Exploration on Online and Offline Blended Teaching of University Computer Foundation

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Abstract. In view of the shortcomings of the traditional classroom model, a blended teaching model of "SPOC + Rain classroom + Educoder" is constructed based on a variety of information technology platforms. This paper analyzes the problems existing in the teaching of University Computer Foundation, designs diversified teaching modes from the aspects of online resource construction, SPOC platform selection, classroom teaching activity implementation, curriculum assessment and evaluation, analyzes the advantages and disadvantages. The proposed teaching mode is student-centered, which greatly improves students' participation and improves the quality of curriculum teaching.

Keywords: Blended teaching, University Computer Foundation, Learning Enthusiasm, Teaching Quality.

1 Introduction

The traditional face-to-face teaching mode has some disadvantages, such as single teaching method, lack of teaching resources, poor classroom interaction, low students' enthusiasm, backward teaching evaluation and so on. It is not conducive to comprehensively improve students' ability and no longer meet the social demand for talent training. Under the "Internet Plus" background, information technology platforms such as MOOC, SPOC, rain classroom and OJ have emerged, and a variety of teaching methods such as flipped classroom, split classroom, BOPPPS and blended teaching have been developed. Using these platforms to carry out online and offline blended learning has become the development trend of higher education teaching reform[1]. Many universities have put it into practice and achieved considerable results. In the blended teaching model, teachers as facilitators and students as participants, combined with rich online network resources and colorful offline teaching activities, realize a diversified and integrated teaching that complements and promotes online and offline, which can effectively improve the students' initiative in learning, improving students' interest in learning, and cultivating students' research and exploration, unity and cooperation spirit, are also conducive to the improvement of teachers' teaching ability and the innovation of teaching methods. Taking the university computer foundation course as an example,

this paper expounds the current teaching situation, explores the activity design and the construction of curriculum evaluation system in each stage of blended teaching mode, and analyzes its advantages and disadvantages, in order to obtain the expected results in the follow-up curriculum construction.

2   Teaching Modes and Tools in the "Internet Plus" Era

2.1   MOOC and flipped classroom

As a new way of knowledge dissemination and learning channel, MOOC (massive open online course) is popular all over the world. The more famous in China are Chinese University MOOCs, XuetangX, Chinese MOOCs, etc. On the MOOC platform, students can choose famous schools and teachers and use fragmented time to learn. The platform integrates practice, homework and discussion, and can obtain certificates through examinations, which can mobilize students' learning initiative.

Flipped classroom teaching mode, that is, flipping the behavior of students in and out of class. In the traditional classroom, students may or may not preview before class, while in the flipped classroom, students must preview before class. Students watch the teacher's video explanation before class and study independently. The classroom has become a place for interaction between teachers and students and between students, including answering questions, cooperative exploration and completing their studies, so as to achieve better educational effect [2]. MOOC is mainly aimed at social learners, who can choose courses of interest from the MOOC platform. For school students, if MOOC is used for preview, flipping the classroom and improving students' learning flexibility and initiative, it is bound to improve the teaching effect.

2.2   Flipped classroom based on SPOC

MOOC provides undifferentiated teaching services to large-scale people, while SPOC (Small Private Online Course) applies MOOC resources to small-scale and specific groups[3]. Teachers can reasonably adjust MOOC resources according to their students, course content and course progress of different shifts, etc., and teach students in accordance with their aptitude. At present, many MOOC platforms have supported SPOC. SPOC platform supports teachers to adjust fragmented MOOC resources according to their own teaching calendar. It can also provide teachers with feedback on students' preview behavior and effect before class, which can be used as a reference for teachers when designing classroom discussion, and effectively make up for the shortcomings of MOOC platform. In the flipped classroom model based on SPOC, teachers are guides and promoters, while students are real participants. This innovative classroom model has stimulated teachers' enthusiasm for teaching and students' learning and improved classroom vitality. The improvement of students' learning interest and in-depth learning experience are conducive to improving classroom quality and course completion rate.

