

# Application Research of Mixed Teaching Mode of Higher Mathematics Based on "SPOC+ Flipped Classroom"

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## ABSTRACT

In this paper, on the basis of analyzing the traditional teaching, based on the " SPOC+ Flipped Classroom " hybrid teaching pattern of "higher mathematics", and from the teaching idea, learning objectives, teaching content and teaching aspects of the teaching model is designed, finally has carried on the teaching reflection in combination with teaching practice, based on " SPOC+ Flipped Classroom " hybrid teaching model provides reference for further studies.

**Keywords:** SPOC; Flipped classroom; Advanced mathematics; Mixed teaching

## 1. INTRODUCTION

Advanced Mathematics is an important basic theory course for engineering students to learn in university. Students generally reported that the course was long and difficult. In order to improve its learning effect, in recent years, many domestic universities have been relying on the rapid development of educational information technology, vigorously carry out the online teaching reform of higher mathematics. In particular, the in-depth development of MOOC in recent years has set off a wave of changes in the field of global higher education [1]. At the same time, new online education forms inspired by MOOC or created in response to the shortcomings of MOOC are increasing day by day, enriching and expanding the application mode and scope of online education, among which SPOC is the most representative. SPOC has all the functions of MOOC courseware, tests, assignments, discussions, announcements, examinations, data statistics, student management and so on, and provides a convenient way for the promotion of teaching resources, learning tasks, and the communication and interaction between teachers and students and students.

At the heart of flipped classroom is personalized learning [2]. Teachers constantly think and actively improve the flipped classroom teaching process, carefully design the teaching content, maximize the use of classroom time, adopt student-centered and student-active learning teaching strategies, communicate and teach with each student individually, and transform the classroom into a place for learning and answering questions, so as to truly teach students according to their abilities.

One of the advantages of SPOC is that it facilitates the connection between traditional teaching mode and online

teaching mode, making autonomous learning, mobile learning, social network learning, mixed learning, ubiquitous learning and personalized learning more possible in the online learning environment [3]. Therefore, it is particularly important to explore how to organically combine face-to-face classroom teaching of Advanced Mathematics with SPOC online learning, study the organizational mode and strategy of "flipped classroom" based on SPOC platform, and turn the collective classroom space into a dynamic and interactive learning environment.

## 2. TEACHING DESIGN

### 2.1. Establish Advanced Teaching Design Concepts

Whether SPOC online learning or flipped classroom, educational ideas and teaching methods have undergone tremendous changes compared with traditional teaching [4]. Educators to use technology to convert all actions in the process of education to education data, by looking at the performance of each student, to help students find and fully develop their potential, make the education from the macroscopic research groups to individuals, so as to promote the comprehensive and free development of personality, realizing data driven personalized learning, scientific and reasonable teaching concept is a guarantee to effectively achieve the teaching goal.

## **2.2. Accurately Analyze Students' Learning Objectives**

In the "SPOC+ Flipped Classroom" teaching mode, the teaching objectives are customized [5]. By collecting individual characteristic data such as students' learning preference, cognitive characteristics and learning style; The data of students' cognitive level, emotional state, attention state and other learning states are collected to diagnose the problems and needs of each student. Then push the learning content to the students actively, in real time and in a personalized way according to the learning needs through groups or individual forms. In combination with the requirements of the teaching syllabus, following the learning characteristics of students, the principle of gradual progress from easy to difficult, comprehensive, specific, layer upon layer in-depth analysis of each student's learning objectives, the starting point and end point of learning activities clearly connected, is the premise of teaching design, effective implementation of personalized learning.

