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Penelitian Praktis Model Blanded Learning Berbasis SPOC pada Matematika Tingkat Lanjut

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Abstrak

Berdasarkan situasi pengajaran kurikulum matematika tingkat lanjut saat ini, penelitian ini pertama-tama membangun model blended learning matematika tingkat lanjut berbasis SPOC melalui penelitian literatur dari tiga aspek: desain kurikulum, pelaksanaan pengajaran, dan evaluasi pembelajaran. Dan merancang kasus pengajaran campuran tertentu yang dikombinasikan dengan "konsep integral pasti". Kemudian, kami melakukan purposive sampling di sekolah negeri bernama Qinghai Normal University, dan memilih 82 siswa dari dua kelas tahun pertama jurusan bioteknologi sebagai objek penelitian, dan melakukan studi empiris selama 18 minggu dengan kontrol eksperimental. Terakhir, nilai akhir dan angket evaluasi pengajaran siswa matematika tingkat lanjut dikumpulkan untuk pengolahan dan analisis data. Hasil penelitian menunjukkan bahwa siswa di kelas pembelajaran campuran SPOC memiliki nilai matematika yang lebih baik dibandingkan siswa di kelas pengajaran tradisional, dan pembelajaran campuran dapat mempersempit kesenjangan dalam kemampuan matematika siswa. Pada saat yang sama, survei kuesioner menemukan bahwa siswa percaya bahwa pembelajaran campuran dalam mata kuliah matematika tingkat lanjut memiliki sumber daya yang melimpah, interaksi dan komunikasi yang sering, dan dapat meningkatkan efisiensi pembelajaran. Namun, pembelajaran matematika tingkat lanjut tradisional memberikan banyak tekanan, dan mereka sibuk mencatat di kelas dan tidak dapat menjawab pertanyaan guru tepat waktu.
Kata Kunci: blended learning, matematika tingkat lanjut, reformasi pengajaran, SPOC

The Practical Research of the Blended Learning Model Based on SPOC in Advanced Mathematics

Abstract

Based on the current situation of advanced mathematics curriculum teaching, this study first constructs a blended learning model for advanced mathematics based on SPOC through literature research from three aspects: curriculum design, teaching implementation, and learning evaluation. And designs a specific blended teaching case combined with the "definite integral concept". Then, we conducted a purposeful sampling in a public school called Qinghai Normal University and selected 82 students from two first-year classes majoring in biotechnology as the research objects, and carried out an 18-week empirical study with experimental control. Finally, the final grades and teaching evaluation questionnaires of students in advanced mathematics were collected for data processing and analysis. The research results showed that students in the SPOC blended learning class had better math scores than those in the traditional teaching class, and blended learning could narrow the gap in students' math proficiency. At the same time, the questionnaire survey found that students believe that blended learning in advanced mathematics courses has abundant resources, frequent interaction and communication, and can improve learning efficiency. However, traditional advanced mathematics learning puts a lot of pressure, and they are busy taking notes in the classroom and cannot respond to the teacher's questions in time.

***Keywords**: advanced mathematics; blended leaching; SPOC; teaching reform*

INTRODUCTION

Currently, many universities adopt traditional teaching methods for advanced mathematics courses, which mainly have several problems: There are a lot of students in the offline classroom, and some students may not be able to hear and see the teacher's lecture clearly; Due to the large content of advanced mathematics courses and limited classroom teaching time, students are unable to solve problems in the classroom promptly; The students' performance in class was dull, their enthusiasm for learning was not very high, one-third of the students fail to pass the final exam (Shan, 2019). In this regard, some researchers try to use the MOOC platform to conduct mixed teaching with traditional classrooms. However, due to the limitation of the functional modules of MOOC itself, it is impossible to effectively manage learners' learning behaviors, nor to obtain and analyze big data of learning behaviors, which brings great difficulties to teaching evaluation, resulting in incomplete blended teaching (Yin, 2015). So, in the era of education information, how to optimize the teaching of advanced mathematics courses, and effectively manage, interact, and evaluate online and offline learning behaviors? How to build a systematic blended teaching system to improve the existing problems of the curriculum?

