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Research and Practice on Blended Learning of Probability Theory and Mathematical Statistics in the Economics and Management Disciplines

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Combined with the practice of teaching, this paper first makes a comprehensive analysis of the problems of probability theory and mathematical statistics teaching in the economics and management disciplines of Chinese universities. Then Blended Learning of probability theory and mathematical statistics is studied and put into practice to improve the teaching quality of the course.

Keywords: probability theory and mathematical statistics, Blended Learning, flipped classroom, Yu Classroom, the new era

Introduction

Xi Jinping pointed out in the report of the 19th National Congress of the Communist Party of China the idea of realizing the connotative development of higher education. The connotative development of higher education is inseparable from the improvement of mathematics teaching quality. Li (2006), chairman of the Teaching Steering Committee of Mathematics and Statistics of China's Ministry of Education, pointed out that mathematics is a science and technology, a language and culture, and a foundation and tool. In fact, mathematics is also a kind of thinking and literacy. Probability theory and mathematical statistics is a mathematical discipline to study the quantitative regularity of random phenomena, which are highly abstract and widely applicable. French mathematician Laplace thought that most of the most important problems in life are only the problems of probability in essence. Probability theory and mathematical statistics is a very important public basic course and professional compulsory course for all students majoring in economics and management. It is also a course that students generally feel more difficult at present. Through studying probability theory and mathematical statistics, students majoring in economics or management can not only acquire basic knowledge of probability and statistics, but also lay a necessary foundation for studying other specialized courses of economics and management. More importantly, it can cultivate students' abilities of data processing and analysis, logical reasoning, abstract thinking and creativity, to deal with basic problems in economic and management by combining qualitative and quantitative methods, to analyze and solve practical problems by using probability and statistics knowledge, etc.; it can also provide the necessary mathematical

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basis for follow-up course study and future work and life of students. The theory and methods of probability theory and mathematical statistics are applied in almost all fields of science and technology, industrial and agricultural production, and various sectors of national economy (Fang, Tian, & Wang, 2014). The teaching quality of probability theory and mathematical statistics will directly affect the overall development of students majoring in economics or management. How to improve the teaching quality of probability theory and mathematical statistics in the economics and management disciplines of Chinese universities is a problem that every probability and statistics teacher must pay enough attention to and seriously consider. The teaching quality of probability theory and mathematical statistics in the schools of Economics and Management of Chinese universities is not high in present. Therefore, it is important and necessary to carry out the teaching reform pertinently and find out the methods to improve the teaching quality of probability theory and mathematical statistics in the economics and management disciplines of Chinese universities.

Blended Learning refers to the combination of traditional face-to-face teaching and online teaching, which not only plays the leading role of teachers in guiding, inspiring, and monitoring the teaching process, but also reflects initiative, enthusiasm, and creativity of students as the main body of the learning process. The purpose of Blended Learning of probability theory and mathematical statistics is to fully tap the time and potential of students of learning probability theory and mathematical statistics, so that students can grasp the basic knowledge and clarify the problems in their learning according to the guidance of teachers and through self-taught teaching materials, micro-videos, and other curriculum resources before class; in class, emphasis is placed on internalizing knowledge and improving thinking ability. Under the organization of teachers, students can solve difficult problems and key ones by means of diversified activities (such as classroom demonstration, group cooperation, experiential learning, problem solving, whole class communication, teacher explanation, etc.), and understand in depth and internalize knowledge. Teachers should complete a considerable amount of online resources, including PPT, self-study content, testing, and other curriculum resources. With the rapid development of information technology, the emergence of a large number of excellent online open courses, such as National Open Video Course, National Resource Sharing Course, Massive Open Online Course, and Micro Course, has greatly promoted the deep integration of information technology and teaching. It expands students' learning ways and methods and promotes profound changes in the teaching modes and methods of probability theory and mathematical statistics course in order to meet the needs of the society in the new era for training of innovative talents (Fang, Wang, & Wu, 2018). In the traditional teaching of probability theory and mathematical statistics, students' participation was not high, and autonomous learning ability, language expression ability, and innovative ability of students could not be effectively trained, resulting in students' poor understanding of knowledge and easy forgetting what they have learned. In recent years, many universities in China have relied on various teaching platforms to carry out Blended Learning online and offline combined and complementary in and out of class to explore methods to solve these problems, but mostly for small classes with less than 50 students, and have used the way that students watch teaching micro-video for preview in the pre-class, flip classroom in class, review and feedback on the teaching platform after class (Zhao & Li, 2015; Su, Zhao, Ye, & Zhang, 2015; Yang, He, & Peng, 2017; Liu, Liu, & Li, 2017; Chen & Huang, 2018). There are few studies (such as Fang et al., 2018) on Blended Learning of probability theory and mathematical statistics for the classes with more than 50 students. For a long time, the teachers of mathematics feel that it is difficult to improve the teaching quality of probability theory and mathematical statistics in the economics and management disciplines of Chinese universities. Therefore, the research and practice of scholars on Blended

