

An Application Research on the MOOC-based Flipped Classroom Teaching Model

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Abstract:

MOOC is mainly the use of the network platform to show the teaching content in the form of micro-lesson, and flipped classroom is a unique innovative and individualized teaching model. The MOOC-based flipped classroom teaching model is the use of network technology and resources to flip the teaching goal and teaching form, teaching subject and teachers, and to create a new situation of teaching and learning. On the basis of a full study on the current situation and related theories of the application of the flipped classroom and MOOC, this paper constructs the MOOC-based flipped classroom teaching model, and applies it to the course *International Trade Practice English*. The author carries on the teaching experiment to explore the effectiveness of flipped classroom teaching model in college English teaching. The experiment proves that the application of the MOOC-based flipped classroom teaching model improves students' academic performance and the teacher and students have a positive attitude towards the implementation of the MOOC-based flipped classroom teaching model. Finally, the author summarizes the major findings for the follow-up research with a hope to provide some reference for the future application.

Keywords:

MOOC, Flipped Classroom, Teaching Model, Empirical Study

1. Introduction

With the rapid development of computer network technology and media technology, people's access to information and knowledge is more intelligent and diversified. The promotion of information is changing new learning methods, which are changing the way people perceive, so the traditional teaching model can no longer meet the needs of learners in all aspects. Therefore, educators all over the world are actively exploring effective teaching models to adapt to learners' cognitive structure and cultivate innovative talents with good autonomous learning ability, interpersonal communication ability and research ability. Among them, MOOC and flipped classroom are one of the latest educational teaching models, which are concerned by the attention of educational researchers all over the world [1].

At present, the research on flipped classroom abroad is relatively mature. Most domestic research is limited to the detailed introduction or subjective evaluation of this kind of teaching mode. In general, the teaching practice in accordance with the national conditions of our country is rare, especially in higher education courses. The author believes that exploring the appropriate flipped classroom teaching mode is the key to the further development of flipped classroom in China, reform the existing classroom teaching model and perfect the long-term drawbacks of the traditional education model to achieve better teaching results. This thesis studies the contents of the relevant knowledge of MOOC and flipped classroom, and makes a scientific analysis of the teaching results of the course International Trade Practice English, in order to further enrich and perfect the teaching model, teaching means and teaching strategies of flipped classroom, hoping that it can provide some theoretical suggestions for improving the teaching quality of this course and help to perfect the theoretical research on the MOOC and the flipped classroom in China.

2. Literature Review

Previous Studies on Flipped Classroom Based on MOOC at Home and Abroad:

Combining international and high-quality MOOC with flipped classroom is beneficial to the dissemination of high-quality courses, the improvement of teaching quality, the development of curriculum content forward-looking and the prominence of students-oriented teaching objectives [2]. The flipped classroom based on MOOC takes advantage of the network and digital innovation, subverts the traditional classroom teaching mode, reconstructs the classroom extracurricular learning content, and causes the domestic and foreign scholars to attach great importance to it. The examples of using MOOC courses to carry out flipped classroom teaching practice are common abroad. For example, Stanford University opened a flipped classroom based on MOOC in the fall of 2012, named Materials Science, the first material science course flipping class based on MOOC [3]. San Jose State University has tried a flipped classroom based on MOOC teaching model, which allows students to use MOOC to learn basic knowledge in extracurricular time, while in class, students can discuss and solve problems with each other [4].

Domestic researchers began to realize the importance of the combination of MOOC and flipped classroom in recent years, and have also carried out a series of theoretical and practical studies. Such as Tsinghua University released the MOOC platform “Xuetang online”, which is not only for off-campus learners, but also for on-campus students to watch the teaching videos on the MOOC platform before class, and implement the MOOC-based flipped classroom teaching model [5]. Professor Lu Zhiyang of Peking University also used the flipped classroom based on MOOC teaching model in his “International Forum” experimental project [6]. There is also Hu Jiehui of the University of Electronic Science and Technology who has established a school-based MOOC platform. The practical results of flipped classroom teaching on college English show that the flipped classroom teaching model based on MOOC has been recognized by students and improved the quality of teaching to meet their individual needs [7]

3. Research Methodology

3.1. Research Questions

What is the effect of MOOC-based flipped classroom teaching in the *International Trade Practice English*?