2.3   Rain classroom

Rain classroom is a new intelligent teaching tool. Based on PPT and wechat, it realizes all-round, diversified and multi-level interaction between teachers and students, enables teachers to obtain students' mastery of relevant knowledge and deal with problems in time[4]. Rain classroom only requires students to have an online mobile phone, and they can join the course through the invitation code sent by the teacher. It can not only push slides and homework to students before class, but also carry out Q & A interaction and even bullet screen communication in real class. It can record students' attendance and answers to classroom questions, which can not only provide teachers with students' complete learning track, but also improve students' attention to teaching content and learning effect.

2.4   OJ platform

OJ (online judge) platform supports online submission and real-time evaluation of programs. There are many OJ platforms at home and abroad, but the platforms including curriculum teaching management mainly include Educoder, Python 123, etc. Applying OJ to assisted instruction can make up for the shortcomings of slow and inaccurate manual evaluation program, and reduce the workload of teachers' evaluation program homework. Teachers can view students' answers in real time through the platform, master students' homework progress, correct students' mistakes in time, and improve teaching quality[5]. Students can verify the correctness of the program through automatic evaluation. OJ platform can also support student competitions, effectively stimulate students' interest in learning, and improve students' practical ability, self-study ability and realistic and pragmatic scientific attitude.

2.5   Blended teaching

Blended teaching is a kind of "online + offline" teaching that combines the advantages of online teaching and traditional teaching[6]. The blended teaching stage is divided into pre-class, in class and after class stages. For pre-class preview, teachers should sort out the teaching content, select some knowledge points, build online video course resources, and enter exercise questions; students will watch the video and complete the preview homework assigned by the teacher. For the in class stage, teachers should reasonably design teaching activities according to students' preview and completion of homework, maximize students' enthusiasm to participate in the classroom, and use the rain classroom to record data in real time. For the after class stage, teachers should assign consolidation homework and expansion homework, and evaluate students' learning effect through appropriate evaluation methods. At present, as a new teaching mode based on information technology, blended teaching has attracted more and more attention from the educational circles. Many universities have also carried out in-depth and systematic exploration and practice, and formed considerable practical results.

3 Disadvantages of the Current Teaching Model of University Computer Foundation Course

University computer foundation course is a public basic course for all students in the university. At present, the course teaching in our university is affected by many factors, and there are still some problems.

3.1 Backward teaching concepts and methods, classrooms lacks interactivity

At present, we adhere to the traditional classroom teaching mode and take "teaching + computing" as the main teaching method. In the theoretical teaching class, teachers give priority to teaching. Due to the limited time and many teaching con-tents, information is spoon-fed to students. At present, the teaching content is not the traditional basic teaching of computer culture, but this leads to more complicated content, deeper difficulty, insufficient class hours and reduced learning efficiency. Moreover, teachers and students lack interaction. Teachers only interact through classroom questioning, and students' enthusiasm is not high, which does not achieve the effect of students' in-depth interaction with teachers through learning and research. For the computing class, students practice, and teachers provide unified guidance for common problems. The class hours are limited, and the extracurricular students' learning enthusiasm is not high, especially the students with poor basic level, their learning interest will gradually decrease. In addition, fixed teaching contents and single assessment methods cannot meet the learning needs of students of different majors, and cannot highlight the dominant position of students in the classroom, which is not conducive to cultivating students' autonomous learning ability, computing thinking ability and practical operation ability. Therefore, the traditional teaching is difficult to meet the needs of the development and practice of information technology.

3.2 Students lack interest in learning and have weak awareness of autonomous learning

For university computer foundation courses, there are great differences in students' basic ability and learning ability. If teachers adopt unified teaching guidance methods and practical operation means in teaching work, it is difficult to carry out targeted teaching and guidance according to the differences of different students, resulting in the polarization of students' academic performance, and the learning enthusiasm of students with poor basic level will be reduced.

In view of this, teachers are actively doing a good job in the ideological work of students and trying to innovate teaching methods, such as strengthening interaction, guiding poor students separately, using OJ platform to arrange breakthrough homework, etc. However, teachers' analysis of students' learning characteristics and needs is

often insufficient. It is difficult to take into account the interest characteristics and differences of each student, and it is also difficult to explore targeted teaching methods. There is still little effect in stimulating students' learning interest.

