Research on Examination Reform of Linear Algebra Intelligent Online Test System Based on Mathematical Modeling

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Abstract: The idea of mathematical modeling refers to a way of modeling the mathematical phenomena existing in real life. The use of this way can further improve the role of mathematics in the process of human life, and at the same time can optimize the practical application of mathematics. This paper introduces the assessment mode of linear algebra course of linear algebra intelligent online testing system based on mathematical modeling idea, and analyzes the assessment mode. Linear algebra online intelligent learning system is a tool that combines linear algebra courses in colleges and universities to enable students to use network resources for online learning and testing. Based on many years of teaching experience of teachers and students' experience in learning linear algebra, this paper focuses on the establishment of linear algebra online intelligent learning system and its significance in learning linear algebra.

1. Introduction

Linear algebra is an important basic mathematics course for science and engineering majors and economic management majors in colleges and universities. It is also one of the courses that must be taken in the national unified entrance examination for master's degree students. It has high abstractness, logicality and wide practicability [1]. Through the study of this course, help students master and use linear algebra, which is a mathematical tool, can further cultivate students' logical reasoning ability, spatial imagination ability, calculation ability and other rational thinking ability, and lay the necessary mathematical foundation for learning subsequent professional courses and further expanding their knowledge. Through the investigation, we found that most colleges and universities have less class hours for mathematics courses. In order to catch up with the teaching progress, teachers can only choose to race against time. As a result, students are more difficult to understand the content of linear algebra courses, which not only reduces students' interest in this course, but also leads to boredom over time [2]. Therefore, it is necessary to change the teaching method of linear algebra through the fusion of appropriate ideas such as mathematical modeling ideas. Due to students' poor computational ability and weak logical thinking ability, students are at a loss in the process of learning and forget it soon after learning. In order to adapt to the students' learning of linear algebra, we have developed the "linear algebra online intelligent learning system", which enables students to use network resources for online learning and testing, improves students' learning interest and learning effect.

2. The Meaning of Mathematical Modeling

Mathematical modeling is the establishment of a mathematical model in a popular sense, and specifically refers to a way to explicitly deal with mathematical problems in real life through symbols and formulas in mathematics [3]. It can either explain some objective phenomena, or predict the future development law, or provide an optimal strategy or a better strategy in a certain sense for controlling the development of a certain phenomenon. In order to meet the needs of the development of contemporary social science and technology, mathematical modeling has been gradually carried out in college mathematics education. Therefore, many colleges and universities have carried out teaching reform on mathematics courses based on mathematical modeling teaching

and competition. The application of this method can model the mathematical problems existing in real life and is of great significance to improve the efficiency of event processing. The detection of results by mathematical modeling thought needs to be based on actual information, and if it passes the test, it means that the model is reasonable [4]; on the other hand, if the test fails, the mathematical model needs to be revised again until the test passes. This process of abstracting and refining mathematical models from practical subjects by applying knowledge is called mathematical modeling. However, it is worth noting that the completion of mathematical modeling needs to be based on the careful observation and analysis of actual problems by researchers, and its accuracy and scientific degree will also be greatly affected by the research process.

3. The Current Situation

3.1 The Teaching Content is Too Theoretical

At present, the traditional linear algebra teaching material is still dominated by theory, emphasizing the integrity of the theoretical system, too much emphasis on proof and deduction, and the inherent abstractness and logicality of the course itself as well as the complexity of manual calculation make it difficult for students to learn and have low interest in learning [5]. The evaluation of normal performance is subjective and cannot well reflect the students' normal learning situation. Therefore, it cannot play a good role in urging students to study consciously. However, due to the relatively small class hours, short learning period and many abstract concepts in the course of linear algebra, it is difficult for students to digest what they have learned in a short period of time, and it is also difficult to find the rules for these numerous calculation problems [6]. In order to solve these problems, more application examples should be introduced so that students' knowledge of linear algebra courses can be improved from perceptual knowledge to rational knowledge, thus deepening their understanding of knowledge and improving their enthusiasm for learning.

