

Exploration and Reflection on the Teaching Problems of“Linear Algebra”

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Abstract: This paper takes the public basic mathematics course“Linear Algebra”as an example to explore the common problems in offline,online and blended teaching,such as single teaching material,single teaching mode and not objective assessment method.To solve these problems,this paper proposes some teaching reform methods and measures from three aspects:discipline orientation,teaching mode and assessment mode,in order to achieve the purpose of improving the teaching effect and teaching quality,and training and improving students’comprehensive analysis and application ability.

Keywords: Linear algebra;Teaching reform;Teaching mode

1. Introduction

In 2020 and 2021,Li Keqiang twice stressed the need to strengthen basic research and applied basic research,with special emphasis on mathematics,because mathematics is the foundation of all disciplines^[1].In the 15th issue of“Qiushi”magazine published on August 1,2023,in the book of“Strengthen basic research to achieve high-level scientific and technological Self-reliance and self-improvement”,the General Secretary Xi Jinping stressed that strengthening basic research is an urgent requirement to achieve high-level scientific and technological self-reliance and self-improvement,and is the only way to build a world scientific and technological power.As one of the required basic mathematics courses for science and engineering students in colleges and universities,Linear Algebra has been applied to various disciplines^[2].However,due to its strong theory and abstract concepts,students have many difficulties in the learning process,and they do not know either its nature or its reason. Therefore,in order to improve the teaching effect of“Linear Algebra”and students’ability of application and innovation,various universities have carried out research on the teaching of“Linear Algebra”.Taking the teaching of“Linear Algebra”for science and engineering major of our university as an example,this paper puts forward the corresponding solutions to some problems existing in the teaching process.

2. Problems Existing in Current Teaching

Linear Algebra,as a basic mathematics course for non-mathematics majors majoring in science and engineering,focuses on cultivating students’logical thinking ability,calculation ability and the ability to solve practical problems.However,there are a large number of dull and obscure basic concepts that are difficult to understand in the course of Linear Algebra,which makes students afraid of learning it.Based on the observation of the actual classroom teaching process and the in-depth communication and investigation for students and teachers,this paper summarizes the three main problems in teaching.

2.1 Problem 1:The selection of textbooks is single

The class hours of“Linear Algebra”are 40,and the learning content includes five chapters,such as determinants,matrices,systems of linear equations,characteristic values and eigenvectors of matrices,quadratic forms.Due to limited class hours and extensive content,the commonly used textbooks are relatively thin,the textbooks generally selected are relatively thin,that is,they mainly focus on theoretical knowledge,only the most important concepts and conclusions,and lack the corresponding theoretical background introduction and case citations^[3].Due to the limitation of class time and the fast pace of class,many knowledge points cannot be expanded and explained in detail.

2.2 Problem 2:Single teaching mode

The strong logic and rigorous thinking mode of mathematics have always been the "easy to fail" course in the public basic course, and Linear Algebra is no exception. Since 2020, due to the impact of the novel coronavirus, online classroom has become an inevitable choice. After that, the online and offline blended teaching mode has gradually become dominant^[4], and smart classroom has become the focus of the construction of various disciplines. Whether it is the online classroom in special period, the traditional offline classroom, or the wisdom classroom that combines online and offline widely adopted today, they are all the teacher-led classroom in which students only passively receive the irrigation of knowledge as participants. Moreover, the teaching effect of smart classroom is more dependent on students' self-discipline and autonomy, but it is obvious that the current blended mode is only another learning venue for students, and even greatly reduces the teaching effect because of the use of mobile phones in class.

2.3 Problem 3:Single assessment method

At present, the assessment of Linear Algebra in most universities is the sum of the usual score and the final score. The kind of assessment method to a large extent takes into account the students' learning process and test scores, but it lacks certain objectivity in the implementation process, especially in their daily performance. The course evaluation of Linear Algebra is composed of five parts: attendance, homework, classroom performance, tests and benchmarks. It may seem detailed, but due to the lack of specific standards, it is greatly influenced by the personal factors of the teacher, which makes it difficult to objectively and comprehensively reflect the problems.

It is a topic currently discussed and researched by teachers that how to solve or improve the above problems in the current teaching, enhance students' interest in learning, reduce learning difficulty from the teacher side to enhance students' abstract thinking and logical reasoning ability, and cultivate students' comprehensive analysis and problem-solving ability. In view of the problems mentioned above, this paper puts forward some suggestions according to its own situation, in order to improve the current situation.

