Application of Online Teaching Platforms for Postgraduate Course—Taking Advanced Statistics as an Example

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Abstract. Postgraduate course teaching plays an important role in postgraduate training, and the online teaching platform promotes the provision of more abundant teaching resources for it. How to make use of online teaching platforms to improve teaching effectiveness remains an urgent problem to be solved in the teaching reform of *Advanced Statistics*. In this paper, we analyze the advantages and disadvantages of various online teaching platforms in comparison with the traditional teaching problems of Advanced Statistics, integrate the teaching characteristics of the *Advanced Statistics* course and interpret them from three perspectives: learners, teachers and school then selects Rain Classroom as the online teaching platform, which has realized the efficient interaction between teachers and postgraduates before and after class, and has improved the teaching effectiveness of the *Advanced Statistics* course.

Keywords: Online Platform · Advanced Statistics · Rain Classroom

1 Introduction

With the development of social economy and the progress of science and technology, statistics has become an indispensable and important tool for people to understand the objective world [1]. In September 2020, the Ministry of Education, the National Development and Reform Commission and the Ministry of Finance issued the Opinions on Accelerating the Reform and Development of Postgraduate Education in the New Era, which pointed out that in order to improve the teaching quality of postgraduate courses, it is necessary to innovate teaching methods, highlight the cultivation of innovative capabilities, create high-quality demonstration courses, and promote the sharing of high-quality resources [2]. Under this circumstance, using high-quality teaching resources and high technology to assist the teaching of postgraduate courses becomes an inevitable trend.

Although the traditional classroom statistics training mode has incomparable advantages in theory and knowledge transfer, the knowledge points taught in the classroom are limited [3]. Given this, in order to enrich teaching resources and provide more channels for learning, the online teaching platform came into being. This kind of novel teaching pattern breaks the limitation of time and space, enabling students to learn when they

want to learn and ask questions when they want to ask, which solves the present problem existing in classroom teaching.

At present, there are multiple online teaching platforms, such as MOOC of China University, Classroom School, Smart Classroom and Nail Classroom. This paper takes the course of Advanced Statistics as an example to provide reference for teachers to choose an optimal teaching platform for online teaching activities. Based on the comparative analysis of the advantages and disadvantages of various online teaching platforms, this paper chooses a suitable online teaching platform according to the characteristics of the course of Advanced Statistics to provide theoretical support and practical basis for postgraduate teaching reform and improve the statistical literacy of postgraduates.

2 Problems of Traditional Classroom Teaching of Advanced Statistics

The main content of the Advanced Statistics course consists of three parts: data acquisition, data processing and analysis, and the discovery of characteristics and patterns of organizational operations based on the analysis results [3]. Advanced Statistics is generally a required course for management science and engineering majors, and its main goal is to train graduate students to use statistical methods for data analysis and processing. Graduate students in management science and engineering majors come from different undergraduate majors, involving economics, management, arts, science, agriculture, medicine, etc. Undeniably, traditional classroom teaching has its unique advantages, but some problems also exist, mainly in the following three aspects.

(1) Time and space limitation of knowledge transfer.

Within the limited class time, it is difficult for teachers to teach graduate students every knowledge point, to carry out case discussions and to put statistical theory and methods into practice. After the class, although the graduate students can use the form of drawing a gourd from a sample to operate statistical software and get relevant information, such as ANOVA tables, regression coefficient tables and decidable coefficients, etc., most of them only comprehend the message contained in these tables, while still having little understanding of the meaning and use of the indicators in them. Furthermore, when combined the class content with specific case studies, their ability to interpret and analyze is weak. The main reason is that in the traditional classroom, when the teacher teaches theoretical knowledge or practical operation, the graduate students seem to understand but just swallow it whole, and after the class, they can only review the class with their own memory. However, after using the online platform, due to the assistance of the playback function, the graduate students can use their spare time to study the unfamiliar knowledge points indefinitely and their puzzlements can be answered.

(2) The interactive atmosphere of traditional classroom is relatively poor.

In the traditional offline classroom, the graduate students are too nervous and ashamed to speak as actively as in the online platform, and they may even don't speak and ask questions at all for fear of saying the wrong thing or asking too simple questions that will cause the rest of the graduate students to laugh. Under this circumstance,

the graduate students can feel embarrassed, making it difficult to construct the relaxed atmosphere of teacher-student interaction in the traditional offline classroom.