In addition, some students are weak in autonomous learning, fail to change their learning mode from middle school to university, and have a weak awareness of self-learning and autonomous learning. What's more, some students don't pay enough attention to this basic course, just to get credit.

3.3   Single evaluation method and poor teaching effect

The course assessment takes the form of "formative score + final score". The formative score mainly depends on the usual homework and periodic test results. The final score takes the form of computing assessment and written assessment. With regard to the evaluation of formative achievements, it is difficult to prevent students from plagiarizing homework in order to obtain credits. Due to the complexity of teaching content, teachers have a large workload of marking homework. Sometimes they can only mark some homework, and the results given are lack of objectivity and fairness. The final score accounts for a large proportion, and if the final assessment is not enough, the score of this course will not be passed, which leads to students not paying attention to the formative score. There is often a phenomenon that students study hastily for an impending examination, but do not really treat the course learning from the perspective of improving their computer knowledge level and computational thinking ability. The results are that students lack interest in learning, the examination scores are not ideal, and the expected teaching objectives and effects are not achieved.

4   Design of Diversified Blended Teaching Mode for University Computer Foundation Course

University computer foundation course has many knowledge points and strong practicality. The blended teaching of "SPOC + rain classroom + educator" is conducive to improving the learning effect. Many universities have carried out blended teaching of this course and obtained achievements[7,8]. Based on their experiences and combined with the characteristics of our school's curriculum, we build a blended teaching model with the main line of "learning knowledge before class, practicing ability in class, strengthening application after class and adjustmenting strategies through continuous evaluation". Its overall framework is shown in the figure below:
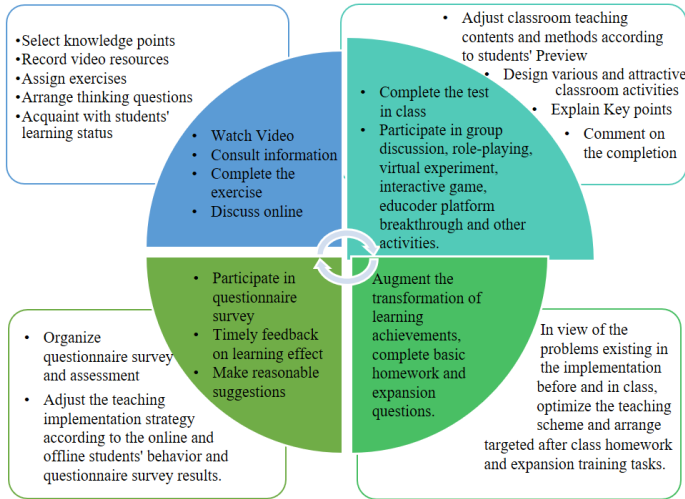
Fig. 1. Overall framework of blended teaching (for each stage, the outer rectangular shows the teacher's activities, and the inner fan shows the students' activities)[Owner-draw]

4.1   Fragmented online resource design

"Online resources" is a prerequisite for the construction of blended teaching model. University computer foundation course has many independent knowledge points, which is very suitable for making micro video for fragmented teaching. Based on the course teaching plan, teachers should re-sort out the contents of the traditional classroom, break up a large number of knowledge points, and make it easy to adjust MOOC resources according to the teaching progress. Teachers should clarify the logical relationship between knowledge points and select appropriate knowledge points to build MOOC resources according to the characteristics of each knowledge point. Generally speaking, offline teaching is more appropriate for more abstract and difficult knowledge points. The contents of course should go from the easy to the difficult and complicated, and highlight the keys and difficulties, and should be profound in some degree and range. For online contents, teachers need to consider the individual differences of students and make multi-dimensional course resources. The university computer foundation teaching group fragmented all knowledge points and selected about 20 knowledge points to record MOOC videos.

