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Innovative Microlecture Classroom Teaching Mode under Informatization

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***Abstract* – In order to reform the traditional holistic flooding classroom teaching of Probability Theory, through transforming some concepts, focuses, difficulties, practical applications, and chapter summary and review into microlectures, this paper introduces microlecture teaching under informatization into the classroom. It innovatively explores the microlecture classroom teaching mode, provides preliminary feasible experiences and matters needing attention, allocates microlecture resources outside of class, takes students as the center, effectively stimulates students' classroom learning interest, improves classroom teaching quality, improves students' independent learning efficiency after class, realizes normalized "offline+online" microlecture teaching under informatization, and achieves good teaching results.**

***Keywords* – Microlecture, Informatization, Teaching Reform, Independent Learning, Online Learning.**

I. INTRODUCTION

Microlecture refers to a short and complete online video course designed and developed around a single knowledge point (key, difficult, doubtful, etc.) or teaching process, mainly based on short and interesting micro videos, presented in the form of streaming media. It is an important exploration of educational informatization and meets the teaching needs of the new era. The duration of microlecture videos is generally 3-8 minutes. Microlecture, as a new type of teaching resource, has the characteristics of strong targeting, clear goals, and short time. Therefore, they have played a positive role in the teaching of highly abstract and difficult university mathematics courses, including the teaching of university mathematics professional courses and public courses [1].

Probability theory is a branch of mathematics that studies random phenomena and their regularities. With the development and application of big data, artificial intelligence, data mining, and machine learning theories, this course is increasingly valued by teachers and students. It is a compulsory course for students majoring in science, engineering, and economic management in higher education institutions, as well as one of the mathematics courses for undergraduate students taking postgraduate entrance exams. The main purpose of studying this course is to master the basic concepts, theories, and methods of probability theory, and to lay a solid foundation for subsequent professional courses such as mathematical statistics, regression analysis, mathematical economics, data mining, and machine learning. However, due to its research object being random phenomena, the concepts and methods involved in the course are unique and rich in content. The learning and thinking of the course knowledge is different from traditional mathematical disciplines, and some concepts and theoretical results are difficult to understand. Some students even have mastered theoretical calculations, but their understanding of the laws of probability and statistics is not thorough enough. On the other hand, in terms of classroom teaching methods, traditional teaching mainly focuses on definitions, formulas, and theorems, and pays more attention to explaining the mathematical principles of course knowledge, neglecting the introduction of abstract concepts, simulation experiment demonstrations of theoretical knowledge points, and intuitive

display (visualization) of statistical laws. To a large extent, it causes students to have a fear of difficulties, low initiative and interest in learning, and unsatisfactory teaching results [2].

In recent years, with the widespread experimentation and popularity of Mooc, Microlecture, Flipped Classroom, and other technologies worldwide, the education field has shown unprecedented innovation and development trends, and the education mode has undergone profound changes. In the context of the big data era, there is a higher demand for talent and more skills need to be mastered. Probability and statistics methods and techniques are crucial in application skills. If the foundation of probability and statistics is not solid, no matter what industry you are engaged in the future, you will inevitably be negatively affected. So, the urgent task now is to effectively improve the teaching quality of this course, so that students can better grasp the content they have learned and apply existing theories in practice. Improving the existing teaching mode is an urgent task to achieve this goal. Therefore, it is a bold and beneficial attempt for us to carry out microlecture teaching of Probability Theory.

