

Practice and Exploration of “Tries-Tries” Flipped Classroom Teaching Mode in Mechanical Courses

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ABSTRACT

As a new teaching mode, the flipped classroom has become a research and application hotspot in university education. How to realize the conversion between students and teachers in flipped classroom and how to organize the implementation process of learning before class, in class and after class are the key and difficult points of research. Based on the knowledge internalization and construction as the core, combined with the flipped classroom teaching mode, this paper constructed a set of “Tries-Tries” flipped classroom teaching mode. Through the implementation of three-ones and three-steps teaching, the process of knowledge internalization completes four times, and each group has learning outcomes, and it makes the participation of students reach 100%. It will provide a reference for the research and application of science and engineering flipped classrooms.

Keywords: *“Tries-Tries” flipped classroom; Mechanical professional courses; Knowledge internalization and construction; Learning outcomes*

1. INTRODUCTION

In 2011, flipped classroom teaching mode was introduced in China. In 2012, Zhang Jinlei [1] constructed the flipped classroom teaching framework according to his teaching practice, and carried out the design and implementation of the flipped classroom. By 2020, flipped classroom has experienced many years in China, and there are still some problems such as flipped formalization and knowledge fragmentation in its usage [2]. Further exploration is needed to form China's experience.

First of all, strengthening the understanding of flipped classroom and meeting the requirements of teaching software and hardware conditions are the key for college teachers to carry out classroom flipping. However, the current situation of teachers' competence in flipped classroom is worth considering [3]. Secondly, flipped classroom teaching needs to be practiced according to the characteristics of various disciplines, so different researchers have formed their unique teaching practice process. Wang Xin [4] compared the differences of flipped classroom between China and the United States, and put forward reasonable suggestions from the aspects of teaching philosophy, teaching mode, teaching method and assessment form. Mao Qiming et al. [5] reflected on the practice process of flipped classroom, and put forward the view that flipped classroom takes deep learning as the goal and uses it flexibly. Guo Jianpeng [6] proposed a general O-PIRTAS flipped classroom teaching mode by summarizing different teaching modes, including seven links: goal, preparation, teaching video, review, test, activity and summary. Wang Xinyue et al. [7] took shared

courses and effective teaching as examples, used the cooperative flipped classroom teaching mode and selected appropriate teaching content to carry out teaching research on flipped classroom of liberal arts courses. Flipped classroom puts forward higher requirements for teachers' ability. Sun Weimin et al. [8] discussed in detail the requirements of teachers' role transformation and ability in flipped classroom in English teaching. In order to study the impact of flipped classroom on students' learning, Qin Chao et al. [9] took 14 students as the research objects and analyzed the behavior types and characteristics of students under the mixed teaching mode of “MOOC + flipped classroom”. Zhu Wenhui [10] pointed out that flipped classroom is an effective means to realize deep learning.

To sum up, flipped classroom teaching mode has been widely applied. There are various types of flipping and there is no fixed form. The effect of flipping is uneven and it is difficult to accurately evaluate. Based on this, combined with the implementation effect of flipped classroom teaching mode that members of the research group have applied in the teaching of professional courses [11], this paper establishes the “Tries-Tries” flipped classroom teaching mode, and carries out in teaching practice.

“Tries-Tries” flipped classroom aims at knowledge internalization and knowledge self-construction, and takes the flipped classroom teaching mode as the theoretical basis, and implements “Tri- ones” and “Tri-steps” respectively. Before class, we use the three-ones to understand and master the knowledge. In class, we test and discuss in groups to form the design scheme. After class, we practice the optimal design scheme. This research mode will provide a reference for the implementation of science and engineering flipped classroom.

2. “TRIES-TRIES” FLIPPED CLASSROOM MODE

The “Tries-Tries” flipped classroom teaching mode in this paper comes from the mode established by our research group [12]. In order to implement the effect of flipped classroom, it is very important to organize and implement it step by step in a planned way. After nearly 7 years of exploration and continuous attempts, our research group has established the “Tries-Tries” (Tri-ones and Tri-steps, referred to as “Tries-Tries”) flipped classroom teaching mode. The specific mode is shown in Fig.1.

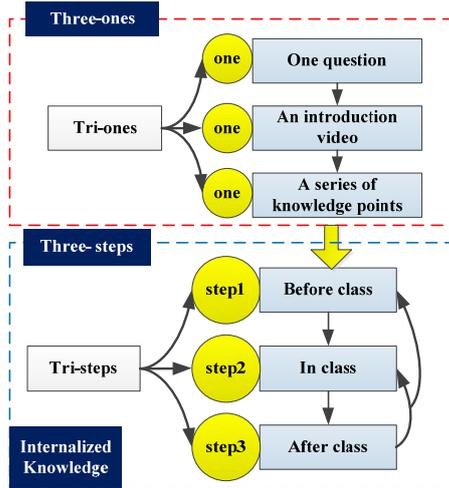


Figure 1. Tries-Tries flipped classroom mode

It can be seen from Figure 1 that students have learned the main knowledge points of this lesson according to the questions and videos before class; Combined with the characteristics of mechanical courses, group discussion, debate or report in class are carried out to determine the optimal solution to the problem; after class practice plan or writing report are used to implement the solution to the problem.

3. IMPLEMENTATION PROCESS OF FLIPPED CLASSROOM

The effective implementation of flipped classroom is the guarantee of students' knowledge internalization and knowledge construction. According to the “Tries-Tries” flipped classroom teaching mode, taking the clutch of transmission system in “automobile structure” as an example, the implementation of flipped classroom is carried out under the theoretical guidance of Tri-ones, i.e., one question, an introduction video, a series of knowledge points, and Tri-steps, i.e., before class, in class and after class.