3.2 The Content of the Course Lacks Connection with Engineering Practice and Specialized Courses

Since linear problems exist widely in various fields of technical science, a non-linear problem can be transformed into a linear problem under certain conditions. Especially in today's increasingly popular computer, the position and role of this course are even more important [7]. Students who cannot take the exam for some special reasons have no chance to remedy the situation. In order to overcome these shortcomings, some teachers have made some attempts, for example, according to the characteristics of the curriculum to increase the curriculum papers, strengthen the assessment of the practice link, etc. For mathematics subjects such as linear algebra, only paying attention to the teaching of theory and not to exercises will also reduce students' ability to apply knowledge. Therefore, in the process of integrating mathematical modeling ideas into students' linear algebra teaching, in addition to applying it to the theoretical content explanation such as definitions and cases, it should also be infiltrated into students' daily exercises [8]. Therefore, the methods introduced in the course of linear algebra are widely used in various disciplines, which requires students to have basic theoretical knowledge of linear algebra and master its calculation methods skillfully. At the same time, students are further trained and trained in the ability to analyze and solve problems using mathematical methods.

3.3 Teaching Methods Are Relatively Backward

Due to the emphasis on theory, lack of practical application and the difficulty of matrix calculation, the application of linear algebra knowledge in professional courses and practice will inevitably be affected if advanced software tools are not used. However, public basic courses such as advanced mathematics, linear algebra, probability theory and mathematical statistics are currently mainly based on the assessment method of "usual results+final examination results". The reform of the assessment method has become a bottleneck. Therefore, the reform of the assessment

method for such courses must find new ways [9]. Teachers can assign homework to students and incorporate modeling ideas into them. They can also combine the knowledge students learn in class with real life. Under this kind of teaching mode, on the one hand, it can enrich the classroom teaching content, and on the other hand, it can achieve the goal of cultivating students' team spirit. This can not only enhance students' interest in learning, but also eliminate the view that mathematical knowledge is useless. Therefore, it is very necessary to introduce the idea of mathematical modeling into the daily learning of linear algebra. The introduction of MATLAB software can greatly improve the operation efficiency of the matrix and realize continuous operation of massive data [4]. Therefore, the teaching of linear algebra needs the help of advanced software tools and advanced teaching methods.

4. Examination Mode of Linear Algebra Intelligent Online Test System Based on Mathematical Modeling

4.1 Functions of Intelligent Online Testing System for Linear Algebra

This system is based on the textbook "Linear Algebra" and consists of six sets of test questions, including the first chapter determinant, the second chapter matrix and its operation, the third chapter matrix elementary transformation and linear equations, the fourth chapter vector group linear correlation, the fifth chapter similarity matrix and quadratic and comprehensive test questions. Including the front desk online examination area and the back office management area, it can carry out online tests and online corrections, and has various service management functions of the online examination system. Users (students) need to register and log in to take online examinations or exercises. Click the "Submit" button or when the examination time is up, the system will make online corrections and users can view the results in real time. Linear correlation is the core definition in the course of linear algebra, and a deep understanding and mastery of these two definitions are especially important for the learning of the whole knowledge of linear algebra. However, the linear correlation and linear independence theories of vector groups are relatively abstract. We can use mathematical models to help students understand this group of definitions. The system can count the current number of registered users and the current number of online users. Inquire about each person's test results and time spent in each chapter; Query the test scores of each class and each chapter and the scores of each knowledge point and calculate the corresponding average scores; Can calculate the weighted average score of each person's test scores in all chapters. At the same time, the record of all users (students) answering each set of questions will be stored in the database. Users can also see the ranking information while querying their scores in this test, so as to know their relative positions among students of the same grade.