II. Empirical Approach

A. *Effectively Break Down Some Classroom Teaching Content and Make Microlecture*

From the knowledge points of the entire chapter and section, extract several teaching contents, especially the key and difficult points, from the long and broad PPT content in traditional teaching, and create micro videos to help students learn and master. How to effectively break down knowledge points and design microlectures requires continuous improvement from the teaching staff. Teachers should record a microlecture short video of about 5-10 minutes in advance, and then publish the teaching content of the microlecture video through WeChat platform, QQ group, or other informationized teaching platforms. Students can watch preview anytime and anywhere before class, browse and review after class, and arrange and control their learning time and progress on their own [3]. It is not recommended to have a proof process or too many mathematical formulas in the preview video. Instead, it should focus on the development history and examples of the content being taught. This way, students can concentrate on learning, actively think, conduct in-depth research, and discuss problems with the teacher in the classroom. Through classroom teaching, students have learned that real-life problems can be solved using the methods of Probability Theory, which has increased their interest in learning this course. In the post class review video, the teacher can provide some reference materials or solutions to difficult exercises, and students can freely arrange time for independent learning outside of class. This adopts a blended teaching approach of pre class, in class, and post class, allowing students to truly participate in teaching, learn independently, repeatedly think, practice, and analyze, gradually build and improve their knowledge system, and discuss and exchange difficult problems in the classroom. This teaching model can compensate for problems that traditional teaching models cannot solve, such as insufficient class hours, single teaching methods, and large class sizes [4].

For example, Probability Theory originated from the famous gambling problem and gradually enriched its theory through the exploration and research of Huygens, Laplace, Gauss and so on. Before teaching, record some scientist introductions or problem origins related to the teaching content, and create a microlecture video of about 5 minutes. This not only enriches students' knowledge of probability and statistical history, but also stimulates their interest in learning.

There are many similar examples in Probability Theory, such as the introduction of Kolmogorov's axiomatic definition of probability, the origin of Bayesian formula, the past and present of normal distribution, the emergence of t distribution, and so on. I have made it into a microlecture video of about 5 minutes, and these fragmented content can be "microlecture", which can be played and watched directly in the classroom and also convenient for students to browse outside of class. This microlecture teaching method enriches classroom content and teaching methods, enhances learning interest, and actively guides students to use network devices such as mobile phones to assist in learning outside of class [5].

B. *Select Typical Teaching Cases that Combine Theory with Practice, Adopt Exploratory Teaching Method, and "Microlecture" the Cases*

The teaching process of university mathematics has a strong exploratory nature. It not only imparts knowledge, but also shoulders the task of discovering the unknown and cultivating students' ability to explore new knowledge. In the teaching of professional courses, specific methods and means of scientific research, as well as the forefront and development trends of scientific development related to the teaching content, are introduced in combination with the teaching content. Carefully designed exploratory cases are used for students to practice and experience scientific research, which is practical and feasible. The specific operation process of case teaching is: (1) presenting cases, setting questions and stimulating interest; (2) Actively guide and boldly discuss; (3) Timely explanation, summary and induction; (4) Connect with reality and practice case studies. The entire process of a case teaching can be made into a 10 minute micro video for students to use online [6].

Below, I will introduce a typical teaching case in Probability Theory on how to use exploratory case teaching to play a leading role in scientific research and promote classroom teaching reform. The problem of grouping tests for blood:

To investigate a certain disease in a population of N individuals, it is necessary to test the blood of N individuals. If each person's blood is tested separately, a total of N tests are required. Now group k people into groups, mix the blood samples of k people in the same group and test them. If they are negative, one test is sufficient; If positive, each person will be tested again to determine. Q: Can this method reduce the workload of tests?

Solution: Assuming that the probability of each person having a positive result is p, the probability of having a negative result is $q = 1-p$. At this point, the probability of a group of mixed blood of individuals having a negative result is q^k, and the probability of having a positive result is $1-q^k$. Now let X be the number of tests required for each individual in a mixed test of k individuals, and the distribution of X is listed as follows:

$$\begin{pmatrix} \frac{1}{k} & 1+\frac{1}{k} \\ q^k & 1-q^k \end{pmatrix} \tag{1}$$

Thus, the average number of tests required for each individual can be obtained as

$$E(X) = a_1 p_1 + a_2 p_2 = \frac{1}{k} q^k + (1+\frac{1}{k})(1-q^k) = 1-q^k + \frac{1}{k} \tag{2}$$

And according to the old method, each person should be tested once, so when

$$1-q^k+\frac{1}{k}<1 \quad (3)$$

The grouping test method can reduce the number of tests. If q is known, the most suitable integer k_0 can also be selected to minimize the average number of tests. The magnitude of reducing workload is related to both p and k.

