

An Application Study of the SPOC Project Teaching Mode—Take the Course "Foundations of Engineering Technology" as an Example

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Abstract: This paper elaborates on the applications of project-oriented SPOC-Small Private Online Courses in Foundations of engineering technology courses Hydraulic and Pneumatic Drive module. The paper introduces this teaching mode and analyzes the students' academic achievement before and after the reform as well as their reformed learning experience. Besides, based on the analysis of the influence of the reform on students' learning and the factors that may affect the effectiveness of learning, the paper summarizes the advantages and disadvantages of this teaching mode.

Keywords: SPOC; project-oriented; influencing factor

1. Introduction

With the development of information technology and the transformation of education and teaching concepts, the strengths of "MOOC" in the teaching concept, content, way and effect have made many colleges and universities carry out a large number of reform and practice in flipped classroom mainly based on "MOOC" in recent years, which has a great impact on the traditional education model^[1]. But meanwhile the weaknesses of "MOOC" are also obvious: firstly, the teachers need to prepare more as the fact of "no threshold access to MOOC" and the sharp differences between the students in their learning background and competence. Secondly, the ratio of students and teachers is high so that the students have few opportunities to get direct instruction from the teachers, and even the depth of the students' learning and the breadth of the professional field are not guaranteed. All these factors mentioned result in the high rate of registration but low rate of completing the course, which is not conducive to the sustainable development of the curriculum.

"SPOC" (Small Private Online Course) is the "post-MOOC" era of online education^[2]. In general, they limit the number of online learners to dozens or hundreds and set such criterion for access as being partially open to visitors, which helps to improve the learning participation, interaction and the rate of completion of courses. Therefore, "SPOC" has made great innovations in the operation mechanism, teaching form, teaching process, etc^[3]. In this study, a blended teaching mode (blending traditional teaching with the "SPOC" teaching mode) is adopted in the Foundations of engineering technology courses Hydraulic and Pneumatic Drive module. The reform was carried out based on the engineering practice projects. In addition, this paper makes comparative studies in such aspects as the students' learning motivation, learning effect and problem-solving ability. Furthermore, the paper launches in-depth exploration on how to optimize the online and offline teaching proportion and on how to improve the teaching efficiency and effectiveness through the analysis of examination results, questionnaire survey and other channels.

2. Practical Exploration in the Foundations of engineering technology courses Hydraulic and Pneumatic Drive module based on SPOC Project Teaching Mode

2.1 Curriculum Background

In Ningbo University of Finance & Economics Foundations of engineering technology courses Hydraulic and Pneumatic Drive module is offered for majors like electromechanical engineering and

automation, electrical engineering and automation and mechatronic engineering and the curriculum is the same, while the syllabus is different. There are also individual differences in the learning foundation of students. Due to time constraints, the teachers were unable to attend to more students in large classes, which led to the increase of students' differences in learning, and a loss of confidence of some students in the courses.

2.2 The implementation of curriculum reform

2.2.1 Course features

Foundations of engineering technology courses Hydraulic and Pneumatic Drive module is a specialized course, which is highly practical and requires some basic knowledge of mechanical drawing and fluid mechanics, etc. The ultimate goal of the course is to enable students to read and to design a complete hydraulic and pneumatic system.

2.2.2 Course Design

(1) Course overview

Ever since September 2022, a pilot reform of Hydraulic and Pneumatic Drive module has been carried out for two academic years and the number of experiment teaching classes has been expanded from one to four. The online teaching platform is a self-built platform where videos are mostly recorded by research group teachers, and very few teaching videos are borrowed from other schools' excellent course website. Classroom teaching focuses on discussing and answering difficult problems.

(2) Design idea

The idea of designing the course is to fully develop online learning, offline group discussion and the Q/A, and classroom interaction to display learning outcomes taking the typical mechanical hydraulic and pneumatic system as the main carrier, the basic components as the breakthrough point, the basic loop as the learning unit in the course of teaching.

(3) The implementation of the reform

Preparation stage includes the construction of the network learning platform, the preparation of the project carrier, the recording and selection of small videos related to theoretical knowledge (individual videos are the excellent online course videos), the preparation of the teaching materials and resources for learning, and the preparation of the test data.

