
Short communication

Exploration and Practice of Teaching Methods for College Mathematics Courses Based on Flipped Classroom

Abstract:

In the context of the information age, the flipped classroom teaching model has brought new inspiration to the reform of higher education. The flipped classroom achieves the reversal of knowledge transmission and internalization through the approach of "online learning and offline internalization". Its personalized and collaborative learning environment helps cultivate students' learning abilities and innovative thinking. In response to the problems existing in current college mathematics teaching, the author has explored and practiced the flipped classroom teaching model. By constructing a teaching process consisting of pre-class, in-class, and after-class sessions, leveraging informatization teaching platforms, and adopting strategies such as project-based learning and collaborative learning, good teaching effects have been achieved.

Keywords: flipped classroom; college mathematics; teaching methods; teaching practice

1. Introduction

With the rapid development of information technology, the field of education is undergoing profound changes. Flipped classroom, as an emerging teaching model, has brought new vitality to traditional classroom teaching with its unique teaching philosophy and process. Flipped classroom guides students to learn independently by moving the knowledge imparting stage to before class and using multimedia resources such as videos, while placing the knowledge internalization stage in class ^[1]. Through interactive communication between teachers, students, and students, difficult problems are solved and understanding is deepened. This teaching mode not only improves teaching efficiency, but also cultivates students' self-learning ability and innovative thinking [6,7].

As an important foundational discipline in higher education, the teaching quality of university mathematics directly affects students' professional competence and subsequent development. However, there are still some problems in current university mathematics teaching, such as abstract and difficult to understand course content, single and boring teaching methods, which lead to low students' interest and enthusiasm for learning [8-10]. Therefore, exploring and practicing the flipped classroom teaching model is of great significance for improving the quality of university mathematics teaching.

2. Definition and characteristics of flipped classroom

Flipped Classroom is a teaching model that reverses the two processes of knowledge transmission and internalization in traditional classroom teaching ^[2]. In the flipped classroom mode, students learn new knowledge independently by watching videos, reading literature, and other

methods before class, while in the classroom, they internalize and apply knowledge through teacher guidance, group discussions, practical operations, and other methods.

Flipped classroom has the following characteristics:

(1) Initiative: Students actively acquire new knowledge before class, rather than passively receiving teacher's indoctrination. This proactive learning approach helps to enhance students' interest and enthusiasm for learning.

(2) Interactivity: The classroom has become a place for teacher-student interaction and student-student interaction, where students deepen their understanding of knowledge and enhance their problem-solving abilities through communication, discussion, and cooperation.

(3) Personalization: Flipped classrooms allow students to choose learning content and methods based on their own learning progress and interests, thereby achieving personalized learning.

(4) Technical support: Flipped classroom relies on information technology, such as video production, online learning platforms, etc., providing students with rich and diverse resources and tools for learning.

3. Current situation and main problems of university mathematics teaching

(1) The Current Status of College Mathematics Teaching

Currently, traditional teaching models are commonly used in university mathematics education, which focus on teacher lectures while students passively receive knowledge [3]. In this mode, teachers explain mathematical knowledge in the classroom and reinforce students' understanding through examples and exercises. Students complete their learning tasks by listening to lectures, taking notes, and completing assignments.

However, this teaching model has some shortcomings [4]. Firstly, due to the abstract and difficult to understand content of university mathematics courses, students often find it difficult to fully comprehend and master new knowledge in the classroom. Secondly, traditional teaching models lack interactivity and personalization, making it difficult to meet the learning needs of students at different levels. Finally, traditional teaching methods can easily lead to low students' interest and enthusiasm for learning, thereby affecting teaching effectiveness.

(2) The main problems in college mathematics teaching [5-6]

1) The teaching content is too abstract and difficult to understand: The content of university mathematics courses is complex and abstract, and students often find it difficult to understand and master. This leads to students feeling confused and frustrated during the learning process, resulting in a loss of interest and motivation in learning.

2) Single and boring teaching methods: Traditional teaching models often use a single teaching method, lacking interactivity and interest. This teaching method can easily make students feel bored and affect their learning effectiveness.

3) Lack of personalized teaching: Traditional teaching models often overlook individual differences and learning needs of students, resulting in uneven teaching effectiveness. For students with poor foundations, they may not be able to keep up with the teaching progress. For students with a good foundation, they may feel that the teaching content is too simple and lacks challenge.

4) Imperfect evaluation system: The current evaluation system for university mathematics teaching mainly relies on exam scores, which is too single and cannot fully reflect students' learning situation and ability level. At the same time, this evaluation method can easily lead students to adopt exam strategies such as rote memorization in pursuit of high scores, neglecting the cultivation of

students' innovative thinking and practical abilities.

4. Teaching Design and Implementation Strategies of Flipped Classroom in University Mathematics Curriculum

(1) Teaching Design of Flipped Classroom

We have explored and practiced the flipped classroom teaching model to address the problems in university mathematics teaching. In teaching design, we focus on the following aspects:

1) Preparation before class: The teacher prepares teaching videos, PPTs, and other teaching resources in advance and uploads them to the online learning platform. At the same time, design preview tasks and test questions to guide students to learn new knowledge independently.