For example, when $p = 0.1$, to different k, the values of $E(X)$ are shown in the table below.

Table 1. To different k, the values of $E(X)$.

k	**2**	**3**	**4**	**5**	**8**	**10**	**30**	**33**	**34**
$E(X)$	0.690	0.604	0.594	0.610	0.695	0.751	0.991	0.9994	1.0016

From the table 1, it can be seen when $k \geq 34$, the average number of blood tests exceeded 1, which was greater than the workload of individual tests; when $k \leq 33$, the average number of blood tests was reduced to varying degrees, especially when $k = 4,$, the average number of blood tests was the lowest, and the workload of blood tests could be reduced by 40%.

We can also calculate the optimal grouping number for different incidence rate p, as shown in the table 2.

Table 2. The optimal grouping number.

p	**0.14**	**0.10**	**0.08**	**0.06**	**0.04**	**0.02**	**0.01**	**0.005**
k	3	4	4	5	6	8	11	15
$E(X)$	0.697	0.594	0.534	0.466	0.384	0.274	0.196	0.139

It can be seen from the table above that the smaller the incidence rate p, the greater the benefit of grouping test. For example, at $p = 0.01$, if 11 people were taken as a group for blood testing, the workload of blood testing could be reduced by 80%.

Frontier Exploration:

We focus on mobilizing students' subjective initiative and enthusiasm for exploratory learning in the classroom. Through topic discussions and other means, enhance students' ability to analyze and solve problems, and innovate accordingly. Here, we encourage students to actively think and explore the issue of secondary grouping testing of blood.

We adopt exploratory microlecture case teaching, integrate theory with practice, and promote classroom teaching reform. Our practice has shown that the close combination of professional course theory and practical cases is both vivid and intuitive, which is very conducive to the cultivation of applied talents and innovative thinking abilities, and has achieved good classroom teaching results.

C. *Make the Review of Each Chapter into a Microlecture*

After learning the content of each chapter, teachers can summarize what they have learned, sort out the links between knowledge points, mark the key points and difficulties, and explain the links between the contents of this chapter and the contents of the preceding and following chapters in concise language, and make a microlecture. Typical examples and more difficult exercises are given to solve the problem process and ideas,

students voluntarily watch, strengthen the understanding of knowledge points in class and exercise supplement. In the past, the majority of teachers have strongly reflected the phenomenon of students addicted to mobile phones and other network devices, I think that it is better to dredge than block. In particular, it is suggested that the review and summary of each chapter and the explanation of some typical exercises should be "microlecture", and actively guide students to make reasonable use of microlecture resources after class, so as to change the bad situation of students being stuck in the classroom and having nothing to do after class, which can be an effective supplement to classroom teaching.

D. *Strengthen Practical Teaching and Software Application, and Run Random Simulation through Classroom Teaching*

I mainly used R software to apply stochastic simulation technology to the classroom teaching of Probability Theory to achieve experimental classroom practice teaching on the probability of random events, common probability distribution, numerical characteristics of random variables, law of large numbers, central limit theorem and other key and difficult contents, so as to realize "thinking" is "seeing", so that students can deeply understand the course concepts, principles and conclusions. And the emphasis of teaching is shifted to the cultivation of students' ability and consciousness to solve practical problems by using probabilistic methods. Through R software random simulation programming, we can deeply understand the knowledge points, which greatly stimulates students' interest in learning, which is not only an effective realization of improving students' programming ability, but also a beneficial attempt to adapt to the development needs of the big data era.

The specific practice is to use R software random simulation to carry out confirmative experiments after teaching the theoretical content in class, send R language random simulation code to students, and package the program code into an executable file.exe graphic tool (microlecture resources) to facilitate students to self-experiment after class. I deepened my understanding of the class content, and the successful operation of the program also enhanced my confidence and sense of success in learning this course.