With the development of modern educational technology, online and offline blended learning has gradually been adopted by many educational fields and has become an emerging and trendy teaching model (Zeng, 2023). Blended learning, which can accept diverse groups of students and integrate different learning resources, has been widely used in universities in recent years (Platonova et al., 2022). For example, to better implement the digital education strategy action, the Chinese Ministry of Education pointed out that in realizing modern education and personalized training, high-quality development of advanced education should be the primary strategic issue (Ministry of Education of China, 2022). Universities are required to focus on curriculum practice reforms such as teaching mode and teaching method innovation, learn to use information technology to highlight disciplinary characteristics, and build a smart education platform to integrate high-quality teaching resources (Ministry of Education of China, 2020). Advanced mathematics courses, as compulsory basic courses for students majoring in science and engineering, such as finance, computer science, and artificial intelligence, can support their effective learning of other courses in the future. Therefore, this study aims to construct a blended teaching model based on SPOC for advanced mathematics courses from three aspects: curriculum design, teaching implementation, and learning evaluation, and conducts empirical research to verify the effectiveness of this model.

IIn 2002, during the discussion of an online conference held in Orlando, Florida, it was proposed that teachers could combine face-to-face classroom teaching with online teaching to realize the simultaneous implementation of online and offline classes, so a blended learning method came into being (Sharma, 2010). This teaching mode uses network communication technology to integrate different teaching methods with traditional classroom teaching (Thai et al., 2017) the teaching method is more flexible, and learners can learn both in the classroom and online (McAleese, 2003). Blended teaching has strong adaptability, which can meet the needs of various teaching environments and different groups of students to carry out multi-form asynchronous communication (Rovai & Jordan, 2004), and can also help teachers and students engage in continuous communication (Phillips et al., 2016). Learners can access course content online in blended classrooms and utilize rich learning resources for personal learning and collaborative communication (De Jong et al., 2013). Many college teachers like to use blended teaching. They have tried and studied different blended teaching in the classroom (Suleri & Suleri, 2018), and found that blended teaching can affect students' learning achievement (Means et al., 2013) and student retention rate (Pye et al., 2015), and improve students' learning action (Norberg et al., 2011).

MMOOCs (Massive Open Online Courses) are massive open online courses. One of its characteristics is that it is not limited by traditional teaching locations, times, and course numbers, and students can freely choose courses for learning anytime and anywhere (Cojocaru et al., 2022; Liu & Zhu, 2016). Another characteristic is that it can provide rich and free high-quality learning resources, and students can choose suitable courses according to their interests (Kang & He, 2018). However, because MOOC is large-scale online teaching, teachers cannot effectively monitor students' long-term,

stable, and regular online learning (Yin, 2015), so students with low self-restraint and weak grades will not continue to learn, which will not improve their learning efficiency and quality, they lose interest in MOOC.

To optimize the teaching problems of MOOCs, Professor Armand Fox, the course director of the MOOC Lab at the University of California, proposed the concept of SPOC, which is a small private online blended learning (Fox, 2013), that can deeply integrate MOOC with traditional classroom teaching and promote the optimization of teaching effect. SPOC can combine the advantages of MOOCs and make up for the shortcomings of traditional teaching. For example, teachers can set up study groups, assign learning tasks, and regulate the course teaching progress based on students' needs. Students can also use the SPOC platform to learn repeatedly and indefinitely to meet personalized needs (Xiuli et al., 2019). At the same time, the SPOC teaching platform can also record the frequency of students watching course videos, effective learning duration, consulting course resources, sharing online documents, homework tests, interactive Q&A, and other specific activity tracks to prevent students from ineffective formal learning, promote the authenticity and effectiveness of students' online learning, and improve students' learning enthusiasm and learning quality (Tingting Lu, 2016). The teaching process is that teachers select a MOOC course including videos, courseware, and homework resources in advance, next students learn online through SPOC, then teachers and students have a face-to-face discussion, Q&A, and problem-solving in class, finally students complete online homework and offline final exam. It can be seen that SPOC emphasizes the process of students' construction of knowledge and promotes communication and collaboration between teachers and students at any time through educational technology, ultimately forming an "autonomous, open, communicative, and collaborative" SPOC learning space (Law Kris, 2019).