How do students and the teacher evaluate flipped classroom teaching based on MOOC? What are the problems in the implementation process?

3.2. Participants

The students who participated in the study had *International Trade Practice English* once a week, of which English class 17-2 was an experimental class with 29 students, using the MOOC-based flipped classroom teaching model, English class 17-4 as a control class with 32 students, adopting the traditional classroom teaching mode. The teacher in the two classes is the same, and the teacher has rich teaching experience and more than one year of flipped classroom teaching experience. Students in both classes use multimedia classrooms with about same frequency. The experiment began on March 9, 2020 and ended on June 24, 2020.

3.3. Research Instruments

3.3.1. Tests

In order to solve the first research question, “what is the effect of MOOC-based flipped classroom teaching in *International Trade Practice English*”, in this study, two final exams are used as the pre-test and post-test respectively. Among them, the final examination results of *International Financial English*, which they studied together in the first semester of junior year, were taken as the pre-test results, and the final examination results of *International Trade Practice English*, which they studied in the second semester of junior year, were taken as the post-test results.

3.3.2. Interviews

After the experiment, some students and the teacher in the experimental class were interviewed. Through interviews, we can further understand the students' attitude towards college English MOOC-based flipped classroom teaching, as well as the suggestions and opinions of teacher and students as a reference to improve the teaching model.

3.4. Research Procedures

Through the analysis of the teaching model of MOOC-based flipped classroom and *International Trade Practice English*, the author has a good understanding of the relevant knowledge. In order to improve the students' learning efficiency and promote the curriculum reform in colleges and universities, the author designs a flipped classroom teaching model which is suitable for the course, as shown in Figure 1.

3.4.1 Self-learning before Class

In the pre-class section, the teacher needs to carry out: (1) the teaching/instructional design. The teacher must first analyze and clarify the learning content, the learning objectives, the learner characteristics and other aspects so as to clarify the ideas of the class, and then design learning tasks with appropriate levels of difficulty according to the content, and collect materials related to the course (websites, videos, documents, etc.) so that students can easily access them at any time. (2) issuing learning tasks, which are similar to the autonomous learning task sheets and include a study guide,

learning tasks, and methods and suggestions. The study guide includes the course title, the course objectives, and informs students of the level of knowledge they will achieve through independent inquiry. The learning tasks inform students of the pathways they need to take to achieve the course objectives. Methods and Suggestions are that teachers can provide to students to improve their learning and develop their independent inquiry skills. In this session, students watch the video and consider the questions raised by the teacher for independent learning. (3) providing learning resources. Teachers upload relevant information collected before class to the MOOC platform for students to use. (4) opening pre-class testing. At the end of each chapter on the MOOC platform, there will be an online quizzes corresponding to content, all objective questions, with reference to the course objectives and key points for learners to complete after learning. Students use the resources provided by the teacher to investigate the problems, focusing on the inner connection between things and grasping the laws to form their own understanding, and then take online tests on the MOOC platform or We-chat group to verify their understanding of the new concepts.

After the students get the pre-class autonomous learning materials and the task sheet, they watch the teaching video, and complete the tasks. In the autonomous learning module, students rely on learning materials (guidance cases, teaching materials, learning resources of mobile terminals) to solve the problem. Students obtain relevant knowledge information by consulting relevant materials, complete the study in advance, and take notes. Students use the exercises provided by the teacher to test and master their own learning and give feedback, sorting out their doubts and questions that need help. Teachers can follow and guide students' independent learning through the online platform, and understand the problems students encounter in their video watching. Teachers initiate online discussions and question and answer sessions to address learning difficulties encountered by students. By collecting students' completion of tasks and exercises related to the independent learning task sheets, the teacher summarizes the problems encountered by students and the suggestions made by students to prepare for the next step of classroom teaching. Finally, teachers use student learning feedback to study and grasp the learning situation, adjust classroom teaching plans and teaching tasks, and develop individual tutoring plans to improve the relevance of classroom teaching.