(3) Insufficient innovation among graduate students in traditional classrooms.

Graduate students in traditional classrooms habitually imitate the teacher's operation to practice, but why they choose this way and how to choose different methods for different problems seem to be understood but not thoroughly enough. The graduate students seem to have mastered the basic theories and methods of statistics, but their ability to refine scientific problems and analyze them independently is relatively poor. They are unable to understand the intention of writing high-level academic papers, and they are not innovative enough in writing academic papers and declaring scientific projects.

3   Comparison and Selection of Online Teaching Platforms

3.1   Comparison of Five Online Teaching Platforms

According to the popularity of the use of online teaching platforms, five online teaching (supplementary) platforms commonly used by teachers were selected for analysis. The comparison of each teaching platform's advantages and disadvantages are shown in Table 1 [5].

As can be seen from Table 1, the five commonly used online teaching platforms have their own advantages and disadvantages. Considering that the course of Advanced Statistics has many teaching resources and is difficult to learn, and Rain Classroom has features such as supporting data management and easy login to WeChat applets, this platform can meet the requirements of teachers to realize course resource sharing, communication, interaction between teachers and students and classroom teaching evaluation [4]. Therefore, it is suitable for online teaching of Advanced Statistics course.

3.2   How to Choose Online Teaching Platform

For the selection of the online teaching platform, it is proposed to analyze why Rain Classroom is chosen for the Advanced Statistics course from the perspective of learners, teachers and schools.

(1) Learner's perspective

First, by enhancing the existing functions of WeChat and PPT software, Rain Classroom realizes that teachers can push videos, voices, and courseware to graduate students' cell phones outside of class, which greatly reduces the learning cost for graduate students to master Rain Classroom and frees up more time for professional knowledge learning [6]. Second, when studying the Advanced Statistics course on the remaining online platform, many graduate students have the experience that they may still be reviewing the content of the previous PPT page, but the page has already turned to the back page, missing a page of knowledge and making it more difficult to understand the content of the later knowledge, which can only be relearned through the playback function after

Table 1. Comparison of the advantages and disadvantages of five online platforms

Teaching platform	Advantages	Disadvantages
NetEase Cloud Classroom	(1) The platform supports online note function and can correspond to the video time point. Users can jump by clicking notes and share notes; (2) Teachers can tutor and teach students through Q&A; (3) The platform is open for visitors to browse. There is no setting for course permission, which means it welcomes teachers and students with an open attitude;	(1) The platform does not support calendar task function, and there is no clear limit for students to complete tasks; (2) The platform's electronic whiteboard function is only supported in the enterprise version.
Wisdom Tree	(1) The platform supports the electronic whiteboard function, so teachers can write down the teaching content using the whiteboard at any time; (2) Users need to register and authenticate before they can log in to the platform, and teachers as well as students need to bind their work or school numbers, so the atmosphere of the campus is stronger; (3) Teachers can help students learn through meeting classes; (4) The platform sets different permissions for teachers and students with different identities, which is conducive to teachers' management of courses.	(1) The platform does not support the bookmark function, which means teachers and students need to start again from the initial position of the video each time they study. (2) The platform doesn't support timely contact between teachers and students, making students unable to communicate and discuss with teachers in real time when they have problems in the learning process.

(continued)

Table 1. (*continued*)

Teaching platform	Advantages	Disadvantages
China University MOOC	(1) It is an optimal combination of platform teaching resources. The course is not attached to a teacher or a university, which means the platform bringing together the best teachers from many universities across the country to create high-quality courses; (2) The platform lecture time is short. Advocating "dry cargo", the course time is usually 5–10 min, Promoting students to get more concentrated and improve their learning efficiency; (3) The platform is interactive, so students can ask questions at any time in the classroom, and the teacher can answer students' confusions promptly; (4) The platform pays attention to student feedback. Each course is equipped with several teaching assistants, and teachers will answer students' questions at the first time.	(1) The classroom lacks systematization, as there are multiple instructors for the same course but the same series of courses do not develop vertical depth. Therefore, students need to follow different instructors when they need to study in depth. (2) The problem of students' integrity in exams is prominent, and the platform is not strict in supervising students' exams.

