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# Research on the Application of Blended Teaching in Probability Theory and Mathematical Statistics Based on MOOC + SPOC + Flipped Classroom

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## To cite this article:

Gao Jian, Zhi Liping, Sun Jiangjie, Du Yanan, Yuan Min. Research on the Application of Blended Teaching in Probability Theory and Mathematical Statistics Based on MOOC + SPOC + Flipped Classroom. *Education Journal*. Vol. 10, No. 6, 2021, pp. 226-229.

doi: 10.11648/j.edu.20211006.13

**Received:** October 25, 2021; **Accepted:** November 18, 2021; **Published:** November 23, 2021

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**Abstract:** Based on the characteristics of probability theory and mathematical statistics, this paper analyzes the problems existing in the traditional teaching mode of this course, such as teachers being tired of teaching knowledge and students lacking interest and motivation in learning. Combining the characteristics of MOOC, SPOC and flipped classroom, this paper puts forward the blended teaching mode, in which MOOC + SPOC is the teaching resource and the flipped classroom is the teaching method, and introduces in detail the concrete implementation process of this teaching mode, the implementation process can be divided into four parts: preparation before class, internalization in class, consolidation after class, evaluation and feedback. The practice shows that the blended teaching mode of MOOC + SPOC + Flip classroom can improve the teaching quality of probability theory and mathematical statistics better than the traditional teaching mode, and train the students' ability to analyze and solve problems with the knowledge they have learned. The blended teaching mode has played an active role in promoting the realization of the goal of talent training in colleges and universities, and also provided reference for the teaching reform of other courses in colleges and universities.

**Keywords:** MOOC, SPOC, Flipped Classroom, Blended Teaching, Probability Theory and Mathematical Statistics

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## 1. Introduction

Probability theory and mathematical statistics is a mathematics subject with wide application, mainly studying random phenomena and their statistical regularity. Firstly, the knowledge and methods of probability theory and mathematical statistics are mostly used in the fields of building mathematical models or analyzing data. Secondly, this course is also the basis for subsequent study of other university courses. The knowledge and methods of probability theory and mathematical statistics have become an indispensable part for the cultivation of comprehensive quality and the improvement of personal ability of contemporary college students, which plays a very important role in promoting the realization of the goal of talent cultivation in colleges and universities [1].

Most of the theoretical knowledge of probability theory and

mathematical statistics, such as formulas and theorems, is abstract and flexible in practical application, so it is difficult for students to master its essence. At present, the resources of teachers and classrooms in most colleges and universities are very limited, so the teaching of this course mostly adopts the large-class system, and the teaching mode is mainly in the form of multimedia courseware and blackboard writing. In addition, due to the influence of factors such as less class hours and more teaching content, teachers are tired of teaching knowledge, students lack interest motivation, which ultimately leads to the teaching effect with less effort. As for the higher level of the comprehensive knowledge of practical application of capacity-building almost become empty talk. Based on the above problems, the teaching reform of the course is imperative.

## 2. Overview of MOOC, SPOC and Flipped Classroom

MOOC stands for Massive Open Online Courses. With the rapid development of Internet and modern information technologies, a large number of excellent free MOOC courses appear on various online learning platforms. In May 2014, China's Ministry of Education officially announced the launch of "Chinese University MOOC", which is a MOOC learning platform with China's own intellectual property rights. At present, the number of MOOCs in China has ranked first in the world. Compared with traditional classroom teaching, MOOCs can be completely free of time or space constraints. Students can watch the teaching video repeatedly at any time and any place according to their needs, and enjoy the teaching video of famous teachers from famous schools in China for free. MOOCs not only expand students' learning approaches and methods, but also greatly promote the reform of teaching methods and education models [2].

SPOC is the Abbreviation of Small Private Online Course, also known as "Private courses", which is mainly open to students of specific classes in school. MOOC teaching is systematic, and the whole process is online.

SPOC, as a supplement to MOOC, has the disadvantage of knowledge fragmentation and is not suitable for systematic teaching, but it can be conducted online and offline simultaneously. In order to make up for the shortage of MOOC, we can take the high-quality teaching resources of MOOC as the basis, aim at the study demand of the students in the class, make the corresponding SPOC course, really teach according to the students' aptitude and aim at the target [3]. Therefore, the combination of MOOC and SPOC is imperative in order to guarantee the teaching effect, which should consider both the systematization of teaching and the promotion of individuation [4].

