



Application of Online and offline mixed teaching mode in Probability Theory and Mathematical statistics course

Rui Chen^{a,1}, Liang Fang^{a,*}, Wenchao Chen^b, Manli Zhang^a

^a College of Mathematics and Statistics, Taishan University, Tai'an, China

^b Shandong Institute of Highway Technician, Jinan, China

¹Email:chenruimengting@163.com

*Email:fangliang3@163.com

Abstract—Probability theory and mathematical statistics are important basic courses of science and engineering colleges. In view of the drawbacks of traditional teaching, combined with modern educational technology, this paper puts forward the reform of online and offline mixed teaching mode. Practice has proved that the new teaching mode can well make up for the deficiency of traditional teaching, mobilize the enthusiasm of students, broaden the scope of students' knowledge, improve the ability of students to analyze and solve problems.

Index Terms—Probability theory and mathematical statistics; Mixed teaching; Online classes; Teaching mode; Reform of curriculum.

I. INTRODUCTION

The concept of mixed teaching was put forward by Smith J. and Eilert Macie by combining the traditional learning concept with the pure technical learning concept [1], which came into being with the continuous accumulation of teaching experience and the gradual reform of teaching methods in the information age. It organically combines traditional face-to-face teaching with online learning to form a teaching model that integrates independent learning and professor learning [2]. This combination of online and offline teaching enables students to not only participate in face-to-face classroom learning, but also make use of abundant online teaching resources for independent learning to achieve personalized learning goals [3]. The online part and the offline part of mixed teaching are a unified teaching whole. Both the online autonomous learning of students and the offline face-to-face question-and-answer of teachers are part of the whole teaching process, and both are indispensable.

Probability theory and mathematical statistics is a mathematical discipline which studies the statistical regularity of random phenomena in the objective world. As an important basic mathematics course in universities, it is characterized by many contents, theories, difficulties and formulas. In the past, due to the limited teaching

conditions, the courses of probability theory and

mathematical statistics were mostly taught in offline traditional classes, with problems such as fewer class hours, fewer methods, fewer tools and fewer interactions [4]. The teaching methods are outdated, the teaching model is backward and the assessment method is single, which limits the teaching of teachers and students to a certain extent, and the teaching objectives cannot be effectively realized. In order to solve these teaching quandary and give full play to the function of modern information technology in the field of education, the mixed teaching mode based on Internet + comes into being. In recent years, Chinese colleges and universities have carried on exploration and practice, and gained rich teaching results. Aiming at the main problems in the actual teaching process of probability theory and mathematical statistics, Wang Fen et al. carried out an in-depth study from the aspects of teaching means, teaching content, interactive process and assessment methods based on blended teaching, and put forward specific reform measures [6]. Xiaofeng Han systematically studied the intelligent teaching model of college mathematics based on the concept of intelligent education, the definition of intelligent classroom, the characteristics of intelligent teaching of college mathematics, the problems existing in traditional mathematics teaching, the comparison and analysis between traditional mathematics classroom and intelligent classroom, and the reform of intelligent teaching of college mathematics [7]. However, some mixed teaching practices based on the "Internet +" are manifested in the form of simply using and splicing or directly using digital teaching tools such as online classes to teach traditional classes [8]. However, the real innovation and reform is not simply to abandon or apply a certain teaching mode and method, but to make use of modern information



technology to the comprehensive and collaborative application of diversified teaching and multi-modal learning.

II. ONLINE AND OFFLINE MIXED TEACHING IMPLEMENTATION PROCESS

A. Mixed online and offline teaching process design

The combination of online and offline is a mixed teaching and learning activity that promotes the joint participation of teachers and students to realize online learning and offline traditional classroom learning [9]. The effective combination, mutual blending and organic integration of online and offline teaching forms can, on the one hand, break through the time and space restrictions of teaching and learning and enrich the teaching forms and contents; On the other hand, it can change the problems caused by excessive teaching in traditional classroom teaching, such as students' low learning initiative, insufficient cognitive participation, and large difference in students' learning effect.