Table 1. (*continued*)

Teaching platform	Advantages	Disadvantages
Xue Tang Online	(1) the platform plays an important role in the field of supplementary teaching, combining lectures, tutorials and Q&A with independent learning; (2) the platform supports a combination of online and offline teaching to produce better teaching results; (3) the platform supports a combination of independent inquiry and group collaboration to provide students with a variety of learning styles;	The overall stability of the platform system is poor and prone to lagging.
Rain Classroom	(1) The platform supports WeChat applet login, and WeChat pushes messages at any time, which is convenient for teachers and students to check messages; (2) The platform has live broadcast function, and teachers and students can interact during live broadcast, which can solve students' problems in real time; (3) The platform supports data management, which provides teachers with teaching data of the whole cycle, namely before-class-class-after-class, and all teaching implementation processes at a glance.	The platform does not support voice, students can only use pop-ups to communicate, and it is easy to cover the screen when sending pop-ups from cell phones, which impairs the effect of watching learning.

the class, affecting the learning efficiency of graduate students. Rain Classroom enables teachers to send the lectured slides to the graduate students' end instantly, and the graduate students can adjust the PPT interface by themselves, which effectively improves the teaching efficiency. For every new knowledge point learned by graduate students, they immediately try the exercise test issued by the teacher, which serves to strengthen the consolidation effect.

(2) Teacher's perspective

Online education platforms all basically realize the function of automatic scoring by the system or online scoring by teachers, which improves teachers' work efficiency and allows teachers to spend more time on Innovating courses and communicating with students. However, teachers cannot set time limits or record the submission time of graduate students when assigning tasks on many teaching platforms, which is not conducive to teachers' calculations on the completion of graduate students' assignments. Rain Classroom compensates for this deficiency since it has a time limit for assignments and can record the time period in which graduate students complete their submissions. In Rain Classroom, the instructor can use the time of submission of graduate students' assignments as one of the criteria for evaluating the regular grade, screen out the graduate students with positive completion attitude and give them encouragement in real time. Through the in-class time-limited exercises, "don't understand" button, "pop-up" discussion and "mobile courseware", all the learning behaviors of graduate students are automatically collected. These data, after being integrated and analyzed, will help teachers fully understand the learning effects of graduate students and become an important basis for teachers to tailor their teaching to their needs [6].

In terms of course design, various online teaching platforms provide teachers with diverse design tools, which give them greater autonomy to a certain extent, but the human-machine interface is not friendly enough, which makes some teachers unable to apply it to their teaching practice. The application process of Rain Classroom is rather simple, and teachers can apply it directly in the PowerPoint during the teaching process. The simple and convenient operation improves the using experience of the software, thus increasing teachers' willingness to use it.

(3) Manager's perspective

When choosing an online teaching platform, administrators need to consider the training cost of the platform as well as the rest of the investment. Rain Classroom is simple to apply and can be used without training, so it is gradually becoming the first choice of the majority of teachers and students for a smart teaching platform. By using Rain Classroom, schools do not need to pay extra investment cost for the time being, and only need to install the software to upgrade the existing multimedia classrooms into smart classrooms.

4 Teaching Practice of *Advanced Statistics* Course Based on Rain Classroom

4.1 Teaching Implementation of *Advanced Statistics* Based on Rain Classroom

The online teaching of *Advanced Statistics* is carried out by using Rain Classroom. Graduate students can directly participate in the teaching of Rain Classroom through the online way of WeChat applet, which is simple and convenient to operate, and the specific operation process is shown in Fig. 1.