The implementation stage contains the following steps: Firstly, students are divided into 8 groups and each group has one leader and one recorder. The assignment of learning tasks goal-oriented and each group is assigned a typical hydraulic system of typical mechanical and electrical equipment of comparable difficulty. The teacher guides the students to decompose the hydraulic drive system into a number of simple circuits that can achieve certain actions, and then separate the circuit into several hydraulic components. The structure and working principle of each component is accomplished by learning small prerecorded videos with function of animated demonstration on the platform. The internal learning process in each group can be dispersed, but the analysis of the function of basic circuit, component, and the analysis of hydraulic system should be completed by group discussion. Teachers are only solvers and each group will show staged learning outcomes in class after each completion of a circuit, and finally show the learning results of the whole hydraulic system. There is a certain competitiveness among groups and each presentation should both state the understanding of the content and answer questions raised by the students and teachers. As judges, teachers and group leaders make evaluation on the performance of each group as a routine assessment.

Assessment stage: a comprehensive evaluation will be given combining the process assessment and final examination.

3. Analysis of Teaching Effects

3.1 Comparative analysis of the results in the exams

In order to analyze the results of the reform better, the research group designed the test paper for the comparison before and after the reform to ensure the difficulty of each part basically stays the same as

that before. It is found that the results after the reform are more obvious than those before the reform by making comparison between the results of the first reforming class and the results of a relatively good class before the reform.

3.1.1 The comparison of the number in each grade

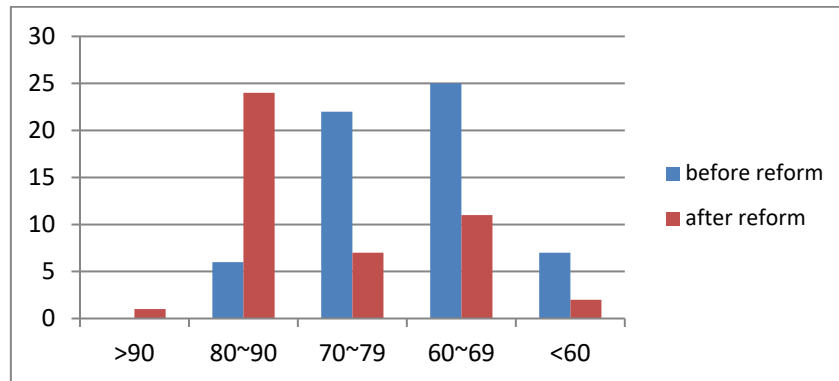


Figure 1: The comparison of the number in each grade

The number of high segments after reform has been significantly increased, as shown in Figure 1.

3.1.2 The comparison of average score

Before the reform, the average score was 68.73 and the average score after the reform was 77.67 that was 8.94 points higher than that before the reform.

3.2 Analysis on the Questionnaire

150 valid questionnaires were issued and recovered by the research group. The basic situation is as follows:

3.2.1 Reflection and recognition on the course reform

(1) Compared with the conventional teaching methods, the knowledge and feelings of the curriculum reform

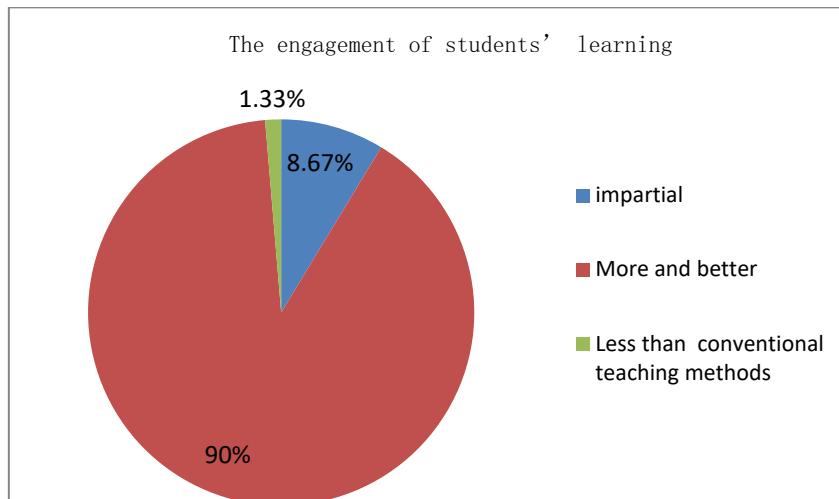


Figure 2: The engagement of students' learning

The data presented in Figure 2 demonstrates the high level of engagement exhibited by students in their pursuit of this course. (2) the level of mastery of course knowledge.