Blended teaching emphasizes the application of appropriate technology at the right time to achieve the best teaching objectives, which coincides with the thought and purpose of educational objective taxonomy by American educational psychologist Bloom. Under the guidance of Bloom's educational objective classification theory [10], according to the course characteristics of "Probability Theory and Mathematical Statistics" and based on modern information technology, the teaching process of "mixed online and offline" is designed: online pre-class preparation stage, offline in-class teaching stage, online + offline after-class strengthening stage, online + offline evaluation stage. Teachers can achieve "student-centered" high-quality teaching effectiveness with high order and challenge through "teaching preparation → teaching implementation → teaching reflection → teaching evaluation" and students can achieve "student-centered" high-quality teaching effectiveness with high order and challenge through "preview → learning → practice → feedback".

B. Mixed online and offline teaching process content

a. Pre-class stage

At this stage, online teaching is adopted to arouse students' learning initiative and enthusiasm. First, the teacher will make a list of preview tasks according to the teaching content and push it to the students through the online class. The content of the push can be repeated learning knowledge points or watching teaching videos during the course of learning. After the preview, students should complete the corresponding exercises to test the preview effect. If students have questions they don't understand during online learning, they can check various teaching resources and carry out inquiry-based learning by themselves. They can also ask questions and exchange in the discussion board of the Rain Class or the MOOC discussion board of China University. Teachers can also participate in the discussion to answer questions and solve doubts. Learning and communication between teachers and students on an open platform can improve students' enthusiasm for learning. Teachers check the online teaching

platform through the online class or the background MOOC of Chinese university to know the learning situation of students, optimize and adjust the teaching content according to the learning effect of students, so as to improve the teaching effect.

b. Mid-class stage

The mid-class stage is the offline teaching part, which is the process of students' face-to-face theoretical learning with teachers in the classroom. In this process, the teacher sets relevant test questions according to the students' online preview content, and conducts class test in the form of live PPT in class. The students submit the answers in time within the stipulated class time, and the teacher analyzes and answers the students' existing problems. At this stage, various teaching methods such as teaching method, question-driven method and group collaborative inquiry method are used to analyze the key and difficult points of the course content and students' difficult problems in detail. At the same time, teachers can also show excellent cases of students' analysis of problems in the online discussion section through PPT to lead students, improve students' learning enthusiasm and participation, and optimize the teaching effect. Therefore, it is recommended to set some practical problems related to the teaching content and of interest to students to participate in the discussion. For example, when teaching small probability events, the questions can be pushed so that students can use what they have learned to analyze the effectiveness of joint prevention and control measures taken by the country under the current COVID-19 epidemic and express their views, so that students can learn to put what they have learned into practice. After learning the concepts of mathematical expectation and variance, students can be sent homework to analyze the application of this knowledge in insurance, investment and financial management with examples, and learn to use the knowledge to analyze practical problems closely related to us in life. At the same time, it can also carry out ideology and politics in the teaching of probability theory and mathematical statistics. For example, when learning normal distribution, it can push "Why normal distribution is also called" Gaussian "distribution" before class, so that students can understand the growth process of Gaussian and its contribution to mathematics, and prepare to speak in class, and inspire students with inspirational stories of mathematicians. When teaching the content of statistics, one interesting application of statistical knowledge can be emphasized, that is, it can help the analysis of literary works. Students can refer to the materials by themselves to illustrate the author of A Dream of Red Mansions for example, and give their own reading methods in class, so that students can understand how to think and analyze problems in a dialectical way, etc. These tasks related to the teaching content but easy to complete can be pushed to students before or after class, so that students can preview and review with questions and bring their learning results back to class for discussion, which can greatly mobilize the enthusiasm of students in learning. It can also combine the online direct broadcast function of the rain class to record the classroom content in real time, so that students can review the study and review after class.