## **2.3. Design Personalized Teaching Content**

Educators should reasonably arrange online and offline content, reshape knowledge structure, carry out personalized hierarchical design and different presentation methods, so as to adapt and meet different learners' requirements [6]. Besides being relatively independent, smaller and more effective, the teaching content also has multi-dimensional association, namely flexible organizational relationship. Learning resources are clustered around the knowledge points, making the knowledge points into a "resource package", which contains all the resources needed to learn the knowledge points, including micro lessons, courseware, audio, animation, exercises, activities, etc. In addition, learners can start learning a certain knowledge point at any time with a certain randomness, and not necessarily according to the knowledge structure. They can also choose the knowledge points they are interested in, or the knowledge points recommended by the learning system, etc. Teaching content knowledge, therefore, the model could not use the traditional way of knowledge tree, need to find other ways of architecture should also have a custom, modular, optional features, teachers should design different forms of the same knowledge, according to the students' learning style, foundation and learning ability to push.

## **2.4. Build a Student-centered "Flipped Classroom" model**

Scientific teaching mode is an important guarantee for the effective completion of teaching content [7]. The reuse of classroom time is the core of the whole teaching process. What is the value of classroom time if students can get all the content without coming to class? What do students

really need a realistic, standing in front of them? There should be many possible answers to this question, because every student has different talents. For teachers, students are a combination of talents, abilities, hobbies and interests. The greatest strength of flipped classroom is the ability to customize learning for each student. In class, teachers can organize interactive learning activities by combining the learning achievements Shared by students before class and applying collaborative interactive communication and real-time feedback evaluation techniques. You can also use a variety of terminals to organize classroom quiz contests, group discussions and game exercises and other interactions. In the process of practice, teachers can set advanced rules. According to the results of students' practice, teachers can feedback the completion time and performance analysis of the practice to teachers, and then teachers can push personalized learning materials to students at different stages according to the situation. In the whole process, we need to deal with the following aspects: (1) how to take into account that every student can participate in the class;(2) how to deal with the relationship between teachers and students; (3) How to stratify to the student, grouping ability is reasonable and effective.

## **3. TEACHING PRACTICE**

In order to promote the deep learning of advanced Mathematics, further improve the teaching quality. Since 2018, the course team has carried out teaching practice for first-year science and engineering students, and selected three classes to conduct experiments for two years. Students' ability of independent learning, teamwork and winning prizes in mathematical modeling contests were all improved.

First of all, students' self-learning ability and teamwork ability are significantly improved. The course team has released abundant teaching resources on the network platform, including knowledge explanation videos, mathematics history and related knowledge expansion, so that students' learning resources are no longer limited to a single paper textbook, but multi-dimensional and diversified online resources with rich content. In this way, on the one hand, students can study independently, complete online tests, and upload assignments through the network platform, which can be read publicly. On the other hand, students can record the difficult problems in the process of watching and online testing, so that students can ask questions online and have targeted discussions in class [8]. The course team will answer questions in time. Thus realizing the interaction between teachers and students of online teaching. This interaction provides a good environment for students to construct their own mathematical concepts in independent learning and exploration.

In the past two years since the implementation of the mixed teaching mode, students have achieved outstanding results in the Mathematical Modeling Competition, and the first batch of students in the class of 2018 have

participated in the mixed teaching mode of SPOC+ Flipped Classroom. Compared with the students of the same major in previous years, both the number of winners and the level of winners have made a breakthrough, which indicates that blended teaching has improved students' practical ability in scientific research and innovative thinking.

## **4. TEACHING REFLECTION**

### ***4.1. Change of Teacher's Role***

SPOC+Flipped classroom is a new challenge for teachers. Practitioners have found that the biggest obstacle to the implementation of the flip is the flip teacher's thinking. Teachers should change their ideas, set up the student-centered concept, and be the organizer, guide, helper, coordinator and promoter of students' learning. Often appear in practice, when students discuss incomplete or watching video the effect not beautiful, teachers unconsciously back to the original track, gush to teach, solve the problem is that teachers should constantly improve the teaching design, do a good designer, guide students to actively explore, not override all students to complete. From the perspective of the whole teaching process, teachers subvert the original whole teaching process, and need to reshape knowledge structure, record micro-videos, refine teaching objectives, study teaching effects, design evaluation methods, and organize classroom discussions [9]. In the teaching design of the course, it is necessary to consider which chapters are suitable for flipping, which chapters are more suitable for teaching, and which questions are suitable for students' independent discussion, etc. These all consider the breadth and depth of the teacher's knowledge of the course, the ability to interact with students, and the ability to organize, coordinate and work as a team.