Learning of probability theory and mathematical statistics in classes with more than 50 students is far from enough.

Flipped classroom refers to engaging students in gaining basic knowledge before class, and providing more activities, such as doing exercises or interacting with peers and the teacher in class (Pierce & Fox, 2012). Bergmann and Sams (2014) further defined flipped learning by emphasizing the importance of designing in-class learning activities to engage students in higher order thinking. Bergmann and Sams (2015) thought that the flipped learning allows teachers to implement multiple learning strategies in their classroom, and creates a dynamic and interactive learning environment for students to apply knowledge and engage in project-based learning or inquiry learning. Direct instruction in the flipped classroom or flipped learning is done through video, or some other digital learning object, which students can individually use before they come to class. This time shift allows the teacher to use class time for work that is either better done as a large group or requires individualised attention by the teacher (Bergmann & Sams, 2015; Hwang & Lai, 2017). The concept of the flipped classroom or flipped learning has been applied to many courses in recent years (Mason, Shuman, & Cook, 2013; Slomanson, 2014; Teo, Tan, Yan, Teo, & Yeo, 2014). Providing teachers with those principles (i.e., guidelines and strategies) is particularly important given the lack of instructional experiences of Chinese teachers of probability theory and mathematical statistics in implementing a flipped classroom model in their classroom practices.

The author was supported to study in France by the National Plan for the Construction of High-Level Universities for Public Overseas Students in 2008. During his study abroad, he has carefully studied the measures taken by developed countries in Europe and America to improve the teaching quality of probability theory and mathematical statistics. After working in Beijing International Studies University in 2012, he has also been paying close attention to the problems in probability theory and mathematical statistics teaching in the schools of Economics and Management of Beijing International Studies University and seriously thinking about how to improve the teaching quality of probability theory and mathematical statistics; in the seven-year teaching practice in the schools of Economics and Management of Beijing International Studies University, the author has constantly tried and applied the methods and experience he has learned. The students' feedback is good. In order to improve the quality of classroom teaching and personnel training, the teaching reform of Blended Learning has been vigorously promoted in Beijing International Studies University. Taking this as an opportunity, considering the current situation in China and the reality of Beijing International Studies University, and combining with the experience of teaching probability theory and mathematical statistics in the schools of Economics and Management of Beijing International Studies University for seven years and 300 students in each semester, this paper first makes a comprehensive analysis of the problems of probability theory and mathematical statistics teaching in the economics and management disciplines of Chinese universities, then Blended Learning of probability theory and mathematical statistics is studied and put into practice.

The Problems of Probability Theory and Mathematical Statistics Teaching in the Economics and Management Disciplines of Chinese Universities

Because the research objects of probability theory and mathematical statistics are random phenomena, and the research methods are mainly the ones of probability and statistics and analysis ones, students find it difficult to understand concepts, master methods, and do exercises in this course.

The View of Talents Is Not New Enough

The view of talents in the new era is that "talents are diversified and everyone can become a talent". According to the new view of talents, probability theory and mathematical statistics course should emphasize its popularity and applicability, fully satisfy the diversified learning modes, have a diversified evaluation system, and introduce modern educational technology.

The Syllabus Is Too General

At present, the syllabus of probability theory and mathematical statistics in most Chinese universities is highly generalized and condensed, and its content is general and broad, mainly aiming at examinations.

The teaching content pays too much attention to theory and neglects practical applications, so it is difficult to cultivate students' ability to solve practical problems with the ideas and methods of probability theory and mathematical statistics.

