hours and lecture contents when the course is set up. Finally, the students of different levels in each major are subdivided, that is, the course of "Higher Mathematics" has been completed in the form of course stratification + student stratification.

3. The connotation of “stratified” teaching

First, the three-layer teaching targets are clarified: the base layer, the normal layer, and the strengthening layer. The goal of the base layer training is to train Emerging

Engineering Education professionals and technical personnel, paying attention to the teaching of basic knowledge and basic skills of mathematics, so that the students can systematically master the basic knowledge and common mathematical methods to carry out certain thinking training, to improve learning methods, to establish a good mathematical self-confidence, to solve some basic problems with the learned knowledge, and to lay a good foundation for the study of subsequent courses. The establishment of this layer has a guiding role in the stratification of teaching content and teaching objects. The goal of the normal layer is to train Emerging Engineering Education complex engineering talents. Focusing on stimulating students' interest in learning and enthusiasm for learning, guiding students to form good learning habits and effective learning methods can help the students systematically and in-depth understand and grasp the basic concepts and research methods in the curriculum. The students have cultivated their ability to apply practical mathematics to solve practical problems to become Emerging Engineering Education complex engineering talents with high quality. The goal of the strengthening layer is to cultivate Emerging Engineering Education pioneering and research-oriented talents, paying attention to inspiring their thinking and developing ability. By cultivating their higher mathematics qualities and focusing on cultivating their self-study, exploration and creativity consciousness and ability, the students of this layer have a long-lasting learning motivation and conscious study habits, and can flexibly apply the knowledge and methods they have learned to solve complex problems and lay a solid foundation for future work.

Then, based on the teaching target, the teaching content is also divided into three layers: the base layer, the ordinary layer, and the strengthening layer. Teaching content is the main carrier to achieve teaching goals, and the reform of teaching content is the key to teaching reform. At the base level, the teaching content needs to go from the easy to the difficult and strives to be detailed, some concepts and theorems can be appropriately diluted. Focusing on cultivating students' essential mathematical foundation and basic skills of applied mathematics can satisfy the follow-up professional learning and development. In the ordinary layer, the teaching content strives to be deep, leading to mathematical thinking and thoughts. Focusing on cultivating students' solid mathematical foundations and skills can meet the learning and development of follow-up majors. In the strengthening layer, the teaching content strives to be thorough, analyzes its mathematical thinking and thoughts. Introducing some modern mathematical thinking methods to broaden the mathematics foundation of students, combining some of the postgraduate questions to cultivate their interest and tap their potential. It focuses on cultivating students' theoretical analysis and application ability. The stratification of teaching content requirements indicated a direction for specific teaching organizations, such as the stratification of teaching objects, the distinction between teaching plans, and the choice of teaching methods.

Secondly, the teaching objects should be divided into three layers according to the teaching targets and teaching missions: the base layer, the ordinary layer, and the strengthening layer. According to the proportion of stratified class, the base layer students can be set at 30%, the ordinary layer students can be set at 50%, and the strengthening layer student can be set at 20%. Then, different teachers are assigned to directionally cultivate the stratified class.

The final is the formulation and application of the assessment mechanism. The advantage of unified assessment is that the evaluation criteria are consistent and can fully reflects the fairness problem. However, this is precisely the shortcoming of the

stratified teaching assessment, because the teaching contents and the teaching targets of different layers are inconsistent, which is unfair for the students at the base layer. There are also many problems faced by stratified assessment. The first is that the assessment criteria are

4. Implementation of stratified teaching

Under the background of Emerging Engineering Education, the Higher Mathematics stratified teaching pilot was first launched in the Information Engineering Department of our school. "Higher Mathematics" is one of the most important basic courses of each major in the Information Engineering Department. The Information Engineering Department first revised the syllabus of "Higher Mathematics" according to the requirements of stratified teaching. Secondly, taking into account the differences of the mathematical foundations of student sources, the newly enrolled students are divided into 6 classes according to the base, ordinary, and strengthening three layers, namely 2 base classes, 3 ordinary classes, and 1 strengthening class. Finally, teachers are divided into 3 Departments to teach these three layers of classes separately.