3.4.2. Internalization of Knowledge in Class

In class, teachers create appropriate teaching situations according to the teaching content, and students internalize knowledge through cooperative inquiry and interaction. Instead of explaining all the knowledge points in detail, the teacher asked each group to make a PPT presentation of the relevant content in front of the podium according to the questions in the learning task sheet. The teaching activities in the classroom are mainly based on group work and teacher-student interaction. First, the teacher organizes each group to show the study results of the pre-class task sheet. After each group presents a certain knowledge point, students of other group can ask questions about what they don't quite understand and the group presenter or inter-group collaboration can answer questions and solve problems, and other groups can also make appropriate additions. The last group to present can throw out a question to other group members, or a question that their group has not yet solved in the learning for help. If a question is not answered by all the groups, the teacher will give appropriate guidance or extend it to further research outside the classroom. Finally, the teacher reproduces the common problems of the students and the important and

difficult points of the lesson learned in the pre-class communication, and then summarizes the feedback after the students' answer, so as to better promote the consolidation and mastery of the knowledge points. The classroom activity is helpful to promote learners' knowledge construction and internalization and improve teaching effect.

3.4.3. Knowledge Consolidation after Class

According to the teaching objectives and teaching contents of each chapter, teachers design scientific and reasonable post-class test questions to test students' mastery of relevant knowledge points and their ability to flexibly apply knowledge to solve practical problems. After completing the course, students log on to the "learning assessment" module in the *International Trade Practice English* platform after class to further consolidate and internalize the knowledge learned and improve their knowledge application skills.

4. Results and Discussion

In one semester's experiment, the author tested the students in the experimental class and the control class before and after the experiment. After the experiment, some students and the teacher of the experimental class were interviewed about the implementation effect of MOOC-based flipped classroom teaching model.

4.1. The Results and Discussion of Tests

4.1.1. Comparison of the Pre-test between EC and CC

The results of this study were analyzed by SPSS statistical software. In order to understand the difference of the initial learning level between the experimental class and the control class, the author collected the final grades of International Financial English in the last semester of the two classes as the pre-test data (Appendix A), calculated the mean value, standard deviation, and carried out the t test of independent samples. The results are presented in Table 1 and Table 2.

Table 1. Group Statistics of Pre-test in EC and CC.

Class		N	Mean	Std. Deviation	Std. Error Mean
Pre-test	CC	32	85.72	4.305	.761
	EC	29	85.17	4.252	.790

Note: EC=Experiment class, CC= Control Class, N=Number

Table 2. Independent Samples Test of Pre-test in EC and CC.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	sig.	T	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pre	Equal	.10	.74	.49	59	.620	.546	1.097	-	2.742

- test	variances assumed	5	6	8					1.649	
	Equal variances not assumed			.498	58.549	.620	.546	1.097	1.648	2.741

As shown in Table 1, the average grades of control class and experimental class are 85.72 and 85.17, which are similar. In Table 2 independent samples t-test, the Sig. value of Levene's Test for Equality of Variances is $0.746 > 0.05$, indicating that there is no significant difference in equality of variance. According to the data in the first line of independent sample t-test, Sig.(2-tailed) $0.620 > 0.05$ shows that there is no significant difference between the experimental class and the control class before the experiment. It can be concluded that the grades of the two classes are similar before the implementation of the experiment, and the student level varies little.

