

Effect of SPOC Flipped Classroom Learning Based on MOOC Platform

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Abstract. To improve student's learning efficiency in classroom teaching, taking the circuit analysis basic course as an example, the SPOC flipped classroom teaching reform project was analyzed. Through structured questionnaires, interviews and MOOC platform data, students' learning experiences, learning styles, learning effects and influencing factors in the flipped classroom model were investigated and compared with students in the traditional teaching model. The research results showed that in terms of learning experience, the average score of SPOC students was higher than the traditional classes, and the difference was significant. It is concluded that the factors that affect the learning effect are student factors, learning experiences and learning methods. In addition, learning objectives, learning pressure and evaluation methods in the learning experience have the greatest influence on the learning effect.

1. Introduction

In 2008, Stephen Downs and George Siemens conducted the first large-scale online open course (CMOOC), setting off an online learning style. In 2013, MOOC (massive open online course) attracted wide attention in China. Major universities such as Tsinghua University and Peking University have joined the MOOC style [2]. In October, the domestic online course "School Online" hosted by Tsinghua University was officially released to the world. College students started skipping classes on campus but they choose classes on the Internet. This is a challenge for colleges and universities. It is also an opportunity for teaching reform.

Ten Years Development Plan for Educational Informationization (2011-2020) points out that the development of educational informatization should be guided by the innovation of educational philosophy, based on the construction of high quality educational resources and information learning environment, and centered on learning mode and educational mode innovation. The SPOC flipped teaching mode [2] makes full use of MOOC online high-quality curriculum resources to mobilize the enthusiasm of students for active learning and change the role of teachers and students in the classroom. Teachers serve as guides and promoters of the classroom only, and learners are the center of classroom activities. Preparing the MOOC video in advance leaves more time for designing learning activities in class, which increases teacher-student interaction [3] and helps to promote the internalization and promotion of knowledge. At present, Tsinghua University's SPOC teaching reform experiment provides us with reference.

The main purpose of this study is to explore the student learning experience under the SPOC flipped teaching model by combining the "circuit analysis basis" SPOC teaching reform project of student majored in electronic science and engineering.

2. Design and Implementation of the Flipped Class Based on SPOC

2.1 Overall Architecture of SPOC Flipped Class

The electronic science and engineering at N University took the opportunity to integrate the use of resources in the laboratory's experimental system. It was designed by the Dean of the school of electronics technology and engineering [4]. The teacher W was the chief person in charge. The MOOC/SPOC curriculum platform was created by the N University's style center. Gradually, the private cloud service is established. On the basis of the curriculum platform, it is divided into three

parts: The first part is curriculum teaching reform. The video resources of the curriculum mainly refer to the video of the Yu Yujie teacher of Tsinghua University [5]. The Professor K is mainly responsible for the flipped classroom. The second part is experimental system reform. The Professor Z is responsible for the experimental class. His task is to open the laboratory, provide online guidance, and intersect theoretical and experimental classes. Compared with the traditional curriculum arrangement, the experimental class is easier to connect understanding, application and creation, and is more conducive to cultivate students' innovative thinking and practical ability, and ensure the implementation of flipped classroom. The third part is student management reform. The student secretary is mainly responsible for this part. Graduate students in educational technology help teachers to do a good job in students' guidance. Combined with SPOC flipped teaching model, the research of the freshmen's zero grade plan, the analysis of the students' learning behavior, the study effect investigation and the overturning teaching mode are carried out. In addition, the training program is carried out to provide data analysis for the training of international first-class talents.