Most examination systems adopt the mode of generating multiple sets of examination papers on the server side and randomly extracting the examination papers from the examinees. First of all, the management personnel set the difficulty coefficient and coverage of the test paper. The system generates the expected number of test papers according to the test paper generation strategy. Then the client sends the test request, and the server randomly selects a set of test papers to send to the client. The conceptual model of the system is shown in Figure 1.
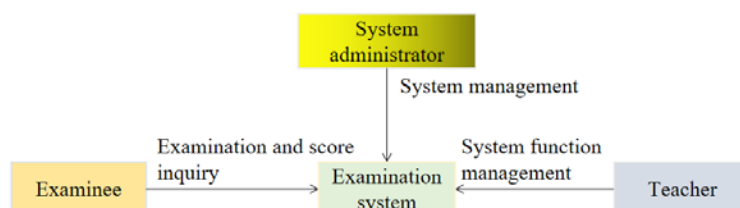

Fig.1 System Conceptual Model

When students enter the home page of the online self-test system, they will first see the login box; If you are a new user, you need to click the "Register" button to register first. After that, enter the

student number and password, and then click "login" to enter the system to answer questions. The background management organization structure of this system is shown in Figure 2.
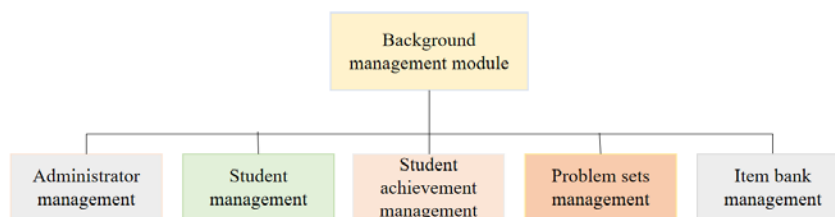

Fig.2 Distribution Diagram of Background System Modules

There are no ready-made test questions and solutions in this system. All the test questions and solutions are generated by computers on site. Theoretically, there are endless test questions in this system. The application of this idea in exercises can not only enable students to put the idea of mathematical modeling into practical application, but also facilitate the mutual communication and discussion among students. Judgment questions mainly test basic concepts, basic methods and main conclusions; Fill in the blank question mainly tests the basic method and the important conclusion, among them the computation quantity is small; Calculation questions mainly test the comprehensive application ability of knowledge and have a large amount of calculation. For example, the system can randomly generate a vector group, use the matrix rank calculation method to obtain the rank of the vector group, then use the rank of the vector group to determine the linear correlation of the vector group, further obtain a maximum linear independent group of the vector group, and use the maximum independent group to linearly represent the vectors that do not belong to the maximum independent group. The system will give the specific calculation process of each step. The system can comprehensively analyze the test situation of all participants in the test, and point out the whole class's mastery of each knowledge point in this chapter, so that teachers can grasp the whole class's learning situation in time and provide reference for teachers' teaching. Teachers can regularly model the knowledge at this stage and use this method to consolidate the teaching content. In some sense, the integration of mathematical models into linear algebra teaching can help students to contact scientific research methods as soon as possible, which is of great significance to cultivate students' ability to solve practical problems.

4.2 Assessment Mode Based on Test System

Overall evaluation result = chapter 1 test result ×10%+ chapter 2 test result ×10%+ chapter 3 test result ×10%+ chapter 4 test result ×10%+ chapter 5 test result × 10%+comprehensive test result ×50%, in which the tests in chapters 1 to 5 are not limited in time, place or number of tests, and students can test at any time and place, and any number of tests they want to do in each chapter can be done, so far as they are satisfied. The system can give a detailed solution to each topic at any time. Students can check their mastery of the corresponding content step by step according to the solution method. The system can repeatedly generate other topics of the same type but the results may be completely different for students to practice. Moreover, it can continue until the solution to the problem is fully mastered. Comprehensive tests must be completed in the designated place within the specified time, but multiple tests can be applied. In order to prevent cheating (cheating here refers to students asking students with good scores to do the tests in the first five chapters on their behalf), we stipulate that those who score less than 56 in the comprehensive test will not pass the overall test regardless of the test scores in the first five chapters. Taking the concept of matrix as an example, teachers can start with simple problems, and then combine simplified modeling and linear algebra concepts together. In this way, students can more easily accept it, which is conducive to students to form long-term memory, thus improving students' innovation ability and mathematical application ability.