From Fig. 1, we can see that Rain Classroom realizes intelligent teaching in the era of big data through the functional support of three links: before class - during class -
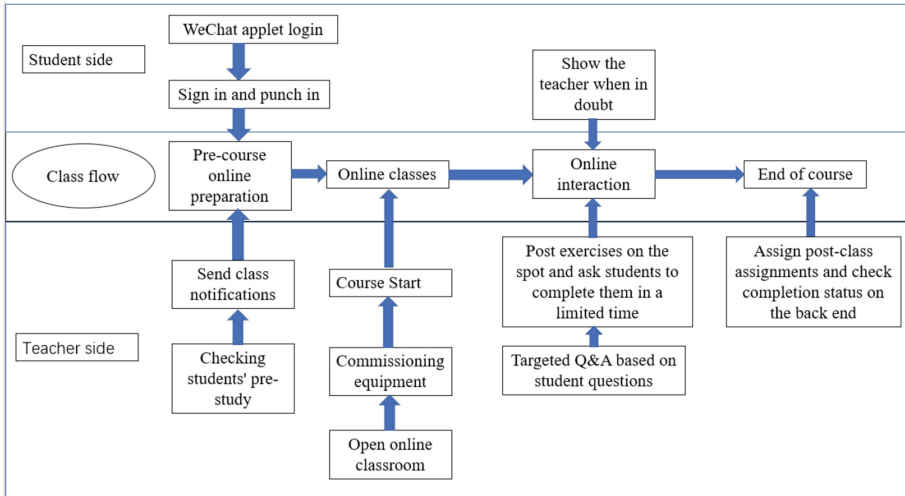
Fig. 1. Online teaching operation flow of Rain Classroom

after class, including real-time interaction system between teachers and students, and evaluation system of graduate students' usual performance. The teaching of Advanced Statistics based on Rain Classroom is mainly designed in three aspects: before class, during class and after class. In the pre-class teaching session, we analyze the learning situation of graduate students, upload teaching resources related to the course, assist graduate students in independent learning and respond to their questions. In the classroom teaching session, we use "pop-up" teaching questions and classroom quizzes to get hold of the learning situation of graduate students in real time and carry out teaching management. In the post-class teaching session, we check the attendance of graduate students through the back-end system, issue assessment materials in view of the course teaching content, and provide timely feedback to the post-class questions of graduate students. The following is a specific analysis of the three teaching design processes.

(1) Pre-course teaching session design

In the pre-course teaching phase, teachers upload teaching materials, including cases, UTD24 papers and advanced statistical knowledge points, etc., for graduate students with different statistical bases to choose to study independently. The learning analysis of graduate students is conducted before the class. Then new courses and classes are created in Rain Classroom, and graduate students can directly use the WeChat applet to join the class according to the class number. Teachers make short, concise and beautiful videos to present the main points of teaching content, which effectively enhance the concentration of graduate students in independent learning. Teachers release assessment materials and reference answers through Rain Classroom, and command the current learning situation of graduate students in the mobile client, so as to clarify the difficulties and key points of classroom lectures. If there are group assignments, the teacher can set the number or limit of each group, so that graduate students can freely form teams in Rain Classroom.

(2) Classroom teaching session design

Classroom teaching is the most important link in the whole session. On the basis of understanding the preparation of graduate students before the class, the targeted teaching is carried out to teach the key points and difficulties of the class, and the post-class training is reasonably arranged to help graduate students consolidate the knowledge content according to their performance in the classroom learning session. During the class, the graduate students are more willing to raise confusion about the content of the page part in time in the platform, which improves the communication between teachers and students without affecting the pace of the teacher's class. At the end of each class, graduate students will receive a learning report automatically pushed to them by Rain Classroom to guide them in self-improvement. For example, when explaining regression analysis, a small video of SPSS operation is inserted after the lecture on model setting, analysis steps and other knowledge points of regression analysis, so that students can operate on the spot, understand different operation inputs and reasons, analyze SPSS output results, etc., to deepen graduate students' understanding of regression analysis.

(3) Post-class teaching session design

Post-class teaching design is mainly to assess graduate students' learning of the class content and help them review. Teachers using Rain Classroom can release cases, empirical research papers and statistical exercises for graduate students to complete in a limited time. Based on their completion, graduate students learn how well they are able to analyze and solve problems. After the class, Rain Classroom provides a mutual assessment function to achieve effective integration of convergent and divergent thinking between faculty and students [7].