When designing MOOC videos, we should use various presentation forms to maximize the attraction and ensure that students can watch it for 10 minutes without distraction. For the video of a single knowledge point, we need to design guidance, key learning content, interaction and test, and ensure that the video duration does not exceed 15 minutes. Online MOOC resources are mainly used for students' self-study, and the basic principle is that most students can understand and master independently. Students' learning results of MOOC video resources can be used to assist teachers in designing offline classroom activities.

4.2   Select the suitable SPOC platform for curriculum

Excellent SPOC platform should provide teachers with flexible curriculum arrangement function and perfect feedback function of students' learning behavior and learning results. The platform should be able to provide comprehensive customization of a series of dimensions such as time, space, learning objects, teaching contents and the display form of knowledge points, and provide precipitation and sharing of resources, fine-grained data statistics and analysis services. Many universities have established their own SPOC platforms. Our teaching group adopts the form of independent SPOC, that is, we carry out curriculum design independently and organize small-scale teaching in our university entirely by using our own teaching resources.

After the SPOC platform and form are selected, the curriculum will be set up. SPOC platform supports personalized customization. Teachers should first establish groups according to the number of classes they undertake, and then organize the presentation order and time of MOOC resources according to the teaching calendar of different classes. For the resources of each class, teachers set the effective time of the course, the effective time of a single resource and the completion time of exercises. Teachers can also establish a knowledge point system for the curriculum, so that students can intuitively see the completion time of each knowledge point and the relationship between each knowledge point, so as to clarify the position of the learned knowledge point in the curriculum system, and guide for subsequent learning.

4.3   Design online and offline blended classroom

Teachers can release online learning resources in advance, so that students have enough time to complete online preview independently. Students first watch the SPOC video, during which they can have online discussion and communication. After watching and understanding, they can complete the exercises independently to test their mastery of knowledge points. SPOC platform records the duration and times of students watching videos online, the correct rate of answering questions and the time required to complete them. For the knowledge points that need programming, students submit programming assignments on the educoder platform.

Through online learning, students can master the basic knowledge points. In offline classroom, teachers will check and make key breakthroughs according to students' learning situation. At this time, the most important thing is that teachers should carefully design offline classroom teaching activities, which can not only fully mobilize students' learning enthusiasm, but also effectively make up for the shortcomings of online course learning, and finally consolidate and flexibly apply the basic knowledge learned. Record students' learning feedback in offline classes through the rain classroom and educoder platform.

In the offline classroom, teachers should design diversified teaching activities centered on students, which should actively attract students' participation, and the main role of teachers is to guide learning and plan activities. There are many ways to choose: debate competition, group discussion, task driven, case-based learning, role-playing, virtual experiment, etc. Using rain class and educoder platform, teachers regularly push

exercises, and summarize core knowledge points. After class, students continue to complete the discussion and programming homework assigned in the class, so as to externalize, transfer and apply the learned knowledge.

Taking several typical knowledge points in university computer foundation course as examples, we illustrate the specific implementation process and expected learning effects of the blended teaching mode, focusing on the specific activities of offline classroom.

Table 1. Teaching Process of "Turing Machine"[Owner-draw]

Knowledge-Points	Turing machine;Development of computer.
Teaching activities	Online activities: Watch video; Complete the exercises of Turing machine Questions: what role does Turing machine play in the development of computer? What is Moore's law?
	Offline activities: group communication and debate. Using rain classroom, teachers test students' online knowledge mastery. Teachers assign Turing machine questions with increased difficulty. Using Turing machine as a guide, let students communicate and discuss in groups, and discuss the development process of computer, and display the discuss results. Then there is a debate about whether Moore's law will end. Finally, the teacher makes a comment and summary.
Learning effects	Understand the composition and operation mechanism of Turing machine.