As a compulsory basic course for students majoring in science (non-mathematics), advanced mathematics is highly abstract, logical, and applied. However, due to the variety of course contents and the large number of students in class, teachers mainly adopt the traditional teaching method of teaching courses by individuals. Students are busy taking notes in class, unable to interact with teachers frequently, unable to stimulate students active learning, and unable to meet students' individual needs, students will have great pressure and confusion in the learning process (S. Wang & Wang, 2014). Therefore, to stimulate students' interest and initiative in learning mathematics, this study will conduct empirical research on advanced mathematics courses based on SPOC blended teaching based on the good information literacy of college students (Zhao et al., 2016) and their willingness to improve the learning efficiency of higher mathematics through the Internet (You et al., 2020). Mainly solve the following two problems: how to construct and design a blended teaching model for advanced mathematics based on SPOC? And what is the effectiveness of the implementation of SPOC-based blended teaching in advanced mathematics?

METHOD

This study first employed literature research to construct a blended learning model for advanced mathematics based on SPOC and provided specific blended learning cases in combination with the concept of definite integrals. Then, based on this teaching model, an experimental control study was conducted on two classes, where both classes were taught by the same teacher using the same textbook for 18 weeks. The control class adopts traditional teaching, and students' learning materials include textbooks and problem books. The experimental class adopts SPOC blended teaching, and students' learning materials include textbooks, problem books, and online learning platforms (video courses, e-books, study guides, interactive communication boxes, etc.).

Participants

To prevent other factors from interfering with SPOC blended teaching and to compare and analyze the teaching effect of SPOC blended teaching and traditional teaching, this study adopted objective sampling in Qinghai Normal University (a public school) and selected two first-year students of the same biotechnology major as the research objects (41 students in each class, 82 students in total). In addition, the difference test of the mathematics scores of students in the college entrance examination

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of the two classes was conducted in advance before the research, and it was found that there was no significant difference($p = 0.662$) in the mathematics scores of students in the two classes, indicating that the mathematics level of students in the two classes was similar and there was no great difference.

Data Collection

The data in this study is mainly divided into two parts: one is to collect students' math score data through final exams, and the other is to collect students' evaluations of the two teaching modes through the school's teaching evaluation system by distributing evaluation questionnaires. The final test paper is percentage-based jointly discussed and produced by teachers from the school's mathematics teaching department, which includes five types of questions: selection, fill in the blank, calculation, answer, and comprehensive application. This final test paper can reflect students' mastery of advanced mathematics knowledge and can test their mathematical abstraction, logical reasoning, and problem-solving abilities. The evaluation questionnaire is adapted from existing research scales (Dunrong & Fan, 2009) and school teaching evaluation scales, and is evaluated from three aspects: course content difficulty, course resource enrichment, reasonable teaching methods, interactive teaching processes, course learning pressure, and learning effectiveness. It is evaluated using the Likert scale's "5, 4, 3, 2, 1" levels.

Data Processing

This study first used Excel spreadsheets and SPSS 23.0 software to statistically analyze and organize the data. Then, descriptive statistical methods were used to compare and analyze the mathematical scores of students in each score range and their evaluations of the two teaching modes in two classes. Finally, differential tests were used to analyze whether the blended learning based on SPOC has a significant impact on the teaching of advanced mathematics courses.

Model Construction

SPOC-based blended teaching model to enhance students' interest in learning advanced mathematics and cultivate their self-learning ability, this study utilizes the SPOC learning resource platform to construct a blended teaching model of advanced mathematics based on SPOC from three aspects: course design, teaching implementation, and learning evaluation (Fig.1), enabling students to achieve personalized learning in an "autonomous, open, communicative, and collaborative" learning space (Law Kris, 2019).

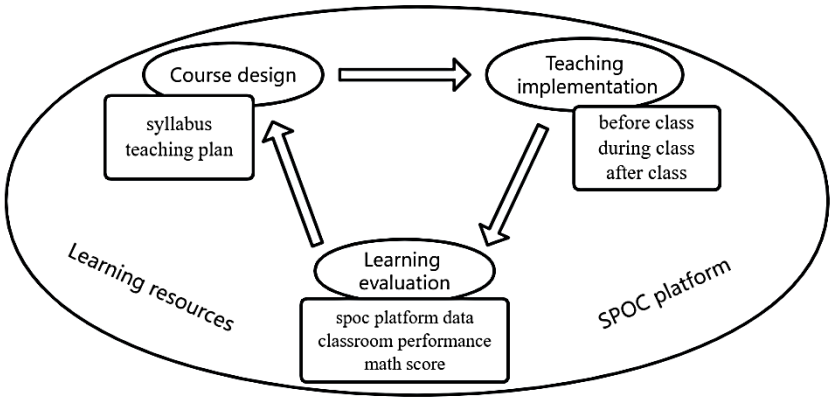

Figure 1. Blended Teaching Mode of Advanced Mathematics Based on SPOC

Course Design

Course design can accurately guide the implementation of the teaching process, mainly including the teaching syllabus, teaching plan, SPOC in class, and after-class teaching design content of advanced mathematics courses. Firstly, the teaching syllabus includes the overall goal of cultivating students' abstract thinking and problem-solving abilities, specific teaching objectives and requirements suitable