4.1.2. Comparison of the Post-test between EC and CC

Score is the most direct way to test the effectiveness of teaching. After the flipped classroom instruction, students in both classes took a final test at the same time as required by the school. The final grades of the experimental and control classes (Appendix B) were counted and analyzed with SPSS software to see if there were differences in the grades of the two classes, with the following results. The results are presented in Table 3 and Table 4.

Table 3. Group Statistics of Post-test in EC and CC.

Class		N	Mean	Std. Deviation	Std. Error Mean
Post-test	CC	32	83.97	5.233	.925
	EC	29	89.17	5.813	1.079

Note: EC=Experiment class, CC= Control Class, N=Number

Table 4. Independent Samples Test of Post-test in EC and CC.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	sig.	T	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Post-test	Equal variances assumed	.222	.639	-3.680	59	.001	-5.204	1.414	-8.033	-2.374
	Equal variances not assumed			-3.680	56.638	.001	-5.204	1.422	-8.051	-2.357

Table 3 shows that, in the post-test, the average score of control class is 83.97, while the average score of the experiment class is 89.17. The average final grade of the experimental class was higher than that of the control class. In Table 4 independent samples t-test, the Sig. value of Levene's Test for Equality of Variances is $0.639 > 0.05$, indicating that there is no significant difference in equality of variance. According to the data in the first line of independent sample t-test, Sig. (2-tailed) read as $0.001 < 0.05$, which means there is a significant difference between the grades of experiment class and the control class. Therefore, it can be concluded that there is a gap between the grades of the control and experiment classes after the implementation of the MOOC-based flipped classroom teaching model in the experiment class.

Through the average grades and standard deviations of the pre-test and post-test, it can be clearly found: compared with the traditional English course teaching, the results of the course after the teaching experiment are better than those of the traditional classroom. It shows that the flipped classroom teaching model can improve students' performance more effectively.

4.1.3. Comparison between the Data of Pre-test and Post-test in EC

Table 5. Paired Samples Statistics of Pre-test and Post-test in EC.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	85.17	29	4.252	.790
	Post-test	89.17	29	5.813	1.079

Note: EC=Experiment class, CC= Control Class, N=Number

Table 6. Paired Samples Test of Pre-test and Post-test in EC.

Pair1	Paired Differences					t	df	Sig.(2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
	-4.000	5.843	1.085	-6.223	-1.777	-3.686	28	.001

The test grades of the experimental class were collected before and after the experiment as an independent entity to conduct a paired-samples t-test to see if there was a significant difference between the grades of the experimental class before and after the experiment. As can be seen from Table 5, the average grades of pre-test and post-test are 85.17 and 89.17 respectively, a considerable rise in the average grades. We can see from Table 6 Paired Samples Test that the lower and upper 95% confidence intervals of the difference are -6.233 and -1.777, respectively, which do not contain zero, indicating that there is a significant difference between the two variables. At the same time, Sig. (2-tailed) $0.001 < 0.05$, that is to say, there is a significant difference between the pre-test and post-test in the experiment class. Thus, we can conclude that the grades of the experiment class have been improved and the effect is very remarkable after the implementation of the MOOC-based flipped classroom teaching model.

4.2. The Results and Discussion of Interview

After the experiment, the author interviewed some students and the teacher in the experiment class. The first step was to find out students' attitudes towards the MOOC-based flipped classroom model, and what progress or gains students had made

in the classroom. At the same time, we will find out what problems the students think there are in the class using the model. Secondly, we will find out the teachers' evaluation of the MOOC-based flipped classroom teaching model and their suggestions on its application in actual teaching, as well as the problems that need to be improved from the perspective of the teachers. The interview outline is detailed in Appendix C and Appendix D.

4.2.1. Student Interview Results and Discussion

Question 1: Do you prefer MOOC-based flipped classroom teaching model to traditional teaching model? Do you think MOOC-based flipped classroom teaching model helps to improve learning enthusiasm and interest?

Students A: Yes, I prefer MOOC-based flipped classroom teaching model. This teaching model has changed the passive position of the students. I have more autonomous learning time and can design my own learning plan and study time.