4.2 Reflection on the Implementation of Online Teaching of the Course Advanced Statistics

Conducting online teaching of the Advanced Statistics course not only improves the effectiveness of teacher-student interaction, but also helps teachers to scientifically assess the usual learning of graduate students. However, in order to further exploit the teaching effect of the rain classroom, two key points need to be considered when implementing online teaching of *Advanced Statistics*. (1) How to create interesting mini-videos that assist classroom teaching. Various classroom mini-videos can mobilize graduate students' interest in learning statistical knowledge and free them from the boring derivation of formulas. (2) How to evaluate the usual performance of graduate students in a reasonable and systematic way. On the one hand, reasonable evaluation of grades can motivate graduate students to study and facilitate shaping an active and studious atmosphere for learning statistics; on the other hand, it helps teachers to grade graduate students' usual grades in a more rational and scientific way. To this end, relying on the data statistics of Rain Classroom, we can incorporate the indicators of graduate students' sign-in, pre-study before class, the number of times of raising hands in class, reading notes of empirical research papers, group work after class and review time into the comprehensive evaluation system to improve the effectiveness of teaching and learning.

4.3   Evaluation of the Teaching Implementation Effect of Advanced Statistics Based on the Rain Classroom

(1) Improved the level of mastery of statistical knowledge

In order to compare the differences in teaching effects before and after applying the rain-based classroom, we collected the learning situations of the four teaching classes of the grades we taught. The three main aspects include students' classroom performance, reading notes of empirical papers on statistics, and final exam results. Compared with the traditional classroom, students' classroom performance was more active and the quality of their reading notes on the papers was significantly higher after the implementation of the rain classroom. The difference in the level of knowledge acquisition was analyzed mainly by the paper scores of the final exam. The distribution of students' performance based on statistics before and after the implementation of the rain classroom is shown in Table 2.

(2) Increase in the proportion of postgraduates declaring innovative projects and participation in disciplinary competitions

After the implementation of rain classroom teaching, the number of graduate students in management science and engineering participating in postgraduate innovation projects has increased significantly. At the same time, the number of students participating in disciplinary competitions such as Mathematical Modeling Competition, Challenge Cup and Internet + has also witnessed considerable growth. Take mathematical modeling as an example, the previous questions involve the application of statistical methods, which require the selection of appropriate statistical analysis methods and the interpretation of the results according to specific conditions, such as the "Huawei Cup" China Graduate Student Mathematical Modeling Competition, 2022 E, which is about the study of grassland grazing strategies, requiring the establishment of the relationship between different grazing strategies and soil. The mathematical model of physical properties and vegetation biomass of different grazing strategies needs to be constructed, and factor analysis or correlation analysis can be used. In addition, time series analysis can be used to predict

Table 2. Distribution of advanced statistics examination results by academic year

Academic Year	Mode of Instruction	Total Number of Classes	Excellent	Good	Passing	Average Score
2017–2018	Traditional classroom	63	3	13	47	64.33
2018–2019	Traditional classroom	63	5	15	34	64.45
2019–2020	Rain Classroom	66	6	18	36	62.23
2020–2021	Rain Classroom	69	12	23	27	76.22

soil moisture. The increase in the proportion of innovative projects declared and participation in disciplinary competitions reflects the enhancement of students' application ability based on statistical knowledge.

(3) Continuous improvement of scientific research ability

After the implementation of rain classroom, the total publication rate of postgraduate students' journals and conference papers above the core journal level has risen from 38.5% in 2017 to 56.5% in 2021, among which the proportion of empirical research papers in statistics has ballooned from 31.5% in 2017 to 55% in 2022, and the proportion of outstanding master's theses in the university has grown from 5% in 2017 to 15% in 2022.

5   Conclusion

In order to improve the teaching effect of the graduate course "Advanced Statistics", the traditional teaching pain points of the statistics course are directly attacked. Based on the comparative analysis of the characteristics of various online teaching platforms, we choose to rely on Rain Classroom to carry out Advanced Statistics considering the characteristics of Advanced Statistics course, which breaks the traditional time and space limitation of teaching Advanced Statistics course and realizes good interaction between teachers and students. Utilizing Rain Classroom to implement interactive teaching before, during and after class creates a relaxed and active learning atmosphere for Advanced Statistics and sparks graduate students' interest in learning. Of course, different online teaching platforms have their own advantages and disadvantages, and the selection of teaching platforms may be different depending on the nature of the course and the target audience. The teaching of the graduate course "Advanced Statistics" needs further research on how to use the rain classroom to better carry out teaching and create a high-quality online course.

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