for students' learning needs, teaching time for each chapter, and SPOC classroom learning guidelines. Then, the teaching plan includes detailed and specific teaching content, SPOC class time, teaching resources, and course evaluation plans. This course design aims to enhance students' abilities in mathematical abstraction and logical reasoning and give full play to students' enthusiasm and autonomy in learning advanced mathematics courses.

Teaching Implementation

SPOC blended teaching mainly guides students to actively participate in advanced mathematics learning through the teaching implementation plan of "knowledge preview before class, knowledge construction during class, and knowledge consolidation after class" (Fig.2), enabling them to experience the complete process of "understanding-construction-enhancement" of knowledge, and enhancing their enthusiasm for learning advanced mathematics.

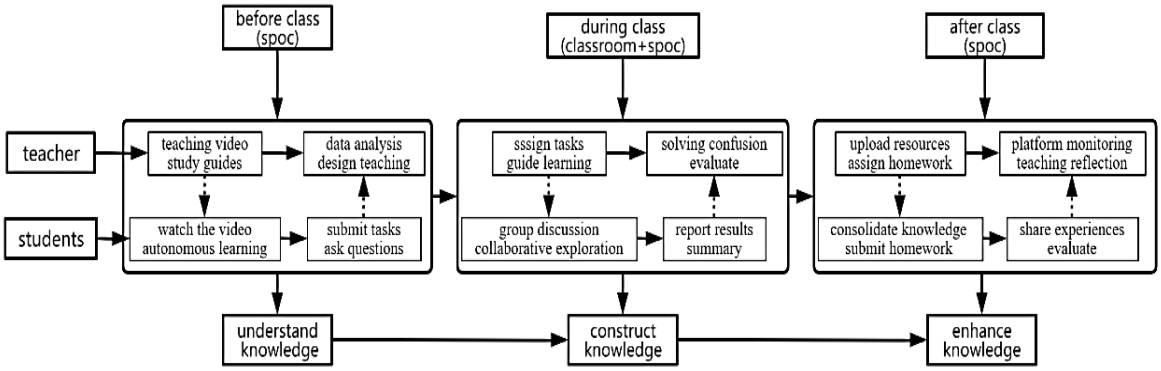

Figure 2. Design Process of Advanced Mathematics Blended Learning Based on SPOC

Before class: knowledge preview. Teachers first push guidance videos and classroom learning guides about knowledge on the SPOC platform and then release messages reminding students to complete preview tasks within the specified time. Students need to complete two tasks according to the learning requirements and process instructions in the study guide： one is to watch the guide video to complete the task list; another, sort out the key points of knowledge and ask questions, take pictures or Word documents and upload them to SPOC platform. Subsequently, the teacher conducts statistical analysis on the actual preview situation of students based on the feedback data from the platform and designs classroom teaching activities that are suitable for students' learning, to provide students with meaningful learning classes.

During class: knowledge construction. To narrow the differences between groups, teachers conduct classroom practice activities in heterogeneous groups based on students' mathematical level and preview results. The classroom teaching is divided into four parts: first, the teacher answers questions about the pre-class preview, presents classroom learning tasks on the SPOC platform, and carries out problem-oriented group activities. next, the student group will collaborate and exchange ideas within the designated time to explore the issues, share the learning results on the SPOC platform, and explain and report on them. then, students will evaluate each other and make a learning summary according to the reports of each group. finally, the teacher makes necessary supplementary explanations to the knowledge content and gives an evaluation of the student's learning results.

