Research on Blended Learning Model of Linear Algebra Based on Rain Classroom

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Abstract. Using software Rain Classroom, this paper considers blended learning in linear algebra teaching. By constructing a mixed learning environment and combining the intelligence and real-time interaction of the Rain Classroom platform, the linear algebra teaching mode combining online and offline is designed. This paper introduces the Rain Classroom and the characteristics of blended learning compared to traditional learning styles. Based on Rain Classroom, a teaching case of linear algebra is designed, a teaching process combining online and offline is designed, and specific teaching measures are designed for the key problems that need to be solved in blended learning. Finally, the method of teaching evaluation is discussed, and the learning effect of students is given.

Keywords: Rain Classroom, blended learning, linear algebra, teaching practice.

1 Introduction

1.1 Research Background

The development of information technology provides conditions for teaching reform, and blended learning model has been explored and practiced by many scholars in the field of education reform. Due to the limitation of teaching space, less teaching materials and less interaction between teachers and students, traditional teaching seriously hinders students' learning and makes students lose their interest in learning. However, the blended learning model can solve the drawbacks of traditional teaching and bring flexible learning methods to students by using online and offline teaching. This learning mode improves the teaching effect and efficiency [1][2][3][4].

Linear algebra is an important mathematics course. However, traditional linear algebra teaching is often taught in the way of classroom lectures and lacks interaction with students, making students lose interest and creativity [5][6].

Tsinghua University has developed Rain Classroom, an intelligent online teaching software that provides online courses and teaching resources. Rain Classroom can also support the organic integration with traditional face-to-face classes to achieve fast, free and intelligent teaching. Rain Classroom can also provide intelligent data analysis

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functions such as student attendance, classroom answers, and classroom activities to provide visual guidance for teaching.

In recent years, some scholars have explored blended learning model based on Rain Classroom [7][8]. In this paper, the author will use the convenience and intelligent interactivity of Rain Classroom software to study how to implement blended learning methods in linear algebra teaching.

1.2 Research Significance

The blended learning model can provide diversified learning styles and personalized learning paths to stimulate students' learning interest. In blended learning, flexible learning style and adaptive performance of learning platform improve students' autonomous learning ability. Students can have more opportunities to discuss problems between groups, which also improves students' cooperative learning ability. It can also provide other teachers with specific cases of the implementation of blended learning design and experience by using Rain Classroom [9][10].

2 Theoretical Basis - Blended Learning

Blended learning mode integrates online learning with offline interactive learning. In this mode, part of the content is delivered online, and the learner can control the time, place, path, or progress. At the same time, part of the content is conducted in the offline place where teachers and students face to face. These two parts complement each other to form a complete teaching and learning process.

Blended learning has the following main advantages. First, blended teaching allows students to organize their learning according to their own schedule, without the constraints of traditional classroom time and location. Secondly, online learning provides students with a lot of educational resources, which can help students prepare, review and practice better. Thirdly, blended learning enables teachers and students to communicate better through real-time interaction, discussion, questioning and answer. In addition, blended teaching provides an immediate learning feedback mechanism, and students can evaluate their learning through online exercises, tests, and other forms of learning. Teachers can provide personalized guidance and guidance according to students' learning performance and feedback results.

3 Blended Learning Case Design Based on Rain Classroom

The traditional linear algebra teaching is mainly completed in the classroom, because the teaching time is less, the teacher can only explain the textbook knowledge in the classroom, the expansion exercises are less, and the specific application of the knowledge is less, so this brings bad teaching and learning results. Due to the lack of classroom interaction, students' autonomous learning and cooperative learning ability cannot be improved. Therefore, we adopt mixed teaching mode, which divides

knowledge learning into three stages: online self-learning before class, interactive teaching in offline class and after-class practice consolidation. The purpose is to change the teaching mode to student-centered mixed learning mode, stimulate students' learning interest and improve their independent learning ability. We use the following strategies to solve some of the problems that may be encountered in the blended teaching process.

In the online autonomous learning before class, the following teaching measures are adopted so that students can preview before class and improve self-discipline. Firstly, we upload preview videos in Rain Classroom 7 days in advance, teachers can check the students submitted homework situation through the Rain Classroom. Remind students who did not click on the video in time. Secondly, in offline classroom teaching, at the beginning of the class, questions are raised about the preview video and students are asked to answer them. Rewards are given to students with good answers, such as giving out milk candy. These incentive measures can encourage students to preview the video more actively before class.

The traditional linear algebra teaching, with a lot of classroom teaching theories, occupies most of the class time, so that students have no time to do some exercises in class, cannot digest the knowledge well, resulting in poor calculation ability of students. We reserve some time in class for students to practice, and check the calculation process and results with each other within the study group to find calculation errors. Improve the students' problem-solving ability, also improve the students' confidence in learning, and help to continue learning. In order for students to better review the class knowledge after class, we record lecture videos synchronously through Rain Classroom, and students can click to watch and review what they have learned in class.

In order to improve students' ability to apply linear algebra knowledge to solve practical problems, we will design a small applied problem in class that students can discuss and solve.

Next, in the course of linear algebra teaching, we take the operation of inverse matrix as an example to design a case of blended learning mode based on Rain Classroom to show our specific teaching steps.

- **Online autonomous learning stage**

First of all, the Rain Classroom pushed a 10-minute teaching video of inverse matrix before class to learn the definition of inverse matrix and the formula of calculating inverse matrix by using adjoint matrix. Teachers use Rain Classroom to get real-time data on students who have already watched the video. Rain Classroom sent a message to remind individual students who did not finish watching the video. In order to test the preview effect, we design a single choice question for an inverse matrix. The number of students who complete the online test provides an indication of their pre-class engagement.