Table 2. Teaching Process of "Function"[Owner-draw]

Knowledge-Points	Function and its application
Teaching activities	Online activities: As above in Table 1.
	Offline activities: task driven, inspiring, interactive teaching and group cooperation. Use the rain class to test the knowledge points involved in the preview. Because the understanding of function is the key and difficult point, students often do not understand it in place. In offline class, teachers set questions to inspire students to think, such as: Why use functions? When is it appropriate to use functions? Teachers set up breakthrough tasks on the educoder platform, guide students to complete step by step, and explain the error prone places at each level. Due to the difference of students' cognitive ability, the team leader is responsible for supervising and guiding each team member to keep up with the learning progress.

Learning effects	Master the definition and calling methods of Python functions. Fully understand the function of function. Be able to solve practical problems with functions. Through debugging errors in programming, cultivate rigorous and serious scientific spirit. Through advanced breakthrough, consolidate knowledge and experience the fun of programming. Through self creation of works, improve self exploration and innovation ability.

Table 3. Teaching Process of "Decimal to Binary Conversion"[Owner-draw]

Knowledge-Points	Decimal to binary conversion
Teaching activities	Online activities: As above in Table 1.
	Offline activities: Students' explanation, formula summary, game participation and enlightening thinking. Use rain classroom to test online learning knowledge points. Select some students to talk about the process of conversion, and the teacher summarizes the formula convenient for memory. Students participate in the "Harry Potter telepathic magic" game and think about the principles used. Extended heuristic topic: how to convert decimal to the base of arbitrary? How to solve the problem of changing money based on what you have learned?
Learning effects	Master the method of converting decimal integers to binary integers. Be able to flexibly apply the knowledge points learned to solve practical problems. It's better to attract student to participate in fishing than to give him fish. Game activities improve students' participation and promote students' active learning and spontaneous exploration.

Table 4. Teaching Process of " Von Neumann Architecture"[Owner-draw]

Knowledge-Points	Von Neumann architecture
Teaching activities	Online activities: complete video learning and testing, and complete online virtual experiment of computer assembly.
	Offline activities: analogy analysis, group communication, role play, heuristic discussion. Use the rain classroom to test the students' mastery of von Neumann architecture. The teacher physically shows each hardware in the computer, and then makes an analogy with the human information processing process. The students are divided into groups. Each student in each group plays different hardware roles such as CPU, calculator and memory, carries out division of labor and cooperation, and cooperates to simulate the working principle of von Neumann structure. Finally, each group cooperates to draw a smiling face or other works. Heuristic question of design: which role is the most important. The position of von Neumann architecture in computer development? Finally, teachers summarize and analyze that each role is indispensable and complementary.

Learning effects	Master the composition and functions of von Neumann architecture.
	Master the characteristics of von Neumann architecture.
	Learn about von Neumann's life and sharing, experience the efforts behind his success, and stimulate students' learning motivation.
	Experience the subtlety of von Neumann's structure and realize the hard won technological progress in the development of information technology.
	Through role-playing, division of labor and cooperation, give play to students' subjective initiative, further understand the functions of each part, and strengthen students' sense of teamwork.

There are many knowledge points in the course. Teachers need to carefully design the interactive design activities of each knowledge point, which needs continuous research and improvement, and is also our long-term key work.

4.4   Optimize the course assessment system

For the blended teaching mode, the curriculum assessment and evaluation includes formative evaluation and final evaluation, which reflects the students' learning achievements and status. Formative evaluation refers to the assessment of the process, which should include online evaluation and offline evaluation, and integrate the statistical data of SPOC platform, rain classroom, educator and other platforms, as well as classroom discussion and task completion. Online evaluation mainly refers to students' watching videos, completing exercises and homework; Offline evaluation mainly refers to students' performance in class, in class homework, group homework and other situations, which can be evaluated by many ways, such as teachers' comments, inter group mutual evaluation and so on. The final evaluation is the final examination. Improving the proportion of formative assessment will help to mobilize students' enthusiasm for participatory learning. Teachers should be strict to students, and students should not feel that they can be easily obtained even if they do not participate. Finally, a scientific, fair and reasonable comprehensive evaluation is formed.