Flipped classroom, also known as inverted classroom, reverses the traditional process of acquiring knowledge in class and internalizing knowledge after class into that of acquiring knowledge after class and internalizing knowledge in class. Flipped classroom changes the roles of teachers and students in traditional teaching. Students take the initiative to complete knowledge learning with the help of high-quality teaching resources on MOOC and SPOC platforms before class, instead of relying solely on teachers to acquire knowledge. The classroom is no longer a cramming classroom, but a place where teachers can answer questions, guide the interaction between teachers and students, and use what they have learned to solve problems. In recent years, more and more educators have introduced flipped classroom into teaching activities to promote teaching reform and improve teaching quality [5].

## 3. Implementation of MOOC+SPOC+ Flipped Classroom Teaching Mode

This paper adopts the blended teaching mode of MOOC +

SPOC + Flipped classroom, in which MOOC is realized by "Chinese university MOOC" platform, and SPOC is realized by new intelligent teaching tool "rain classroom" platform. Teachers can post self-recorded teaching videos and micro-videos collected from the network on the rain classroom Platform as SPOC according to teaching needs. In the teaching process of probability theory and mathematical statistics, we take MOOC+SPOC as teaching resources and flipped classroom as teaching method, divide the whole teaching process into four parts: preparation before class, internalization in class, consolidation after class, evaluation and feedback [6-9].

### 3.1. Preparation Before Class

First of all, teachers extracted the important and difficult points of the teaching content, and selectively designed some expandable basic knowledge, such as important historical figures and historical events in probability theory and mathematical statistics, as well as some difficult content with strong application, such as Bayes formula and central limit theorem, into the teaching mode of MOOC+ SPOC+ Flipped classroom.

Secondly, according to the differences of students' learning ability, teachers choose suitable MOOC teaching resources to provide students with self-study, and make SPOC videos to supplement the MOOC and publish them on the platform of rain class, at the same time design 1 ~ 2 related questions on the platform for students to answer, so as to effectively guide students to learn. Secondly, according to the differences of students' learning ability, teachers select suitable MOOC teaching resources to provide students with independent learning, make SPOC videos for the key and difficult points of the teaching content as a supplement to the MOOC and publish them on the Rain Classroom platform, and design one or two related questions for students to answer on the platform, so as to effectively guide students to learn. Finally, teachers can see the preview data of each student through the SPOC rain classroom platform and master the preview situation of students. Through the feedback of students' preview, teachers can adjust the classroom teaching design.

### 3.2. Internalization in Class

With the introduction of flipped classroom design teaching activities, teachers become classroom leaders and guide students to internalize knowledge. In order to enable students to better grasp the previewed teaching content, teachers can design and ask questions in class, for example: What is the concept of conditional probability? How do you calculate conditional probability? How to derive the total probability formula? Guide students to retell, conclude and summarize the online learning content before class, find out the important and difficult points of the teaching content, and strengthen the memory and understanding of knowledge points. Teachers can also introduce practical cases in class. For example, when teaching Bayes formula, the classic "Three-door problem" can be quoted [10]. The teacher can make three to five students to discuss and analyze the case in

a group, and then let each group elected a representative to elaborate on the results of the group discussion. The other students can complement, correct or raise questions. Finally the teacher answers the questions and summarizes the comments. This kind of teaching method enlivens the classroom atmosphere, arouses students' learning enthusiasm, enables students understand the Bayes formula more deeply, and promotes the internalization of knowledge.

**3.3. Consolidation After Class**

After class, teachers can use SPOC platform to communicate and interact with students, answer questions and help students sort out the knowledge points of teaching content. Teachers can publish homework and practice tests on the SPOC platform to help students check and fill in gaps, review and consolidate what they have learned. In addition, teachers can also supervise and guide students through the SPOC platform to monitor whether students' learning tasks are successfully completed and provide timely targeted guidance to students. Teachers can also adjust teaching content, improve teaching methods and optimize teaching design according to students' learning situation [11].

**3.4. Evaluation and Feedback**

After the application of the blended teaching mode of MOOC+SPOC+ Flipped classroom, the teaching effect needs to be evaluated. We mainly adopt the comprehensive evaluation method combining process evaluation (40%) and summative evaluation (60%). The process evaluation is mainly based on students' attendance, online learning, exercise tests and other data on MOOC and SPOC platforms, offline work and students' participation in the analysis and discussion in class, so as to give a reasonable evaluation. The summative evaluation is given over a period of study using phased or unit tests, or in the form of a closed book exam at the end of the semester [12].

In order to investigate the learning effect of students after the application of the blended teaching mode of MOOC+SPOC+ Flipped classroom in the teaching class of a certain major, the total score of another traditional teaching class of the same major with similar indicators was selected and compared with it. SPSS 24.0 software was used for T test, and  $P < 0.05$  was considered as statistically significant difference. Statistical analysis was conducted on the total evaluation results of two different classes with similar indicators, and the results were shown in Table 1.