c. After-class stage

This stage is mainly conducted online. Teachers can post assignments in the rain class or MOOC of Chinese universities after the end of the class and ask students to complete the assignments within the specified time. The "New Test Paper" function of the rain class can set objective questions, including multiple choice questions, fill-in-the-blank questions, voting questions and other questions. Students can see the answers immediately after completing the objective questions and check the corresponding scores. If students make mistakes, they can go back to the teaching video to understand, or consult their classmates and teachers through the communication group. In addition, the homework section can also set subjective questions. The teacher will correct the subjective questions after the students submit their answers. Teachers can log in the web version of Rain Class and log in by scanning the code of we chat to correct the homework of corresponding classes, which is convenient and fast. Through students' online work, teachers can timely understand students' mastery of relevant knowledge, conduct hierarchical online tracking and guidance for students, remind and guide students with poor performance, and suggest or require them to watch designated MOOC videos and review the knowledge points broadcast directly in class. [11] discussed that according to the observations in this paper, an existing mathematical model of banking capital dynamics should be tweaked. First-order ordinary differential equations with a "predator-pray" structure make up the model, and the indicators are competitive. Numerical realisations of the model are required to account for three distinct sets of initial parameter values. It is demonstrated that a wide range of banking capital dynamics can be produced by altering the starting parameters. One of the three options is selected, and the other two are eliminated. The model is generalized taking into account fractional derivatives of the bank indicators for time, reflecting the rate of their change. Based on numerical calculations, it is established that reduction of the order of derivatives from units leads to a delay of banking capital dynamics. It is shown, that the less the order of derivatives from the unit, the more delay of dynamics of indicators. In all analyzed variants indicators at large times reach their equilibrium values. [12] examined the development and refinement of possible mathematical models for the intellectual system of career guidance. Mathematical modeling of knowledge expression in the career guidance system, Combined method of eliminating uncertainties, Chris-Naylor method in the expert information system of career guidance, Shortliff and Buchanan model in the expert information system of career guidance and Dempster-Schafer in the expert information system of career guidance method has been studied. The algorithms of the above methods have been developed. The set of hypotheses in the expert system is the basic structure of the system that determines the set of possible decisions of the expert system. This set, which is crucial in decision-making, should be sufficiently complete to describe all the possible consequences of situations that arise in the subject area.

Therefore, it is important to improve the mathematical models of the intellectual system of career guidance.

C. Online and offline mixed teaching curriculum assessment system

In traditional teaching, students' final examination results are usually based on the paper examination results, which are counted by means of "50% of the paper results + 50% of the regular scores" or "70% of the paper results + 30% of the regular scores". Usual results mainly include attendance, homework completion, class performance, etc. After adopting the mixed teaching model of online and offline, students' grades are composed of both online and offline parts, so the calculation method of grades is changed to "50% of online grades + 50% of offline grades". Among them, the online performance distribution was: watching videos accounted for 15%; Online work accounts for 25%, mainly including completing unit tests and unit work assigned by MOOCs (10%), participating in online discussion at least 2 times (5%), and submitting homework in class (10%); The final exam of the online course counts for 10%. All online learning parts support data export, the process is clear and complete. Offline results include final exam results as well as regular class attendance and classroom interaction. The new curriculum assessment system increases the process assessment index, pays attention to the examination of students' usual learning, effectively avoids the final examination of the final decision, can reflect the situation of students' learning more objectively. Through the teaching practice of one semester, the author found that compared with the traditional offline teaching mode, the passing rate of students in the final exam increased by about 10%, which indicates that the mixed teaching mode of online and offline is worth advocating in the new era.

III. CONCLUSION

To comprehensively promote high-quality education and teaching, we need to change "teaching" and "learning", and promote the shift from "teacher-centered teaching" to "student-centered learning". There are various forms of teaching mixed online and offline. Under the theme of high-quality development of education, the author puts forward the mixed online and offline wisdom teaching of "Probability Theory and Mathematical Statistics" course: preparation, teaching, thinking, evaluation, preparation, learning, practice and feedback. To be specific, modern information technology should be effectively used to integrate innovative education and teaching theories, methods, techniques and evaluation into the teaching process, so as to improve the quality of education and teaching and effectively promote the practice of teaching reform.

With the continuous development of network technology and new media, education information has become a new trend in the era of "Internet +". Under the general background of advocating information sharing and actively optimizing teaching resources, the mixed teaching model of online and offline will become a new teaching model and will continue to develop. How to reasonably carry out mixed teaching design according to the capacity of the curriculum, optimize the teaching resources, better reduce the burden of offline

classroom, activate more education energy, this is worth thinking of every educator. The author will also continue to revise and improve the mixed teaching mode of online and offline in the future teaching practice, and provide reference for other courses.