Students B: I think MOOC-based flipped classroom teaching model has positive effect on the improvement of students' learning interest and enthusiasm. In traditional classrooms, students are unable to concentrate long and are easily distracted, resulting in lower learning efficiency and interest in learning. While students occupy an active position in flipped classroom teaching model, master new contents through autonomous learning, furthermore, the atmosphere of classroom display is warm, and the participation is very high, so the students' interest and enthusiasm in learning are higher.

Question 2: Can you talk about the biggest difficulties encountered in the past three months and how do you solve them?

Students C: During the first week of flipped classroom, I felt that I was not self-control and efficient. It is difficult for me to complete the learning task in time as other students do, and the accuracy rate of the test is not high. Later, under the supervision and encouragement of the group members, I overcame my inertia, completed my study tasks on time with high quality, and discussed with the group students in time. In the next few months, we encouraged each other. In the end, good results were achieved.

Students D: I think the biggest difficulty I encountered was working as the team leader. During the group learning discussion, everyone expressed their own views, did not give way to each other and insisted on their own views. As a result, the group atmosphere is extremely tense and the reporter cannot unify group members' opinions to present the group learning results. I calmed down and analyzed the situation and the punishment we would face if we couldn't complete the report. After the compromise in the group, the second round of discussion was calmly held, and finally agreement was reached. This incident made me realize the importance and role of being a team leader, and I grew a lot from this experience.

Question 3: Compared with the traditional classroom, what do you think is the biggest advantage of MOOC-based flipped classroom teaching model?

Students E: I think this teaching model makes students become the subject of the classroom, and teachers will consider our learning status according to our learning situation to do the learning plan. In the process of learning, teachers and we have more communication and in time when we have problems, and teachers will also

participate in our group discussions and correct our mistakes timely. So I think the increase in communication is the biggest advantage of this teaching model.

Students F: I think the biggest advantage is autonomous learning before class. We can log on to the learning platform to view the teaching video prepared by the teacher, which allows me to have a preliminary understanding of what I have learned, just like a teacher around to guide me. This makes me learn new knowledge willingly and actively. During this time, I felt more and more comfortable in class, not as nervous as ever.

Question 4: Please give us some specific suggestions for this course.

Students G: The Xuetang online platform we use contains a lot of functions and provides good software conditions for our course. However, in use, we often encounter problems, for example, you can't log in, you can't submit assignments, and your online learning time is not recorded accurately and so on. I hope the designer of the platform can improve the function of the cloud platform and improve the stability of the platform.

Students H: I hope the teacher assign less tasks, for many times we learnt in order to finish the homework, and after the homework were finished, our brains became blank, what's worse, there is no time to think more. So I hope the teacher can arrange the online learning and classroom learning more scientifically.

Students I: I feel that the teacher's supervision is not enough, because some students will fish in troubled waters after class, and the teacher will not take care of every student in class, so I hope the teacher can strengthen the supervision of the students.

In the interview, we try to understand the students' true intention and collect real feedback. In the paper, we list several representative interview records. We collate and summarize the interview records in time, and reflect on the teaching design process. After investigation, many students said that they were willing to continue to learn with this MOOC-based flipped classroom teaching model. Thus, the implementation of this teaching model has been recognized by students and achieved initial success.

At the same time, we also found some problems in the implementation such as, heavy learning tasks; too many learning resources available; insufficient teacher's individualized guidance; the unsatisfaction to the stability of the learning platform; the imbalance task allocation in cooperative learning; poor students' self-discipline, and so on. Therefore, when implementing the MOOC-based flipped classroom teaching model, teachers should strengthen the control and supervision of these activities, both in class and after class.

4.2.2. The Teacher's Interview Results and Discussion

Question 1: Professor X, since the flipped classroom teaching has been going on for three months, what is your feeling?