After class: knowledge enhancement. The teachers will upload the corresponding e-learning materials (textbooks, PPT, homework) and the learning results of each group to the SPOC platform after class. Students can learn and download these course resources multiple times on the SPOC platform and ask confusing questions online. They can also share problem-solving strategies and learning experiences, which improves the efficiency of problem-solving. For common and difficult problems, students can organize study groups to discuss and record meeting content, which can effectively connect with classroom teaching. At the same time, teachers can view the data of students' learning process on the SPOC platform to conduct teaching reflection to improve teaching methods and teaching quality.

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Learning Evaluation

SPOC blended teaching emphasizes the process of students' knowledge construction and generation and adds some process evaluation indicators based on traditional teaching exams. It mainly conducts comprehensive evaluations from three aspects: students' math exam scores, daily classroom performance, and data feedback on the SPOC platform. The data feedback of the SPOC platform includes four aspects: students' learning time, frequency of answering questions, learning results reporting, and completion of learning tasks. The diversified evaluation method hopes to change students' panic about the traditional final exam, avoid students rushing to study before the exam and enhance students' consciousness of independent study.

Case Study

This case is selected from the "Concept of definite integral", Section 1 of Chapter 5 of Advanced Mathematics. As the basic concept of integral calculus, it not only consolidates the knowledge of limit, derivative, and indefinite integral in the early stage but also the basis of the application of definite integral and the basic theorem of calculus. Based on SPOC blended teaching, this lesson designs teaching activities for the course (Table 1), the practical contents include the learning environment, learning objectives, teacher activities, and student activities.

Table 1. Blend Teaching Case Of "Definite Integral Concept" Based On SPOC

No	Content level	learning environment	Learning objectives	Teacher activities	Student Activities
1	knowledge understanding	Before class: SPOC	1. Use learning resources to understand the background and concepts of definite integrals. 2. Preview and upload study materials before class.	1. Upload study task sheets and online course videos. 2. Send study notifications and deadlines. 3. Statistical platform data, design classroom teaching.	1. Watch a video of Newton's quadrature problem and Liu Hui's circular cutting technique. 2. Answer the source of the formula for circular area and the idea of circular cutting. 3. Propose learning confusion.
2	knowledge construction	During class: classroom +SPOC	1. Master the thought method of "division, approximation, summation and limit", and inspire students to solve problems with mathematical thought. 2. Improve students' ability to active inquiry and cultivate team spirit.	1. Question 1: How to calculate the area of the school pool? 2. Question 2: How to find the area of a curved trapezoid? 3. Remind students to solve problems by connecting approximate substitution and limit thinking. 4. Answer questions to solve difficulties and evaluate the learning results of each group.	1. The group explored and tried to use triangles, rectangles, and trapezoids for area segmentation. 2. Solve the area of the curved trapezoid and provide the steps of "segmentation, approximation, sum, and limit". 3. Use the solution strategy of problem 2 to solve problem 1, results display, and experience sharing. 4. Find the common points of the two examples and try to give the concept and geometric meaning of definite integral.

3	knowledge enhancement	After class: SPOC	1. Deepen the essential connotation of the definite integral and stimulate students' critical thinking. 2. Gain learning experience and skills to improve learning efficiency.	1. Upload e-learning materials and publish assignments. 2. Check students' online learning records and evaluate students in a diversified way. 3. Write teaching reflection reports to improve teaching.	1. Review and consolidate, complete homework and tests. 2. Watch Q&A videos or communicate online to solve confusion. 3. Share learning experiences and evaluate each other.

RESULTS

Results of Mathematics Score

By comparing the distribution of final scores in advanced mathematics between the two classes(Fig.3), the number of students in the control class with scores below 60 is 14.6% more advanced than that in the experimental class, and the number of students with scores between 90 and 100 is 9.8% lower than that in the experimental class， and the number of students in the 60-69 and 80-89 sections of the experimental class is advanced than that of the control class. Therefore, the math scores of students in the experimental class are better than those in the control class. Blended teaching based on SPOC can improve students' advanced math scores and narrow the gap in the math level of students in the class.