4.3 Performance Analysis of Assessment Mode Based on Test System

The goal of taking assessment as a means and urging students to study independently by

assessment has been realized. The two assessment models we have explored have one thing in common: students must take the first five chapters of the test system. The system administrator has the highest authority to add and delete users. At the same time, since the "Linear Algebra" course is an inter-hospital public platform course, the course group includes many teachers. In order to realize resource sharing, the system supports registering many system administrators. Each chapter corresponds to a topic with a score of 100. Once the students have answered the questions, the system will automatically score them as long as they submit them. Students can know their mastery of this part of the content through scoring. The system will automatically grade all the questions submitted by students and keep the results. The system will also classify and save all the submitted questions according to errors, so that teachers can easily understand the learning status of all the students in the class. The application of this idea in exercises can not only enable students to put the idea of mathematical modeling into practical application, but also facilitate the mutual communication and discussion among students. In our assessment mode, students can also cheat, that is, ask someone to do it on their behalf, but this kind of situation can be easily found by failing the comprehensive test result or the final test result lower than 56 points, thus punishing such students.

Another purpose of the examination is to check the students' learning situation and the teachers' teaching quality. Because the test system can count the test results of all the people in the class in each chapter, the average test results in each chapter of the class, the score rate of each knowledge point in each chapter of the class and the average score rate of each knowledge point in the class. This makes it difficult for teachers to carefully correct each student's homework, and it is also difficult to have a comprehensive understanding of each student's study. After the application of "Linear Algebra Online Intelligent Learning System", the system has strict examination and grading standards for the submitted content, which replaces the work of teachers correcting homework. It is very feasible to integrate the idea of mathematical modeling into the teaching of linear algebra, but this reform undoubtedly puts forward higher requirements for teachers. Teachers are required not only to have a profound and comprehensive understanding of mathematical modeling thought, but also to have excellent theoretical knowledge and good lecture skills. Teachers can enter the system at any time to check the topics submitted by students in each class. As the system will classify and save the submitted topics according to errors, teachers can easily understand the learning status of all students in the class, thus reducing the work intensity and improving the work efficiency. Therefore, teachers can immediately grasp the learning situation of the whole class, and department leaders can immediately understand the learning situation of all classes. Although each person's test questions are different, the test results are comparable due to the same difficulty.

5. Implementation Effect

The application of the assessment mode of the linear algebra intelligent online test system based on mathematical modeling idea in the linear algebra course has been practiced for three semesters, with 60 classes and 4250 registered students in the pilot class. The total number of tests is 57522, the number of people-level tests is 20.31, and the number of people-level tests in each chapter is 4.7, which shows that the linear algebra intelligent online test system is welcomed by students. We have done a questionnaire survey, 94% of the students think the test system is very helpful to the students, they give a high evaluation to the test system, like to use the test system for autonomous learning. Since its use, the test system has also achieved good teaching results, with the excellent rate of the pilot class reaching more than 20% and the failure rate below 4%.

6. Conclusion

Although the linear algebra intelligent online testing system based on mathematical modeling idea has been used in teaching practice, it still needs to be improved, especially the function of the testing system itself needs to be further improved. Only through practice can problems be found, and we are currently working on this aspect. There is still room for improvement in some aspects of

the current version of the online examination system. For example, the existing question bank is statically added by the administrator. In the future, the expansion of the question bank can be considered. Each test adopts the method of randomly generating sets of questions to increase the use efficiency of the question bank. In colleges and universities, linear algebra teaching involves a wide range of specialties and a large number of students. It is undoubtedly important to strengthen the combination of courses and computers, strengthen the practical application of courses, and let students know and master what they have learned through concrete practice and use what they have learned to solve practical problems. It also requires us to further explore and practice.

Acknowledgements

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