To improve students' enthusiasm for learning, improve the quality of teaching, and appease a small number of students with negative emotions, the teaching and research sections have carried out enough verification activities regularly, and boldly adopted some new teaching methods and assessment programs. For example, the three-layer teaching process adopts the method of mobile competition to allow students to adjust the class layer. The excellent students in the base class can be transferred to the ordinary class. The excellent students in the ordinary class can be transferred to the strengthening class. Students who have a lower grade in the strengthening class are transferred to the ordinary class. Students who have a lower grade in the ordinary class are transferred to the base class. This kind of competition mechanism has greatly stimulated the enthusiasm and initiative of students. In addition, the combination of stage test and final test is used to evaluate the learning effect of students. Each time a teacher completes a teaching task of one chapter, the teacher conducts a unit test to objectively reflect the student's learning state. The test results are recorded as part of the final score of the final exam, and then reviewing and explaining the common problems in this chapter to solid the fundamental knowledge. The actual situation shows that this assessment method is conducive to improving the pass rate of the course to achieve a more ideal teaching effect.

5. Teaching effect and analysis

After the success of the stratified teaching in the Information Engineering Department, our school promoted this model to other colleges. Relying on the reform of stratified teaching of "Higher Mathematics" of the Information Engineering Department, the other colleges fully considered the characteristics of their majors to separately implement their reform of stratified teaching, which also achieved good teaching results. In summary, stratified teaching has the following characteristics:

First, stratified teaching ensures a balanced development of students. The failure rate of the "Higher Mathematics" course under the traditional teaching mode system is higher, while that under the stratified teaching mode system is in a normal distribution state.

Secondly, the stratified teaching mode improves the quality of teaching and achieves better teaching results. From the teacher's point of view, teachers need to put a lot of energy into analyzing, designing, and summarizing the curriculum before conducting stratified teaching, adopt the five-step seminar-based teaching methods: guiding to select the topic, independent exploration, group communication, large class evaluation, and summary improvement. From the perspective of students, students participate in the entire teaching process of teacher design, which enables students to experience the hardships of the teachers' education and students' learning. Therefore they will cherish learning opportunities and take the initiative to accept and absorb knowledge. In addition, the phase-based unit test allows the teacher to grasp the student's learning effect on time and allows the student to find out the lack of knowledge in time. The teacher can also timely leak filling, further consolidating the teaching effect. The first semester of "Higher Mathematics" is relatively basic, and the difficulty is relatively small, but the tasks and difficulty of the second semester have increased significantly. After adopting the tiered teaching mode, the teaching process adheres to the method of learning while practicing, gradually consolidating the knowledge system, and the evaluation method is also more scientific. This avoids the phenomenon of "life-determining", which is conducive to improving students' enthusiasm and learning effect.

The stratified teaching mode has the above two advantages, and there are bound to be some shortcomings. There will also be many problems in the process of teaching reform. For example, how to divide classes scientifically and reasonably is our primary consideration. At present, we adopt the method of entrance examination and the mutual selection of teachers and students. However, whether the coverage of the entrance examination knowledge points is appropriate, and whether the scores of one test can be used as the main basis for placement. We can't rule out the phenomenon that students with good foundations play an abnormal role in the placement tests, nor can they rule out that students with poor foundations play an extraordinary phenomenon in the placement tests.

6. Conclusion

"Higher Mathematics", under the background of Emerging Engineering Education, is an important part to cultivate the general education of talents in higher engineering education. Based on fully considering the characteristics of private colleges and universities, this paper discusses the reform of stratified teaching of "higher mathematics". Firstly, the paper expounds on the necessity and connotation of the stratified teaching reform of "Higher Mathematics", and puts forward the stratified teaching principle based on teaching targets, teaching content, and teaching objects. Secondly, it describes the implementation steps of the stratified teaching in our school, including the teaching process of the base class, the ordinary class, and the strengthening class. Finally, the effect analysis of the stratified teaching after the implementation of our school is explained. It not only analyzes its advantages in improving the quality of teaching but also puts forward many problems in the reform of stratified teaching of "Higher Mathematics" under the background of Emerging Engineering Education. Generally speaking, the stratified teaching mode demonstrates the effectiveness and feasibility of talent training in private colleges and universities and can provide an important reference for the stratified teaching reform of such

courses in the construction of Emerging Engineering Education in other colleges and universities.

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