3. Reform Measures

3.1 Subject-oriented teaching model

"Practice is the only criterion for testing truth", the teaching of Linear Algebra is the same. The situation should be changed where the textbook is sole and the theory is paramount. As a relatively abstract basic subject, Teaching Linear Algebra with pertinence of discipline can improve the teaching quality better. Therefore, the teacher's teaching method should also be adjusted according to the actual situation of the teaching class. Firstly, teachers should carefully prepare lessons, self-supplement the professional theories, and add professional applications to the PPT to help students grasp the application of Linear Algebra in the discipline. Secondly, teachers should adjust the presentation time of each section according to the teaching time to provide students with some time for thinking and communication. For example, some content can be learned through a model where teachers raise questions around theory and professional applications, students collaborate in groups to solve problems, raise questions, and teachers summarize at last. Thirdly, teachers can choose to add some short stories related to the content of this section in class, or use current hot topics and hot topics that students are interest in as the leading words to elicit theoretical knowledge or help students understand the concepts. Familiar events can not only reduce students' psychological fear, but also arouse their desire to explore. Fourthly, if conditions permit, the experimental teaching of linear algebra can be carried out in the computer room. Adding experimental content according to the course progress helps to improve students' understanding and application of the theories they have learned, and also lays a foundation for their future applied research.

3.2 Student led "online and offline"

The "Linear Algebra Research Group" of Tarim University has initially established a teaching framework to improve students' initiative from the teaching process. Students can watch the high-quality teaching videos of teachers in the research group on "Xuexitong" before or after class according to their needs; The practice and test question banks have been set up to publish and check homework online, which not only saves resources, but also reduces the burden on teachers, facilitates statistics and process assessment, and helps to understand students' difficulties. We have established an exercise bank and an exam bank, and publish and check the assignments online, which not only saves resources but also reduces the burden on teachers, is also convenient for statistics and process evaluation, and is more conducive to understanding students' difficulties. Due to the establishment of the question bank, we can conduct progressive evaluation or randomly select questions as the final assessment. Progressive evaluation can help teachers more directly understand the learning effect of students, facilitate students to find problems by themselves, facilitate the subsequent strengthening and urging for students' learning, and focus on breaking through weak points.

The establishment of the above online resources has greatly improved teachers' understanding of students, reduced teaching burden, improved teaching efficiency, and further enhanced students' autonomy. For example, before class, students can simply preview

through textbooks or watching the guide videos posted by teachers in the teaching APP. During class, they can study or discuss and communicate with teachers with the problems existing in the preview. After class, they can conduct targeted exercises, consolidate and expand knowledge through the question bank established in the "Xuexitong". And finally, self-test question bank is used to test students' mastery of the content and learning results. Teachers can grasp the learning effect of students through the results of online tests, and then make adjustments and improvements in classroom teaching.

3.2 Diversified assessment methods

Assessment is used to evaluate students' understanding, mastery and application of the learning content, and then judge the teaching effect and whether the teaching purpose is achieved. The diversified, whole-process assessment methods with unified standard are more conducive to objectively measuring the teaching effect and whether the teaching purpose is achieved. According to the original assessment method of "daily performance+final grade", the assessment of daily performance lacks objectivity due to different teachers' different scoring standards. As for the benchmark score, the research group can formulate it uniformly, and the classroom attendance can also be obtained specifically. As for the test and homework, as well as the class performance, it can be solved through a series of online resources established by the research group mentioned above.

4. Conclusion

As a compulsory basic mathematics in colleges and universities, Linear Algebra plays an important role in improving students' computing ability, cultivating students' mathematical thinking and logical reasoning ability, and also plays an important role in the study of subsequent mathematics courses and professional courses. Aiming at the three problems commonly existing in the teaching of Linear Algebra, this paper puts forward some solutions worth trying. And some measures have been constructed and practiced in the construction of the first-class course of Linear Algebra in our school, and have achieved good results. For example, we established learning videos and question banks that fit the actual situation of teachers and students in our school, as well as the teaching apps used in class, etc. At present, these online resources give teachers and students relative time freedom, reduce the pressure on teachers who teach multiple classes, improve students' learning initiative and enthusiasm, greatly increase teachers' grasp of students' learning process, and solve the problems in teaching effectively and pertinently. We are still exploring and researching those questions of students, "why to learn, how to learn, what is useful, how to use".

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