Table 1. Comparison of results.

class	number	average	standard deviation	t	P
traditional teaching	60	81.3966	8.61850	-3.998	<0.001
blended teaching	60	87.3833	7.63154		

In order to optimize the teaching design, we also need to establish the mechanism of student feedback, teacher reflection on teaching and the mechanism of mutual criticism and discussion between students and teachers, summarize the deficiencies in the teaching process, and improve it in time, to provide guidance and reference for

the design of subsequent teaching process. At this point, a teaching cycle of the blended teaching mode of MOOC+SPOC+ Flipped classroom in probability theory and mathematical statistics ends, and the subsequent teaching cycle can be repeated and repeated. See Figure 1 for specific teaching routes [13-15].

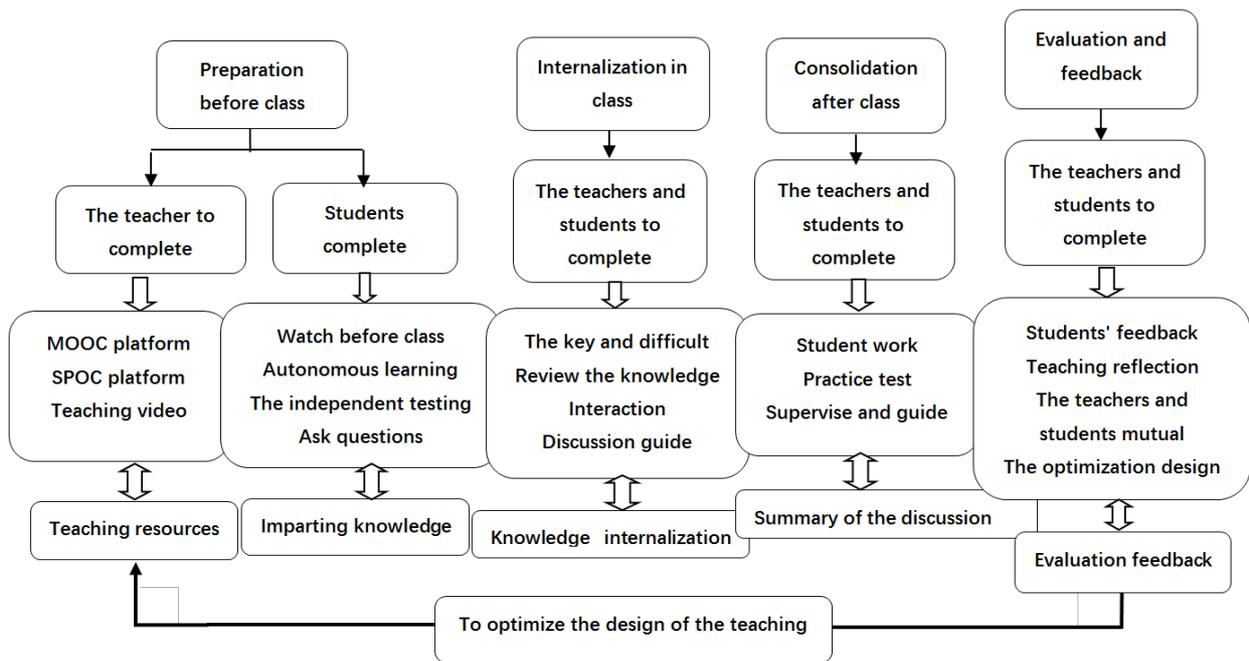


Figure 1. Teaching model roadmap of MOOC+ SPOC+ Flipped classroom.

## 4. Conclusion

The blended teaching mode of MOOC+ SPOC+ Flipped classroom, which takes MOOC + SPOC as teaching resource and flipped classroom as teaching method, is feasible and effective in the teaching of probability theory and mathematical statistics. The practice has proved that the blended teaching mode not only cultivates the students' communication and cooperation ability in the team, but also cultivates the students' ability to analyze and solve problems with the knowledge they have learned, which plays a positive role in promoting the realization of the goal of talent cultivation in colleges and universities. In addition, the application of this teaching model requires teachers to devote more time and energy to carefully design teaching links, and to supplement and build targeted SPOC teaching resources, thus to the teacher's teaching level and the improvement of teaching thinking ability also played a positive role in promoting. Of course, there are many details to be solved in the teaching process of the blended teaching mode of MOOC+SPOC+ Flipped classroom. Later, we will constantly sum up experience and lessons to improve the teaching mode and provide reference for the teaching reform of other courses in colleges and universities.

## Fund

This work was supported in part by the Quality Engineering for research projects of the Anhui Department of Education (Nos. 2018jyxm0771, 2020jyxm0865, 2017070, 2020xj015, 2020SJXSFK1341 and 2020wymax108).

## Data Availability Statement

All datasets generated for this study are included in the manuscript and/or the supplementary files.

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