Professor X: I'll talk about my feelings from the teacher's point of view. Compared with the traditional teaching model, the MOOC-based flipped classroom teaching model has a higher requirement for teachers' preparation before class. In the past, we only need to show PPT in class, many of which were used by teachers over the years, so it doesn't take time and energy to prepare. However, the autonomous learning

before class is very important in flipped classroom, so I will carefully record the video, update the teaching PPT, and upload these learning resources to the learning platform for students to watch and learn. Sometimes it's really tedious, but seeing the students change their ways of learning, I think it's worth the time and effort.

Question 2: Can you talk about the biggest change of the students in the experiment class in this period compared with the students in the control class?

Professor X: The most obvious change is that students' enthusiasm for learning has improved a lot. They will learn independently, and they can complete the learning tasks within the specified time without the supervision of the teachers.

Question 3: What are the biggest problems you encounter? And how do you solve them?

Professor X: The biggest problem is the supervision of students' learning, because the learning platform is not convenient to monitor students' learning situation. Therefore, the supervision of students is done through the classroom supervision and reminder of teacher and the teaching assistant, but it has been proved that this needs to be improved. In addition, in practice, the lack of time or the inability to keep up with students' progress due to their heavy academic load is also a factor to be considered. In general, teachers are still optimistic about the prospect of MOOC, especially in the case of high degree of conformity between the MOOC and the local course, which is conducive to the innovation of teaching model in college education.

Question 4: What are your suggestions and expectations for the design of flipped classroom teaching activities based on MOOC?

Professor X: I think the learning platform have more room for development, such as the function of participating in teaching evaluation, which can bind knowledge learning before and after class and final score, and increase the attention of students. At the same time, students can also build learning resources, and truly become the master of learning.

In the teaching experiment, the course teacher puts forward very valuable suggestions for the research of this paper. After communicating with the teacher many times, we summarize the teachers' feedback on the evaluation of the MOOC-based flipped classroom teaching model.

The teacher said that during the implementation of MOOC-based flipped classroom teaching model, we provided students with sufficient resources, including teaching video and electronic materials, and designed a lot of learning activities suitable for cooperative learning, which enriched classroom teaching and cultivated students' cooperative learning ability and autonomous learning ability. But this teaching model also has some problems. First of all, the required autonomous learning before class makes many students uncomfortable. Secondly, it is difficult for the teacher to control the group cooperative learning, and it may be difficult for teachers to take into account the learning of each group. So the time arrangement for group cooperative study needs to be more reasonable. At the same time, the course design ignores review. Although flipped classroom teaching model focuses on students' "self-learning before class and exploring practice in Class", and realizes the flipped of "teacher teaches in class and students practice after class", it does not mean that students do nothing after class. The necessary review and thinking of the students should be involved in curriculum design.

The course teacher believes that the design of this teaching model is reasonable, which is worthy of promotion and popularization, but there is room for continuous improvement. Nowadays, traditional teaching is still prevalent in the classroom, and being able to make efforts to adopt new teaching modes and inject new vitality into classroom teaching is a basic quality that educational technologists should have.

5. Conclusions

Based on the relevant theory and practice of model of flipped classroom teaching at home and abroad, the author makes an empirical study. By comparing the grades of the pre-test and post-test of the experiment class and the control class, and analyzing the data collected from the interview, the feasibility and applicability of the flipped classroom in the teaching of college English course are confirmed, and the expected results are obtained. The results show that:

Firstly, flipped classroom teaching improves the students' learning effect. Through the comparison of the grades of the pre-test and post-test of the experiment class and the control class, and the comparison of the grades of the pre-test and post-test of the experiment class, it can be seen that the MOOC-based flipped classroom teaching model improves the students' academic performance.

Secondly, the flipped classroom teaching model is widely recognized by teachers and students. After a semester of teaching time, both students and teachers have witnessed the great influence of the MOOC-based flipped classroom teaching model on students. Both teachers and students begin to take a positive attitude towards this teaching model.