IV. ACKNOWLEDGMENT

The work is supported by 2021 Tai'an City Science and Technology Innovation Development Project (Policy Guidance): Application of Mathematical Statistical Model in tourism Development Planning (Project No. 2021ZC486), Horizontal project of Taishan University: Study on Mathematical Modeling of Construction Project Cost Optimization (2022HX-016) and Study on the Application of Small Probability Principle in the acceptance of construction Project (2020LHX057).

REFERENCES

- [1] X.Y.Shi. An Analysis on the Role Orientation of College English Teachers in Blended Teaching Model. Journal of Jilin Engineering and Technology Teachers University, 2019 (1) : 25-27.
- [2] Z.M.Ji, X.H.Zhang, X.X. Zhang, et al. The Role of Blended Teaching in Higher Education: A Case Study of Teaching System Design. Computer Knowledge and Technology, 2017 (10) : 95-96.
- [3] Y.Y. LIU. Design and Application of Internet + Background Offline Teaching Platform. Think Tank Time, 2018 (51) : 277-278.
- [4] W. Liu. Teaching Design and Practice of Linear Algebra under Vivid Teaching Model. Journal of Anqing Normal University (Natural Science), 2015, 21(3): 110-113.
- [5] L.Xi. Online teaching courses and off-line hybrid teaching model research - in probability theory and mathematical statistics course, for example. Journal of Qinghai normal university (natural science edition), 2020, 36 (1) : 83-87.
- [6] F.Wang, S.Y.Zhang, X.Y.Wu. Reform and Practice of Probability Theory and Mathematical Statistics under Blended Teaching Model. Journal of Higher Education, 2020(28): 86-88.
- [7] X.F.Han. Research on Intelligent Teaching Model of College Mathematics. China Journal of Multimedia and Network Teaching (Sunday), 2021(2): 7-9.
- [8] K.N.Wu, X.C.Wang, L.M.Wang. Thinking about the teaching mode of College Mathematics courses: the form of "rain class". College Mathematics, 2021, 37(1): 27-32
- [9] G.Y.Ning. Blended Teaching Model Reform of Probability Statistics Course Based on Rain Classroom: A Case study of Lushan College of Guangxi University of Science and Technology. College Education, 2020 (3) : 89-91.
- [10] W.Liui, X.Y.Mo,S.Y.Yin. Online and Offline Hybrid Wisdom Teaching of "Probability Theory and Mathematical Statistics" [J]. Journal of Anqing Normal University (Natural Science Edition),202,28(02):90-94.
- [11] Christo Ananth, N. Arabov, D. Nasimov, H. Khuzhayorov, T. AnanthKumar, "Modelling of Commercial Banks Capitals Competition Dynamics", International Journal of Early Childhood Special Education, Volume 14, Issue 05, 2022,pp. 4124-4132.
- [12] Christo Ananth, A.R. Akhatov, D.R. Mardonov, F.M. Nazarov, T. AnanthKumar, "Possible Models and Algorithms for the Intellectual System of Professional Direction", International Journal of Early Childhood Special Education, Volume 14, Issue 05, 2022,pp. 4133-4145.



Rui Chen is a lecturer at Taishan University. She obtained her master's degree from Shandong University in December, 2009. Her research interests are in the areas of application of probability theory, and applied statistics in recent years. email id: chenruimengting@163.com



Liang Fang was born in December 1970 in Feixian County, Linyi City, Shandong province, China. He is a professor at Taishan University. He obtained his PhD from Shanghai Jiaotong University in June, 2010. His research interests are in the areas of cone optimizations, numerical analysis, and complementarity problems.



Wenchao Chen is a teacher at Shandong Institute of Highway Technician. She obtained her master's degree from Russian Pacific National University. Her research interests are in the areas of international management.



Zhang Manli, a teacher of Taishan University, graduated from the Department of mathematics of Sun Yat-Sen University in June 2013, majoring in statistical science and applied statistical science, obtained a master's degree, and is committed to basic statistical science and mathematics teaching research.