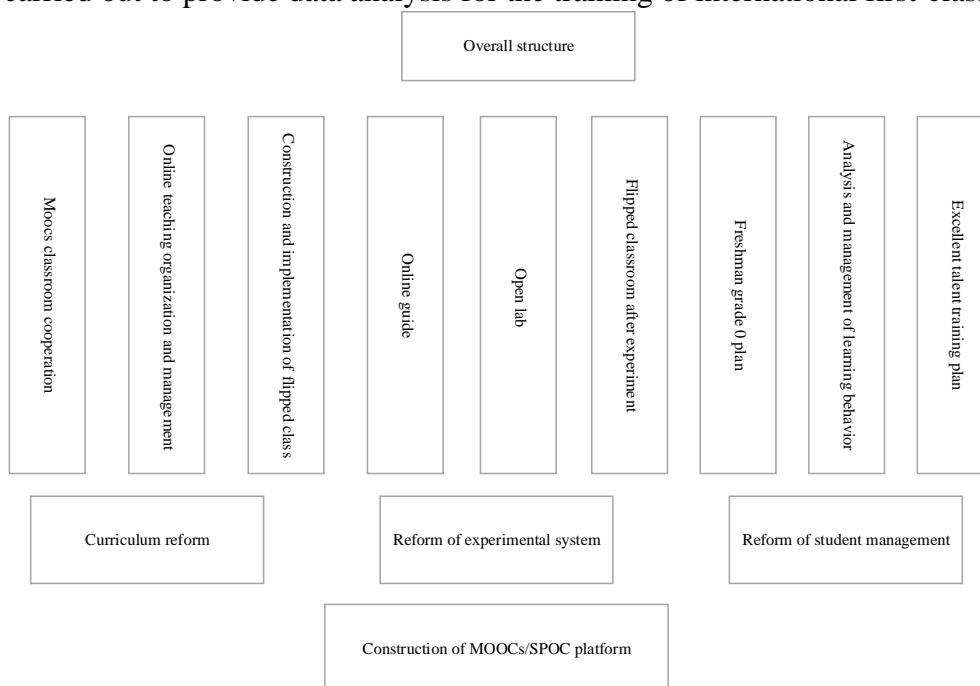


Figure 1. Overall structure of the SPOC flipped class

2.2 Implementation of SPOC Flipped Class

The flipped classroom teaching model is a change to the traditional teaching model. Taking the initiative and participation of students as the goal, we should enhance self-learning ability, time management ability and teamwork ability, and transform the role of teachers and students in order to promote the transformation of traditional "knowledge oriented" to "comprehensive quality". In order to implement the flipping teaching, we must first have high quality learning resources. The learning resources of this course are the most popular MOOC courses [6] on the online course platform of the Tsinghua University. The second is to build a digital collaborative learning space. The environment of this flipped class consists of cooperative group desk, pulley chair, wireless projection, three blackboards and eleven whiteboards. Each round table is equipped with the necessary experimental equipment for the electronic experiment. The learning environment is very free and easy to eliminate the stereotype of "teacher-centered" [7]. Group collaborative learning is more conducive to the internalization and sublimation of knowledge.

Self-study mode before class: Pre-class [8] is a self-study course for students. Students can use the fragmented time to look at the micro-courses and combine the textbooks for further induction. At the same time, students can use a variety of learning tools, such as laptops, mobile phones and tablets. Students can also study at the college's 24 - hour free laboratory. This is also to provide students with the convenience of learning.

Classroom activity organization: The independent study of the students before class is the basis. Before class, students can basically understand what they are going to learn. In class, they can spare

a lot of time for seminars, increase collaboration and communication between groups, and even make some products and share them with others. This course is carried out in 2 semesters. As the depth of content increases, the experiment has gradually moved from verifying to exploratory. In the first part of the class, the first step is that the teacher throws out the problems collected before the class and guides the students to communicate and discuss. Students can display the question on the blackboard or on their own computers by wireless projection. The problem is solved through debate and proof. In the second part of the class, class teachers use problem driven and inquisitive teaching methods. The purpose is to guide the students to discuss together, and to form a group competition atmosphere. The third part is the summary and induction of the class content. It is beneficial to the induction and sublimation of the knowledge points, and is also the construction process of students' knowledge. The total parts of flipped class are show in figure 2:

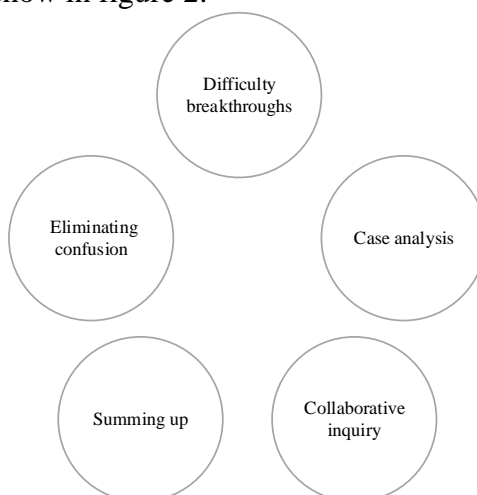


Figure 2. Five links in the flipped class

Learning evaluation methods: Learning evaluation is the standard to test the learning effect. The learning effect with different evaluation methods is different. The flipped class based on MOOC is different from the traditional class. The evaluation of the traditional classroom mainly focuses on the results of the final examination, and is assisted by the regular attendance and homework. However, the flipped class is divided into two parts: pre-class and in-class. Students do not fight alone but work together. Assessment not only pays attention to test results, but also pays more attention to process data. Therefore, the course assessment is divided into four parts: the score on the MOOC platform (10%) + class performance (20%) + homework (10%) + end result (60%).

3. Analysis of Learning Experience and Learning Effect

The flipped classroom teaching reform of the circuit analysis foundation of N College of has been completed for 18 weeks since the end of January 8, 2015. What kinds of changes have taken place in students' learning under flipped classroom teaching mode? What are the prominent points compared with traditional classes? This chapter mainly analyzes and compares students' learning experience, learning methods, learning effects and other aspects. Combined with the contents of interviews and backstage data of the course, sufficient argumentation is prepared for the following questions and suggestions.

3.1 Student Basic Information

The student learning experience and learning effect of SPOC flipped classroom in N College of electronic science and engineering were carried out from December 24th to 25th. Two classes were investigated, with a total of 72 people. As shown in figure 3, the data shows that 86.5% of the students study the "zero grade" program before the new term. Only 5 students do not study at home for various reasons. However, during military training, they use a laboratory computer to study the "zero grade" program. On the whole, students in SPOC flipped classroom class have a positive learning attitude.

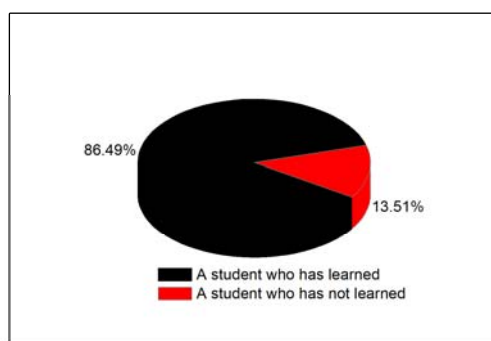


Figure 3. "Zero grade" plan learning

3.2 Analysis of SPOC Class Learning Experience

The learning experiences are mainly based on the courtesy experience questionnaire (CEQ) designed by P. Ramsden. The dimensions of the learning experience include six aspects: good teaching, clear goals, appropriate stress, appropriate evaluation, learning input and learning environment. The interview content mainly involves students' learning adaptability, learning difficulties, learning input and emotional curriculum experience. Course background data mainly includes discussion area, video test accuracy rate and wiki.

The learning experience of flipped classroom is mainly divided into six dimensions: good teaching, clear goals, proper stress, proper evaluation, learning input and learning environment. In general, the mean value of the learning experience of the students in the overturned class is generally above 3.700, indicating that the student's learning experience is good. As shown in table 1, it is concluded that there are significant differences in the five aspects of good teaching, appropriate pressure, appropriate evaluation, learning input and learning environment between the SPOC class and the traditional class.