III. Matters Needing Attention

A. *The Teaching Content of Microlecture Should not be too Much, and the Teaching Time Should not be Too Long.*

First of all, I do not advocate that all the teaching content should be "microlecture" in the classroom, especially the science and engineering courses such as Probability Theory, which are highly mathematical and logical. My suggestion is to introduce some concepts, teaching focus, teaching difficulties, practical application and chapter review and summary in the classroom teaching "microlecture", while the main teaching content, including theoretical derivation and mathematical calculation, is still inseparable from the traditional teaching mode. Therefore, microlecture classroom teaching requires the teacher to effectively split the teaching content, select some specific and reasonable content "microlecture", it is suggested that a micro-video is a short but complete "course fragment". For example, the content of the big section of "distribution of random variable functions" is relatively difficult for most students, so it can be divided into: "distribution of discrete random variable functions", "distribution of continuous random variable functions", "distribution of maximum (minimum) values" and other microlectures, students will learn more easily. Secondly, the teaching time should be short. It is suggested that the microlecture length is about 5-10 minutes, which is convenient for students to

use spare time after class to study independently. Finally, the capacity of micro-video resources should not be too large, it is recommended that tens of megabytes or so, the video format is common MP4, wmv, flv and other formats that support online playback, convenient for online playback or download mobile learning [7].

B. *Teachers Should Design and Produce Fine Microlecture Teaching Resources.*

Teachers should carefully design and make matching microlecture resources for students to use offline. In the microlecture classroom teaching under informatization, the design and production of microlecture itself is a process of self-learning and teaching reflection, which puts forward higher requirements on teachers' ability of informationized teaching design and online resource development. It is necessary to fully mobilize the enthusiasm of teachers to participate in the construction of online courses such as microlectures, and build a three-dimensional teaching resource library. Students outside the classroom can use online resources to create modern teaching methods such as students' independent learning and teachers' online guidance and question-answering to assist classroom teaching [8].

Here we introduce an experience method of linking PPT with micro-video resources: First, we use information technology to convert micro-video resources into two-dimensional code, and then paste two-dimensional code on the corresponding page of PPT for students to scan codes after class.

C. *The use of Microlecture Resources in Class Should be Controlled by Teachers.*

The scientific combination of classroom teaching and micro-video is an effective means to improve students' learning interest and autonomous learning ability, which cannot be separated from the teaching control of teachers. I suggest that the microlecture classroom teaching should be controlled by teachers using multimedia devices to use micro-videos, and it is not recommended that students use mobile phones to watch microlecture resources in class, so as to prevent students from blindly browsing micro-videos "be ignorant and incompetent". After class, we should pay attention to students' online feedback and tutoring [9].

Remember that the microlecture classroom teaching mode is not the subversion of traditional teaching methods, but the reform and innovation of traditional teaching mode to adapt to the tide of information micro times, which is "timely rain" and "icing on the cake".

IV. CONCLUSION

Microlectures can better satisfy students' personalized learning of knowledge points and on-demand selective learning, which not only arouses students' interest in learning but also helps students strengthen and consolidate knowledge, which is an important supplement and resource expansion of traditional classroom learning. With the upgrading of mobile phones, computers and wireless networks, we have entered the micro era, and mobile learning and distance learning based on microlectures will become more and more popular [10]. The microlecture classroom teaching under information technology proposed by me is a hybrid teaching mode combining traditional teaching and microlectures. By "microlecture" part of classroom teaching content, it realizes the sharing teaching of audio, video and digital course resources [11]. From the perspective of classroom teaching practice and students' feedback, this teaching mode has achieved good teaching effect and has good promotion value. I believe that teachers' reasonable design of microlecture classroom teaching ideas, innovative teaching methods, and high-quality microlecture content can effectively stimulate students' interest

in classroom learning, improve after-school learning efficiency, and realize the normalized "offline + online" microlecture teaching under informatization.

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