### ***4.2. Division of Labor and Cooperation Among Course Teams***

The establishment of SPOC course is a huge systematic project. Although there are many existing platforms and resources available, relevant teachers still need to form a course team and work together to complete the course. Flipped classroom also needs to discuss how to optimize and test the teaching practice [10]. First of all, we need to "recruit", recruit a number of good soldiers; Secondly, each teacher is responsible for the design of part of the teaching content, including classroom interaction. In addition, teachers are also required to be responsible for the management and maintenance of the network platform.

### ***4.3. Change of Students' Study Habits***

Based on the teaching practice of SPOC and flipped classroom, teaching is transformed from the starting point of "teaching" to "learning", and the teaching subject is transformed from the perspective of "learning" to students. There are several key points in the teaching process. Firstly, students should watch videos in advance. If students don't learn independently in advance, flipped classroom cannot be carried out [10]. To solve this problem, teachers should make clear rules at the beginning of the course and let students know that the process assessment includes students' independent learning. The second is the communication between teachers and students, that is, teachers teach. This "teaching" is based on the online and offline requirements and guidance for students' learning. This concept is "the teacher should be free, the student should be busy", the teacher assigns, inspects the task, but the student completes the task, the student is in the semi-self-study state, says more does more. Even if teachers teach, they only need more guidance and less indoctrination. In classroom teaching, teachers should explore teaching forms, cooperate with different teaching contents, deepen students' application and understanding of what they have learned in class, and design a reasonable teaching operation system and a strict evaluation system. Students, as the main participants, also need to change their roles and keep learning to adapt to the new teaching mode.

### ***4.4. Construction of Flipped Classroom Environment***

Successful flipped classroom requires the following key elements: teamwork, learning-centered learning model, optimized learning space, support from relevant departments, regular review and reflection, etc [11]. The layout of the learning space can be diversified. The basic principles are to create cooperative space, personal space, highlight the student as the center of the class, and emphasize learning rather than class. There is not only one way to flip a classroom, but to evaluate all aspects of the classroom and continuously improve the practice to meet the needs of learners.

### ***4.5. Diversified and Operational Evaluation System***

Learning evaluation is an important part of SPOC course construction, which involves multiple evaluation dimensions such as students' ability to analyze practical problems, keen insight, bold judgment, highly abstract generalization ability and rigorous logical analysis ability [12]. However, the traditional evaluation method only involves classroom performance and paper score, which is difficult to comprehensively evaluate the mixed learning effect of students. Therefore, the team of teachers should

integrate the evaluation criteria of SPOC online platform, which is designed to be scientific, reasonable and easy to operate, and comprehensively grade students' pre-class and classroom links, so as to comprehensively consider the completion of each item of students in the teaching link.

## 5. CONCLUSION

Practice shows that "SPOC+ Flipped Classroom " is an effective way to deep learning, can combine the advantages of traditional classroom and online teaching, teachers from the traditional teaching of "leader" to "guide", a change from "passive" to "active", the transition to improve the teaching efficiency, at the same time also put forward higher requirements for teachers. First of all, teachers should carefully design the teaching links before, during and after class, and reasonably arrange the online and offline teaching content. Secondly, the new assessment and evaluation mode should be truly implemented to include students' independent learning in SPOC platform into the process assessment. Finally, the flipped teaching content should be selected reasonably, and appropriate forms of expression should be selected according to different types of knowledge points. For example, abstract knowledge can be made into animation by simulation software, which is easy for students to understand, so as to achieve twice the result with half the effort.

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