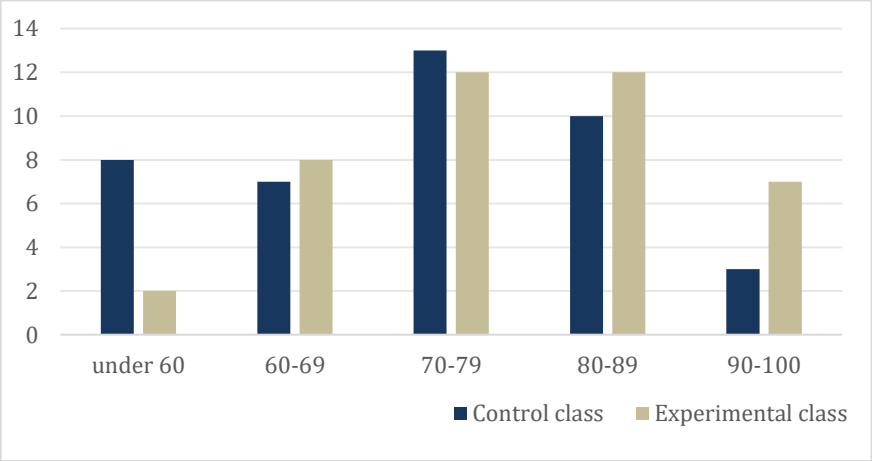

Figure 3. Math Scores Distribution of Students in Two Classes

Table 2 shows that the average mathematics score in the experimental class (average score=78.73) is more advanced than that in the control class (average score=71.63), with a difference of 7.1 points. Moreover, there is a significant difference (p=0.009) in the scores of students in the two classes. The results of this study indicate that blended teaching based on SPOC improved the advanced mathematics scores of experimental class students to some extent, and this teaching mode is effective in improving the teaching quality of advanced mathematics courses.

Table 2 Significance Test of the Final Math Average Scores of the Two Classes

	class	**number**	**average value**	**standard deviation**	**Mean standard error**	*t*	**degree of freedom**	**Sign**
Math grades	Control class	41	71.63	13.351	2.085	-	80	.009
	Experimental class	41	78.73	10.488	1.638	2.677		

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Results of the Investigation

The results of the questionnaire survey of the students of the two classes (Fig.4) show that the experimental class has more advanced mathematics course resources and more frequent interaction and communication during the learning process. 90.4% of the students are willing to use the learning resources of the SPOC platform to solve the remaining problems in class to consolidate and deepen their knowledge, and 72.3% of students are willing to share learning experiences and put forward proposals on the SPOC platform to increase learning autonomy and participation. However, the students in the control class felt that the content of the advanced mathematics course was difficult to understand, and there was much pressure when learning this course. 40.7% of the students said that it is difficult to learn advanced mathematics, and they were busy taking notes in class and rarely responded to the teacher's questions. 59.3% of the students were eager to find an efficient and convenient learning method to help them solve difficult problems in advanced mathematics. This result indicates that blended teaching of advanced mathematics based on SPOC can provide students with rich learning resources, enhance interaction and communication between teachers and students, and improve students' learning efficiency. As for the reasonableness of teaching methods, the evaluation of the experimental class is slightly more advanced than that of the control class, indicating that teachers still need to improve their current teaching methods and teaching strategies further.

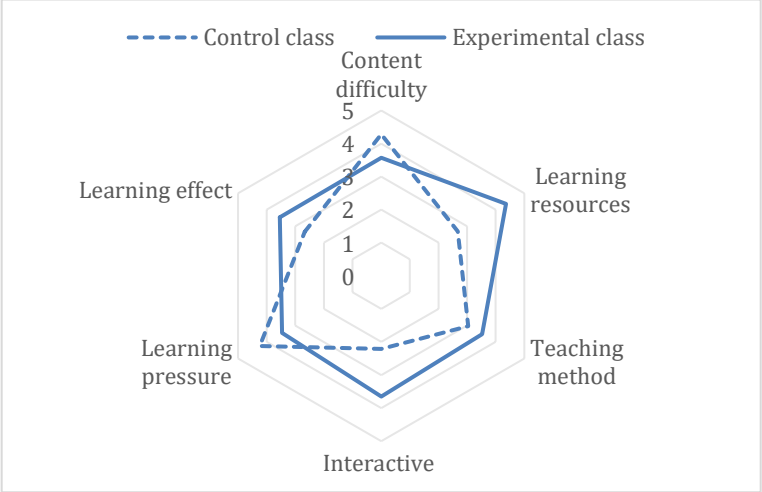

Figure 4. Students' Evaluation of the Two Teaching Modes

DISCUSSION

SPOC-Based Blended Learning Helps Improve Students' Performance in Advanced Mathematics