2) In class interaction: In the classroom, teachers organize students to engage in group discussions, presentations, and other activities, encouraging students to raise and solve problems. At the same time, teachers provide feedback and guidance on students' learning progress, helping them deepen their understanding of knowledge.

3) After class extension: Teachers assign homework and extension tasks, requiring students to consolidate their learned knowledge and apply it in practice. At the same time, online tutoring and Q&A services are provided to promptly solve problems encountered by students during the learning process.

(2) Implementation strategy of flipped classroom

1) The application of information-based teaching platforms: Utilize information-based teaching platforms (such as Xueyin Online, Smart Tree, Rain Classroom, etc.) to provide students with rich and diverse learning resources and tools. Through online learning platforms, students can watch instructional videos, participate in discussions, submit assignments, and more. At the same time, teachers can also monitor students' learning progress and situation in real time, providing targeted guidance and feedback.

2) Application of project-based learning: Through project-based learning, students are guided to apply the knowledge they have learned to practical problems. For example, in calculus courses, teachers can design projects related to real life (such as calculating the volume of irregular objects, analyzing trends in economic data, etc.) to enable students to master and apply calculus knowledge in practice.

3) The development of collaborative learning: Through collaborative learning, cultivate students' teamwork spirit and communication skills. In the classroom, teachers can organize students to engage in group discussions, role-playing, and other activities, encouraging students to collaborate and complete tasks together. This learning method can not only increase students' participation, but also promote their in-depth understanding and application of knowledge.

4) Implementation of personalized teaching strategies: Adopt personalized teaching strategies based on the learning needs and ability levels of students at different levels. For example, for students with poor foundations, teachers can provide more tutoring and support; For students with a good foundation, teachers can design more challenging learning tasks and expanded content. This teaching strategy can meet the personalized needs of students and improve teaching effectiveness.

5. Teaching Cases

Taking the concept and properties of limits in the course of Advanced Mathematics as an

example, we have designed a teaching case based on flipped classroom and inquiry based teaching methods.

(1) Preparation before class:

On the course platform, pre-record instructional videos to introduce the basic concepts, properties, and calculation methods of limits. Provide relevant reading materials on the definition, theorems, and proof process of limits. Students are required to complete the reading of videos and related materials in advance, understand the definition of limits, and solve some simple limit calculation problems.

(2) Classroom teaching:

Firstly, explain the problems encountered by students during their preview. Then divide into groups for discussion, assigning each group a mathematical problem related to limits, such as solving the limits of complex functions, discussing the existence of limits, etc. Further guide students to conduct mathematical experiments, such as using mathematical software to solve limits and observe the changes in limits. Finally, the teacher helps students deepen their understanding of the concept and nature of limits through questioning, guidance, and other methods, and provides a summary.

(3) After class reflection and evaluation:

Firstly, students are required to reflect on their learning process after class, summarize their understanding of the concept of limits and their mastery of calculation methods. Then, a series of exercises and practical problems related to the concept of limits were designed, requiring students to independently complete them to test their understanding and application ability of the concept of limits. Finally, students' learning outcomes are evaluated from multiple dimensions such as classroom participation, group discussion outcomes, homework completion status, and final exams. At the same time, feedback from students was collected through questionnaire surveys and individual interviews to understand their views and suggestions on flipped classroom and inquiry based teaching methods.

6. Analysis of practical effects

Through practice, we have found that the flipped classroom teaching method has achieved significant results in the teaching of mathematics courses.

(1) Enhancing students' initiative in learning

In the flipped classroom mode, students need to engage in self-directed learning before class, which forces them to be more proactive in understanding the teaching content, asking questions, and conducting preliminary thinking. In the classroom, students have more opportunities to participate in discussions and practices, and their learning interest and enthusiasm have significantly increased.

(2) Improvement of problem-solving ability

The flipped classroom teaching method encourages students to solve problems through collaboration, researching materials, and other means, which cultivates students' self-learning and problem-solving abilities. In group discussions, students learned how to divide labor and collaborate, how to communicate effectively, and how to think about problems from different perspectives. These experiences not only help them achieve better grades in mathematics learning, but also have a positive impact on their future career.

(3) Improvement of teaching quality

By implementing the flipped classroom teaching method, teachers can pay more attention to individual differences and learning needs of students in the classroom, and provide more targeted guidance and assistance. Meanwhile, as students have already gained a preliminary understanding of the teaching content before class, teachers can delve deeper into complex concepts and issues in the classroom, thereby improving the quality and efficiency of teaching.

7. Conclusion

Through the practical exploration of the flipped classroom teaching mode in university mathematics courses, the author found that the flipped classroom teaching mode has significant teaching effects and advantages. Firstly, flipped classroom can stimulate students' interest and enthusiasm in learning, improve their self-learning ability and innovative thinking; Secondly, flipped classroom can achieve personalized teaching and meet the learning needs and ability levels of different students; Finally, flipped classroom can enhance students' classroom participation and teamwork skills, promoting their comprehensive development. In the future, the author will continue to deepen the practical exploration of the flipped classroom teaching model in university mathematics courses. On the one hand, we will further optimize teaching design, improve teaching resources and tools; On the other hand, we will explore more diverse teaching and evaluation methods to better meet students' learning and development needs. At the same time, the author will actively communicate and share the experience and achievements of flipped classroom teaching with other teachers, and jointly promote the in-depth development of higher education reform.

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