- **Offline interactive teaching stag**

In the offline classroom, the study group first selects a representative to report the content of the preview video, and then the teacher randomly selects a group of students

to explain the exercises of the preview video before class. Students who give wrong answers will not be criticized, and students who speak well will be rewarded with a piece of milk candy, which will encourage more students to preview the video before class. Then the classroom teacher goes on to explain the inverse matrix of some special matrices, such as the inverse matrix of the unit matrix, diagonal matrix and explain the operation properties of the inverse matrix. In the process of explanation, teachers use the interactive way. Teachers put forward some questions, students can answer through the Rain Classroom barrage, or through the contribution function. Reserve time in class for students to practice the calculation of the inverse matrix of the third-order matrix, and communicate with each other in the study group after finishing, which can improve students' calculation ability. Next, the teacher will teach the application of inverse matrices. The first application is solving matrix equations, and the second application is information coding in the military. First, the teacher introduces the rules of information coding. One study group corresponds to an English sentence as a string of numbers, disguises the string through a matrix A, and sends the transformed numerical information to neighboring groups. Adjacent teams decode the information through the inverse matrix of the matrix A and decipher the corresponding English sentence. By providing simple application cases in class, students' interest in learning can be stimulated.

- **After-class practice consolidation**

In the classroom teaching, Rain Classroom software can record the class lecture video and PPT courseware. After class, students can watch the lecture video again, and students can mark the questions they don't understand in the video and courseware. Teachers can see what students don't understand about the video and courseware, and answer students' questions in real time through the Rain Classroom. The ability of real-time interaction helps teachers to understand students' learning difficulties, and timely answers help students to master the knowledge learned in class. In addition, in the Rain Classroom, we ask students to search for information through the Internet and artificial intelligence, and organize students to exchange application examples of inverse matrices in the exchange area of the Rain Classroom, this enhances students' ability to cooperate in learning.

4 Teaching Evaluation and Teaching Effect

On the one hand, by tracking the completion of online exercises and learning progress in the Rain Classroom, intelligent analysis of the data is carried out to evaluate the effect of students' online autonomous learning. On the other hand, the offline teaching is evaluated through class discussion, group activity performance and classroom answer data. We look at students' mastery of knowledge and assess their engagement.

We did some research to evaluate whether the blended learning model was achieving the teaching results we expected. We handed out 80 survey papers and recovered 80.

As for whether they like the Rain Classroom, 90% of the students have watched the preview video before class, 93.2% of the students think the preview video is useful for

learning, and 92% of the students enjoy easy communication between teachers and students through the Rain Classroom. Majority of people prefer to use the Rain Classroom software for learning, Fig.1 shows that 91.3% of students are willing to continue to use the Rain Classroom for blended learning in the next semester.

In the survey on whether it has improved the teaching effect, 95% of the students think that the interaction is more than that in the traditional course, which stimulates students' learning interest, and 93% of the students think that this blended learning mode makes their learning more effective. 85% of students believe that classroom teaching has improved their ability to calculate and solve practical problems.

The students' final closed-book examination scores were better than those of students who had not previously engaged in blended learning. We examined the correlation between a semester's online and offline student participation scores and their end-of-semester test scores. Fig.2 shows that students' regular performance and their final closed-book examination scores are positively correlated, and we get the correlation coefficient 0.83.

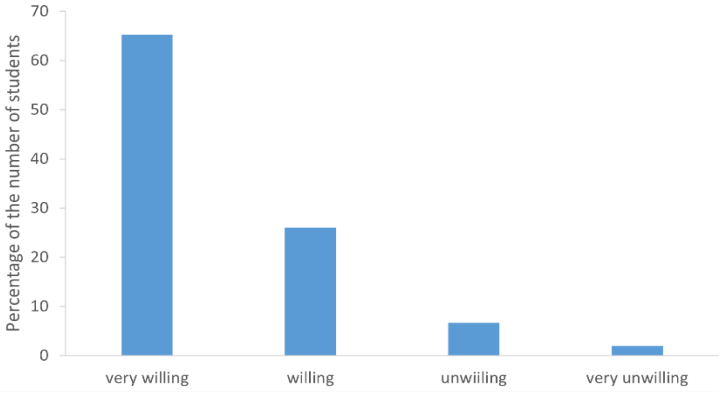

Fig. 1. A survey of whether student prefer to Rain Classroom for the next semester

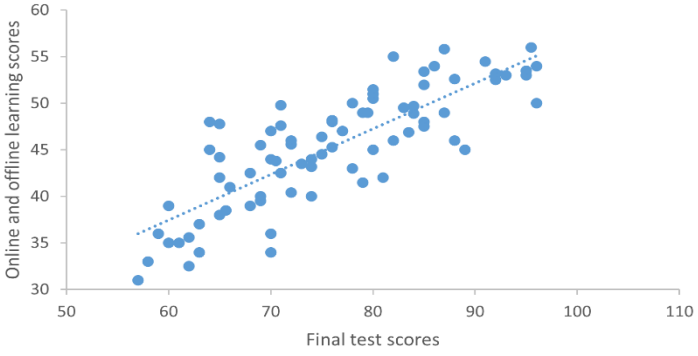

Fig. 2. The correlation between online and offline learning scores and final test scores

5 Conclusion

Through the study of blended learning mode, this paper provides students with rich learning resources and diversified learning experience. Through the autonomous learning of Rain Class online software and interactive discussion in offline classes, students can better grasp the basic concepts and methods of linear algebra and improve their practical application ability. We will continue to explore how to better combine Rain Classroom with online learning, how to combine artificial intelligence technology to conduct intelligent analysis of data, and how to use learning data to accurately evaluate teaching effects in the future.

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