At present, Chinese universities have a complete advanced mathematics curriculum system, with a variety of textbooks and teaching contents to provide services for students' learning. However, due to the large volume and difficulty of the course content and the large number of students in the class, the teaching method is mainly carried out by "blackboard writing + courseware" teaching, which cannot stimulate students' enthusiasm for learning and students' performance in the class is very dull. They do not pay attention to the content explained by the teacher and gradually lose their interest in learning the course, which finally leads to many students failing to pass the advanced mathematics course exam (El-Ariss et al., 2021). In the context of innovative education, traditional teaching methods for advanced mathematics courses are difficult to meet the personalized learning needs of students (Canal et al., 2024), and cannot meet the requirements of innovative teaching methods and deepening curriculum reform. Therefore, the teaching reform of advanced mathematics courses is urgent. The blended learning based on SPOC can greatly promote the development of university teaching models and provide new ideas for the reform of advanced mathematics curriculum teaching. Students can access course videos, study sheets, problem books, and other resources through the online platform while interacting and discussing with teachers in class. This model is conducive to improving students' advanced mathematics

performance because it not only makes full use of the convenience and richness of online teaching resources but also retains the interaction and pertinence of traditional teaching (Kang & He, 2018). First of all, SPOC provides a personalized learning path, and students can choose the appropriate learning content and difficulty according to their learning progress and understanding (R. Wang, 2023), which helps to improve learning efficiency. Secondly, the ready availability of online resources enables students to flexibly arrange their learning time (Law Kris, 2019), making up for the limitations of time and space in traditional teaching. In addition, face-to-face teaching can enhance the interaction between teachers and students, timely solve the problems encountered by students in the learning process, and deepen the understanding of knowledge points. Therefore, blended teaching based on SPOC provides students with a more flexible and efficient learning environment by combining online and offline teaching resources, which is conducive to improving students' advanced mathematics performance.

SPOC-Based Blended Learning Can Enhance Interactive Communication and Learning Experience

The current advanced mathematics class has a large capacity, and many students must keep up with the teacher's teaching pace in the classroom. They are almost all busy taking notes and do not have many opportunities to actively communicate and exchange ideas with the teacher. They rarely express their views and opinions on problems, so students lack interaction and communication between teachers and students in the advanced mathematics class, and do not have a good learning experience. Blended learning based on SPOC can enhance student engagement and interactivity through online previewing (Yin, 2015), classroom discussions, and practical activities, promoting deep learning among students. For example, before class, teachers can prepare online materials, such as video lectures and reading materials, for students to learn independently before class. In this way, students have gained an understanding of basic knowledge in the classroom and can better participate in in-depth discussions and practical activities (F. Wang et al., 2022). During class, teachers can organize project-based, interactive, and collaborative learning activities that encourage students to apply their knowledge learned online and deepen understanding through group collaboration and discussion. After class, teachers can use online platforms to assign homework, grade, and provide feedback, while also providing additional learning resources to help students consolidate and expand the knowledge learned in the classroom (Gueye et al., 2020). Under blended learning based on SPOC, students can actively learn, think, and discuss under the guidance of teachers, thereby improving their learning initiative and classroom interactivity.

SPOC-Based Blended Learning Can Meet the Personalized Learning Needs of Students

The content of advanced mathematics courses is rich, but classroom teaching time is limited, so students may not be able to solve the problems encountered in class in time (Yugui, 2017). At present, most advanced mathematics courses in Chinese universities are taught in traditional large classes, mainly relying on teacher explanations (Chen & Niu, 2017). Students are more likely to learn passively and mechanically (Chen & Niu, 2016), which suppresses their enthusiasm for thinking and classroom communication, causing their thinking inertia and lack of awareness and behavior in actively constructing knowledge (Rosenthal, 1995). Therefore, under the current teaching conditions of advanced education, based on SPOC blended learning, classroom learning content can be transformed into offline online learning and classroom communication and discussion, which can shorten class hours and enrich students' learning experience of communication and cooperation (Tawafak et al., 2020). SPOC digital platform can provide video playback and online resources, not limited to study time and place, allowing students to learn according to their learning speed and style, ensuring that students can repeat the course content for unlimited periods to meet the personalized learning of students. Students can use the SPOC platform to learn new knowledge according to the study list in advance, to prepare for better class participation and cooperative learning, and to relieve learning anxiety and pressure. Students can review and consolidate the online learning resources of the platform to deepen their understanding of knowledge; At the same time, students can also put forward their learning puzzles and difficult problems online and organize classmates and teachers to discuss and exchange. Therefore, the blended teaching based on SPOC integrates online learning with classroom teaching and broadens the

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learning channel for students to learn advanced mathematics. It has a wealth of learning resources that can improve the width and depth of students' learning. Flexible and convenient learning methods break the limitations of students' learning and make it convenient for students to learn anytime and anywhere (Zaranis & Exarchakos, 2018).