The Teaching Methods Are Monotonous and the Teaching Means Are Obsolete

Teaching methods of most teachers of probability theory and mathematical statistics in the schools of Economics and Management of Chinese universities are still relatively traditional. Most teachers of probability theory and mathematical statistics in the schools of Economics and Management of Chinese universities are accustomed to using the old teaching modes and means.

Preparatory Knowledge Is Not Well Mastered

Probability theory and mathematical statistics is the follow-up course based on calculus and linear algebra. Differential and integral methods, partial differential, double integral and infinite series in calculus, and vector space and vectors in linear algebra are all necessary knowledge for learning probability theory and mathematical statistics. But students do not have a good grasp of these preparatory knowledge.

The above problems lead to the lower quality of probability theory and mathematical statistics teaching in the economics and management disciplines of Chinese universities. In the long run, it is bound to affect the students' study of follow-up relevant professional courses, and then affect the development of students in the future.

Blended Learning of Probability Theory and Mathematical Statistics

We use self-built probability theory and mathematical statistics resources as teaching content, school online platform (https://bisu.xuetangx.com) as teaching environment, Blended Learning as teaching mode, flipped classroom as main teaching method, and effectively combine self-built teaching resources with school online courses. In view of probability theory and mathematical statistics course for about 60 students, we rely on school online platform and self-built teaching resources, focus on the guiding scheme, and give priority to students' self-study online and classroom teaching offline. According to teaching content, classroom teaching adopts the methods of flipped classroom, extracting the essence of knowledge, exploring typical problems, discussing hot issues, etc., and the means of practicing instead of speaking, concise speaking and more practicing, answering questions, etc.

In Blended Learning of probability theory and mathematical statistics, we strive to realize the interaction between online learning and face-to-face classroom teaching to achieve the optimal teaching effect. In the online learning link before class, we design online learning activities and select learning resources based on the analysis of teaching objectives, objects and contents of probability theory and mathematical statistics.

According to the task we assigned, the students initially completed the learning and understanding of the designated knowledge points through school online platform. In this process, students will record and present the problems encountered in learning, and we will also answer and guide online. In the face-to-face classroom teaching link in class, knowledge internalization and learning exchange are the main content. In the classroom, students can report to us their understanding of knowledge, homework, and other learning results, as well as the problems encountered in learning. We should answer questions, discuss and deepen questions in class, give feedback on learning evaluation, and emphasize the key points or difficulties of teaching appropriately. In order to consolidate and strengthen learning, we will assign some extra-curricular learning tasks.

In practice, we adopt Blended Learning in probability theory and mathematical statistics teaching according to three steps: pre-class design, classroom practice, and after-class summary.

Pre-class design mainly includes making teaching resources, creating courses, and pushing learning resources. Before class, we first prepare the teaching resources needed for the class. Then we open the "My Course" interface by paying attention to the Wechat Public Number in Yu Classroom, create the course and class named "Probability Theory and Mathematical Statistics" according to the operation procedure displayed on the interface, and guide students to join the class. Finally, we push learning resources to the student side by using plug-in of Yu Classroom in PPT so that students can preview. The preview learning resources include text, PPT, and so on. We can view students' preview feedback in real time on the mobile phone and optimize the course design accordingly.

In class, we first open PPT and Yu Classroom, while students scan the classroom's two-dimensional code by using Wechat to enter the classroom, and then start the class. At this time, our mobile phones can control the teaching resources made; students' mobile phones will receive synchronous teaching content. According to the students' learning situation, we can explain in detail where they have doubts and guide them to discuss. We can also carry out probability theory and mathematical statistics teaching according to the students' real-time feedback. We can also push pre-prepared test questions to students' mobile phones to test what they have learned, and give individual guidance according to the test results.

After class, we need to summarize the students' learning situation. We can make timely adjustments to the curriculum plan through the statistical analysis table of students' learning data generated in Yu Classroom, and push some homework and learning resources in a targeted way. Students can selectively study according to their actual situation and interests. We can also make statistics on the attendance of students according to the module "teaching design and memorandum" in Yu Classroom, such as their absence and truancy (Zhang, Wang, & Pu, 2019).

Results

Under the new view of talents, through the research and practice of Blended Learning, we can solve the problems in probability theory and mathematical statistics teaching in the economics and management disciplines of Chinese universities, and improve the teaching quality of probability theory and mathematical statistics.

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