Table 1. Perception of the learning environment

Dimension	SPOC class		Traditional class		t value
	Mean value	Standard deviation	Mean value	Standard deviation	
Good teaching	4.216	0.626	3.259	0.636	5.768**
Clear goal	4.175	0.658	4.000	0.912	19.446
Proper pressure	3.612	0.616	4.000	0.912	-2.067*
Proper evaluation	4.180	0.631	3.396	0.804	4.597**
Learning input	3.765	0.568	2.689	0.708	7.410**
Learning environment	4.209	0.575	3.290	0.832	4.797**

(* $p < 0.05$, ** $p < 0.01$)

First of all, the average score of good teaching is the highest among students with a score of 4.216. It is nearly 1 point higher than the traditional class, and $\text{sig} = 0.000$ ($p < 0.01$). This shows that the teaching of SPOC and traditional classes is significant difference. After chatting with classmates, students are attracted by the professional water quality and teaching charm of the teacher. Teachers in SPOC flipped classrooms can pay attention to each student's learning situation, and use language and action to induce students to participate in the enthusiasm of learning and sharing. Therefore, students enjoy the process of discussion and sharing. However, traditional large class teaching is mainly based on lectures and the number is large. It is impossible to pay attention to every classmate during the time of interaction. It shows that in classroom teaching, students generally believe that flipped classroom teaching is better than traditional classroom teaching.

Second, the student's evaluation of the learning environment of the flipped classroom is also very high, and the mean value is 4.209. This shows that the collaborative learning environment (hexagonal collaborative desks, with 3 computers on each table) in this flipped teaching class is very popular among students. In addition, three blackboards and wireless projections provide great convenience for students to discuss and display. The movable chair also provides students with convenient mobility and creates a relaxed atmosphere. However, traditional class seats are fixed and cannot be communicated face-to-face, affecting teacher-student interaction and student-student interaction to some extent.

3.3 Analysis of Learning Effects and Influencing Factors

The learning effect is the focus of learning. Judging from previous research on flipped classroom, most of them show higher scores than traditional classes. Tsinghua University's flipped classroom teaching reform class about circuit theory is 8-10 points higher than the traditional class. In addition, the learning enthusiasm has improved significantly; the ability to work has increased significantly. There have been some minor achievements in extracurricular science and technology activities. Although university students have encountered problems such as learning adaptability problems and polarization problems in the middle of the overturned classroom, they have played a promoting role in improving the overall quality and ability. Because the exams for the final exams of SPOC and traditional classes are different and there is no comparison result, the following analysis will be conducted on the students' learning methods and learning effects.

The SPOC learning style tends to deep-learning: The learning methods are mainly divided into four dimensions: deep motivation, shallow motivation, deep strategy and shallow strategy. In terms of the overall level, the SPOC and traditional classes have significant differences at the levels of deep motivation and shallow motivation. As shown in table 2, in terms of learning motivation, SPOC classmates generally use deep motivation. In contrast, traditional classes generally use shallow motives. In terms of learning strategies, although the mean value of deep-level strategy in SPOC class is 0.277, which is higher than the traditional class. Due to $\text{sig}=0.054$ ($P>0.05$), the difference is not significant, which may be caused by the sample selection method.

Table 2. The learning style of SPOC flipped class (CPQ)

Dimension	SPOC class		Traditional class		t value
	Mean value	Standard deviation	Mean value	Standard deviation	
Deep motivation	3.465	0.689	2.935	0.627	3.606**
Deep strategy	3.567	0.552	3.290	0.599	1.989
Shallow motivation	2.392	0.657	2.797	0.763	-2.722**
Shallow strategy	2.784	0.734	3.060	0.725	-1.643

(* $p<0.05$, ** $p<0.01$)

From a local point of view, among the 37 students, this study used a cluster analysis approach. As the name suggests, clustering analysis is to gather similar samples into clusters with a certain algorithm. Similarity is a key factor in cluster analysis. According to the different classification objects, cluster analysis is divided into sample clustering and variable clustering. This study adopts a sample clustering method, which is called Q-clustering (Quick Cluster).