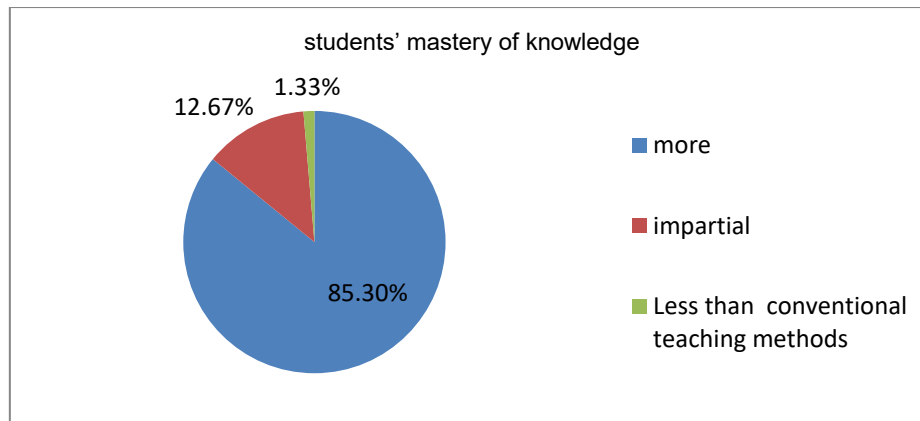


Figure 3: Students' mastery of knowledge

As can be seen from Figure 3, students' mastery of the course has been significantly improved after the reform.

3.2.2 The Effects of reform on students' learning

(1) Positive effects

The main manifestations of the change of the students after the reform are as follows: students can fulfill the tasks of autonomic learning, group discussion and self-test according to the requirements; they can carry out self-study management; can clear the learning task and think and discuss actively; can understand the teaching content faster and more accurately and grasp the way of learning and thinking; can put forward own views on the tasks assigned by teachers; can accomplish certain challenging learning tasks in a certain time after class. Moreover, the ability of organization and coordination as well as the ability of team cooperation has obviously enhanced, and the number of students who actively ask questions to teachers has increased significantly.

(2) Negative effects

Since there is no mature experience available in the reform, a few issues remain with the reform. For example, some students try to fish in troubled waters by the opportunity of teamwork due to inadequate evaluation system. Additionally, there is disparate development among students. Extroverted students have more opportunities to practice, while students with relatively introverted personality mostly drift with the current and do not take too many initiatives so that they can not get enough exercise.

3.2.3 The analysis of factors affecting the teaching effect

(1) The factor of Teachers

The SPOC project teaching mode has changed the role and position of the teacher in teaching. For most teachers who are accustomed to traditional lecture-style teaching mode, they should change their ideology, knowledge structure and work style, etc. They should transform themselves from pure knowledge imparters into designers and organizers of learning activities, constructors of learning resources, facilitators and assistants in the learning process and solvers. Therefore, as this teaching mode is more demanding for teachers, especially in the era of developed network and knowledge explosion, and the problems raised by students are unpredictable, teachers should update their knowledge in time in order to adapt to the constantly changing development needs.

(2) The factor of students

Students should change their position in time from passively absorbing the knowledge into actively studying the related knowledge, raising questions, learning self-management and self-discipline. They should thoroughly change the previous thinking mode of waiting for and depending on teachers that learn what teachers teach and realize that what to learn and how much to absorb rely on themselves and teachers only play role in planning, designing and assisting.

(3) The factor of assessment mechanism

All kinds of assessment mechanism have advantages and disadvantages, and it is difficult to reflect the objective facts fairly and impartially. Therefore it is difficult for some students who engage more in learning to fully embody themselves from the results and a small amount of opportunistic students can

not be truly evaluated. However, any assessment is also a motivational mechanism and means, whose ultimate goal is to promote students to master knowledge, learn how to learn, and learn self-management.

4. Conclusion

The implementation of SPOC project teaching mode in the Foundations of engineering technology courses Hydraulic and Pneumatic Drive module gives teachers and students a new teaching experience, which has also aroused the students' interest in learning to some extent and poses a new challenge for teachers to prepare lessons and give lessons so that teachers and students become more busier. Besides, it highlights the main status of students and gives full play to teacher's role as designers and expositors. However, it is necessary to arouse everyone's enthusiasm by gradually improving the teaching design and assessment mechanism.

Acknowledgments

The work was supported by project of Key Education Reform Project of University (NO. 21jydz05, 22xwkzd15); The 2022 annual "Fourteenth Five-Year" teaching reform project of ordinary undergraduate universities in Zhejiang Province's Department of Education(NO. jg20220628).

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