Recommendations for Future Studies

To promote and implement the teaching mode more effectively in the future, this paper puts forward some suggestions to improve the problems existing in the process of teaching implementation.

Teachers Should Make Detailed SPOC Teaching Objectives and Operational Procedures

To enable teachers and students to clearly and smoothly implement SPOC teaching around teaching objectives and teaching activities, teachers need to set small learning goals for each link in curriculum design and should not confuse the overall goal of the course with these small learning goals. These small goals should be operable and ensure that students can achieve them (Xin-bing et al., 2014). Then, teachers should design a systematic SPOC teaching plan, such as the specific activities that teachers and students need to complete before, during, and after class, and the tasks of classroom teaching and online learning should be detailed to ensure that students can quickly understand and implement the teaching arrangement of SPOC class (Qiu et al., 2020). At the same time, teachers should search and view online learning resources in advance, and select high-quality learning resources to upload to the SPOC learning platform, such as video lectures, reading materials, online discussions, self-tests, etc., to ensure that students can carry out high-quality learning.

Teachers Should Provide High-Quality Learning Resources and Interesting Teaching Activities

First, teachers can set independent learning tasks for different difficulties before class, and provide resources such as video tutorials, online reading materials, and quizzes for students to study by themselves. These resources should be closely related to upcoming class discussions so that students can preview and come to class with questions. Teachers can then set up some interactive online activities, such as adding gamified learning elements (Grévisse et al., 2019), and introducing educational games or competitions to make the learning process more lively and interesting. Teachers can also use online forums or learning management systems to conduct discussions, encourage students to speak out on specific topics, comment on each other, role play and peer teaching (Gao & Chen, 2017), and engage students actively in the classroom to enhance their communication skills and teamwork, thereby promoting critical thinking and deeper understanding. At the same time, teaching activities should pay attention to the combination of theory and practice, so that students can apply the knowledge learned to the real-world situation, and increase the practicality and attractiveness of learning (Zirawaga et al., 2017).

Teachers Shall Formulate Supervision Measures for Blended Teaching

To ensure that students can achieve teaching objectives, teachers should make a detailed teaching plan, including online learning content, offline teaching activities, homework assignments, discussion arrangements, etc., and ensure that these contents are interconnected and complementary. At the same time, clear evaluation standards and methods should be established, which may include various forms such as online testing, project assignments, group discussion performance, etc. Through data feedback from the SPOC platform, it was found that some students did not submit their assignments on time and instead uploaded them near the exam week; Some students have discontinuous learning hours on the platform, with multiple interruptions in their studies. In response to similar phenomena, teachers should regularly track students' learning progress and provide timely feedback and guidance through online discussions, emails, video conferences, and other means; Make clear regulatory measures for rewards and punishments, regularly remind students with poor self-control to complete learning tasks or set deadlines for submitting learning tasks to urge students to learn. Students who actively participate in classroom interaction and dare to challenge learning tasks will be given extra points and praise. At the same time, to prevent students from using information technology improperly, teachers need to clarify

the rules for using information technology, improve students' information literacy, and cultivate students' habits of correctly using information technology for learning (Lee Jae Ik, 2017; Siswono et al., 2018), ensure that all students have fair access to learning resources and opportunities, and avoid unfair phenomena caused by technological or other obstacles.

CONCLUSION

This research empirically studied advanced mathematics courses based on the constructed SPOC blended teaching model. The research results indicate that this teaching model fully integrates online and offline teaching with the advantages of the learning resource platform, enhances students' subjective learning awareness and collaborative exploration ability in advanced mathematics, and improves their math scores. The blended teaching mode based on SPOC complies with the requirements of modern education informatization in terms of teaching form, time breadth, and content depth. However, this research object is only the students majoring in math, they attach importance to learning advanced courses, so it is hoped that this blended teaching model can be applied to other disciplines in the future to verify its effectiveness.

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