For the evaluation of course teaching effect, in addition to the course assessment and evaluation, teachers should conduct a questionnaire survey on students before, during and after class, and the focus of the survey is different in each stage. The content of the survey includes the understanding of the course content, the recognition of MOOC, suggestions on classroom teaching activities, satisfaction with the course teaching effect, students' time spent, students' favorite tasks and so on. The evaluation results will be used as the basis for the comparison between blended classroom and traditional classroom teaching.

5   Analysis of Expected Teaching Achievements and Disadvantages.

Adopting this diversified online and offline blended teaching mode will undoubtedly bring many considerable achievements:

First, the fragmented MOOC resources enable students to learn on demand before class. There are great differences in students' basic level and cognitive ability. Teachers must impart knowledge at a speed in the classroom, which leads to some students learning too much knowledge and difficult to understand, while some students do not have enough knowledge to learn. The fragmented MOOC resources for students' preview before class can effectively solve this problem. Students can spend different time to complete their study according to their personal cognitive ability. Especially for students with poor cognitive ability, they can study repeatedly, realizing on-demand learning and personalized chemistry.

Second, excellent classroom interaction design can greatly stimulate students' learning initiative and significantly improve their attention in class. Through game participation, role play, group discussion, etc. in this flipped teaching classroom, students are often stimulated, showing a completely different learning state from the passive reception of knowledge in the traditional classroom. They will actively explore and excavate the required knowledge in and outside the classroom, greatly improving their learning initiative. Regular push exercises in class and the barrage in the rain classroom enable students to avoid the distraction caused by passive listening in the traditional classroom and improve their attention. After achieving results through self and cooperation, they will gain a sense of honor and collective existence, and improve their outlook on life and values.

Third, it has cultivated students' good habits of research-based learning, unity and cooperation. In the classroom, teachers guide students step by step and inspire students to think step by step. Students complete tasks together in cooperation with team members, and gain a sense of achievement in research-based learning and unity and cooperation. In this process, students will also find that there are many incomprehensible problems. Their doubts about knowledge will guide them to continue to explore and cooperate, and even apply this spirit to the study of other courses.

Fourth, the dynamic and diversified assessment methods that integrate various online and offline activities are not only conducive to the transformation of students' learning ideas, but also conducive to teachers' adjustment of teaching strategies. The data of all online and offline activities of students are recorded through the information technology platform. Teachers can systematically and timely obtain the learning status of students, timely adjust the teaching implementation plan, and provide targeted guidance according to the characteristics of students.

But we should also see the disadvantages of this teaching method. First, both teachers and students need to spend a lot of time. For teachers, designing and recording excellent MOOC resources and designing classroom teaching interactive activities are endless. There is only better, no best. For students, they need spending time to online learning and practicing, and to prepare for participating in offline discussion activities and achievement display. Second, for military academies, there is a contradiction in the control of students' mobile phones. In order to ensure the quality of classroom teaching, mobile phones are not allowed in the traditional classroom. In the mixed classroom, we should ensure that students cannot use mobile phones for chatting and playing games, but to better participate in teaching. Of course, as long as teachers design classroom activities well and can fully attract students to participate, the advantages of carrying

mobile phones outweigh the disadvantages. Third, individual students are used to the traditional classroom mode, and it is difficult to adapt to the new teaching mode for a time, especially in active learning, they are prone to fatigue and boredom. Fourth, the foundation of individual students is too poor. Even if they spend a lot of time on pre class learning, they cannot meet the expected learning effect requirements, which will affect the next offline activities designed by teachers.

Generally speaking, most students are more willing to accept the blended classroom teaching mode, and the overall teaching effect is higher than that of the traditional classroom.

6 Conclusions

The blended teaching mode is a subversion of the traditional classroom, and both teachers and students need to change their ideas to adapt to this mode. At present, the blended teaching mode is still in its infancy in our university, and our course group is also exploring and studying. There are a lot of work to be done, including enriching online resources, carefully designing offline classroom activities, improving the quality of teaching team, etc. More importantly, we should put this diversified blended teaching mode based on "SPOC + rain classroom + educoder" into practice and constantly improve the effects. Finally, students become the biggest beneficiaries, which meets the needs of talent training in the information era.

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