Overall, these two classes of students have high scores on deep motivation and deep strategy. ANOVA shows $P>0.05$ ($\text{sig}=0.423$, $\text{sig}=0.500$). The difference is not significant. Students in SPOC class generally use deep motivation and deep strategy. However, in the shallow motivation and shallow strategy, $p = 0.00$. In addition, the value is less than 0.01, indicating that the difference between the two types of students in the shallow motivation and shallow strategy level is extremely significant. The reason for this result may be the orientation of the questionnaire deep motivation and deep strategy. The students generally have high score, so the difference is not significant. However, the scores on shallow motivation and shallow strategy will be separated. There are 20 deep learners and 17 shallow learners.

3.4 Regression Analysis of Learning Effect

From the above correlation analysis, there is a significant correlation between learning effect and physical mastery level, self-cognition ability, good teaching, clear goals, proper evaluation, learning input, learning environment, deep motivation and deep strategy. Therefore, on the basis of this correlation, this study further explores the factors affecting the learning effect and the influence coefficient through regression analysis.

In Biggs's 3P learning model, there is a complex relationship between student factors, teaching situation, learning experience, learning methods and learning results. There are not only direct and indirect factors affecting the learning effect, but not only one-way causality and backtracking causality. For example, student factors can directly affect the learning effect, and can also influence the learning effect indirectly through the perception and learning methods of the learning environment. Based on Biggs's 3P effect model, taking students as the main research object, taking students as the

main research object, this paper mainly analyzes three aspects: the effect of student factors, students' sense for learning environment and learning methods on the learning effect. However, the factor of teaching situation is not taken into consideration for the time being.

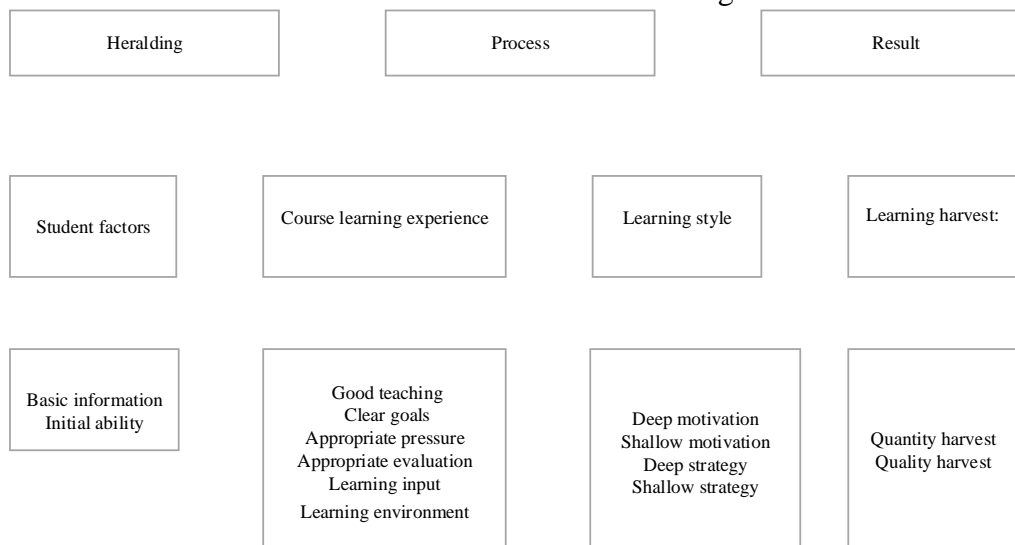


Figure 4. SPOC learning effect model

From the correlation analysis of the previous learning effect, it is found that only the degree of physical mastery and the ability of self-cognition have a significant correlation with the learning effect.

4. Conclusion

The flipped classroom breaks through the limitation of traditional teaching mode by means of network information technology and changes the traditional teaching process. Therefore, the role of teachers and students is completely changed. At the same time, teachers can get the students' learning situation in time before class, and make full preparation for individualized teaching and group cooperative learning. Through the investigation of learning experience, learning method and learning harvest questionnaire, it is found that students in SPOC class tend to learn more deeply and get more in a free environment. The reform of this flipped classroom teaching has achieved good results and has potential promotion significance.

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