However, in order to ensure the successful implementation and achieve the desired results, teachers should pay attention to the following problems before, during and after class:

a. Teachers should be well prepared before class. Teaching video before class and learning task list are the key resources for students to learn independently. Because of the help of the online network resource of Xuetang platform in this study, the design of "learning task list" has become an important part of the preparation before class for teachers. The "learning task list" is actually a program to guide students to learn independently and the key to help students complete high-quality autonomous learning. At the same time, it also reflects the transformation of teachers from traditional imputers to promoters in students' autonomous learning.

b. Teachers should strengthen the supervision of students' autonomous learning before class. Because the self-supervision ability of college students is not strong enough, the autonomous learning before class should be completed under the supervision of teachers or teaching assistants to ensure the quality of students' autonomous learning. At the same time, students should record the knowledge points and their own problems when watching the video, and then complete the study task list to improve the efficiency of autonomous learning.

c. Group activities should go through flipped classroom teaching. Group activities can take in many forms, including games, debates, role-playing, and so on. In order to avoid reducing students' enthusiasm for learning due to the lack of tasks, teachers should group according to the principle of "intergroup homogeneity, intra-group heterogeneity". Diversified communication activities can effectively improve students' interest in learning and change their attitude towards English learning.

d. The evaluation of students should be diversified. In order to fully show the students' learning situation and improve their interest in learning, in addition to the routine written testing after each flipped classroom teaching, we should also pay attention to the students' learning situation before and in class. For example, it is an effective way for students to fill out the student self-evaluation and mutual evaluation.

e. The burden of students' schoolwork should not be increased. The flipped classroom teaching model requires students to complete their self-study before class with high quality, so teachers should carefully design classroom tests, exercises and activities so that students can master and internalize what they have learned in class. After class, in addition to autonomous learning, teachers should not assign too much other homework, so as not to increase the burden of students.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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Appendix A

Table A1. Grades of Pre-test and Post-test in Experiment Class.

Number	Pre-test	Post-test
1	91	94
2	82	88
3	86	90
4	81	87
5	77	82
6	83	87
7	93	94
8	87	91
9	86	87
10	81	87
11	90	95
12	82	87
13	86	95
14	87	88

15	83	90
16	92	92
17	82	96
18	86	90
19	84	90
20	81	87
21	87	89
22	91	96
23	86	87
24	82	90
25	86	87
26	91	96
27	84	90
28	87	89
29	76	65

Appendix B

Table B1. Grades of Pre-test and Post-test in Control Class.

Number	Pre-test	Post-test
1	92	93
2	80	81
3	85	83
4	83	79
5	80	83
6	91	93
7	88	86
8	87	83
9	91	95
10	80	81
11	88	81
12	87	79
13	93	93
14	81	85
15	86	83
16	92	93
17	85	85
18	85	83
19	80	81
20	90	88
21	80	77
22	83	83
23	85	83
24	81	85
25	87	81
26	91	92
27	80	79

28	88	93
29	81	81
30	86	77
31	92	93
32	85	75

Appendix C

Figure C1. Outline of the Students' Interview.

- (1) Do you prefer MOOC-based flipped classroom teaching model to traditional teaching model? Do you think MOOC-based flipped classroom teaching model helps to improve learning enthusiasm and interest?
- (2) Can you talk about the biggest difficulties encountered in the past three months and how do you solve them?
- (3) Compared with the traditional classroom, what do you think is the biggest advantage of MOOC-based flipped classroom teaching model?
- (4) Please give us some specific suggestions for this course.

Appendix D

Figure D1. Outline of the Teacher's Interview.

- (1) Professor X, since the flipped classroom teaching has been going on for three months, what is your feeling?
- (2) Can you talk about the biggest change of the students in the experiment class in this period compared with the students in the control class?
- (3) What are the biggest problems you encounter? And how do you solve them?
- (4) What are your suggestions and expectations for the design of flipped classroom teaching activities based on MOOC?

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