3.1. Implementation of Tri-ones Mode

3.1.1. One question

The University courses are basically carried out according to the class hours. If there are more than one question in a class, the students may exert themselves equally, which makes the deep mining of the question impossible, and the solution is relatively superficial. Therefore, each flipped classroom only chooses to solve one question. Students can think about it pertinently, and give the best solution based on summarizing the existing solutions by consulting the textbooks and literature. Fig. 2 is one question of the clutch.

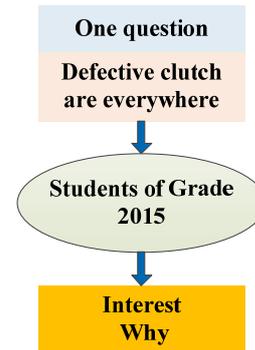


Figure 2. One question-Defective clutch are everywhere

3.1.2. An introduction video

The introduction video is the key for students to master basic knowledge and find questions. To find or make an introduction video, the time should be limited to about 5 minutes. It should include three aspects: the origin of the question, the development of the question and the consequence of the question. The video content should have rich words and pictures to attract students to watch and think. Aiming at the defects of clutch, including the origin, development and consequences of the clutch, students are attracted to watch and think. Fig. 3 is an introduction video of clutch.

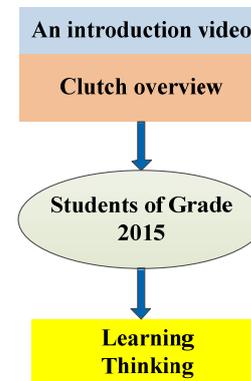


Figure 3. An introduction video-clutch

3.1.3. A series of knowledge points

According to the question and the introduction video, students find the lack of knowledge reserves to solve the problem, and then complete a series of knowledge points according to their own needs. For clutch defects, it is necessary to understand the definition, function, composition and working principle of clutch, complete the first internalization of knowledge points, and construct their own knowledge network to solve the problem of clutch defects. Fig. 4 shows a series of knowledge points of the clutch.

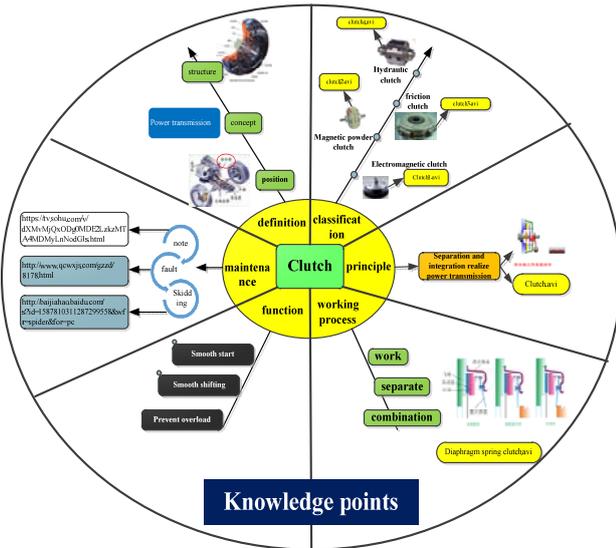


Figure 4. A series of knowledge points-Clutch

3.2. Implementation of Tri-steps Mode

3.2.1. Before class

The preparation before class is reflected in Tri-ones. Students have basically mastered the knowledge points of this class and clarified the problems to be solved through a short period of study.

3.2.2. In class

In order to achieve the goal of knowledge internalization and knowledge construction, students' mastery of knowledge before class can be understood by means of small test, defense or group report.

3.2.2.1. Classroom tests

In the flipped classroom of clutch defects, let each group give as many as possible the defects of the clutch, and send them through the mobile phone, so that the teacher can cast

the screen for everyone to learn and reference. Through the intercommunication between groups, students can find out their lack of knowledge and reach the second internalization of knowledge points. Fig. 5 shows the clutch defect sharing of 40 students majoring in vehicle engineering after being divided into 6 groups.

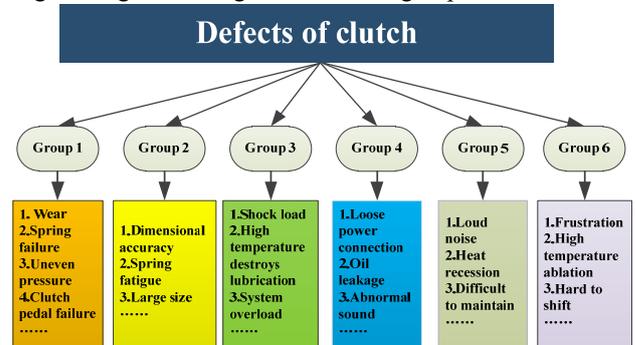


Figure 5. Clutch defects of each group

3.2.2.2. Scheme review stage

According to the clutch defects, each group will discuss and find out different design schemes. Any member of the group will report the solution after discussion. The teachers and other students will be the review experts. They will question the scheme of the group, so as to promote the formation of the optimal scheme in the group. The other groups will review it in the same way. The scheme review makes the problem-solving solutions in the group more convincing and completes the third internalization of knowledge. Fig.6 shows the picture of students discussing and answering questions between groups.



a) Group discussion



b) Answer questions

Figure 6. Group discussion and scheme determination

3.2.3. After class

The solution to the problem is implemented after class. According to the solution of the clutch defect, students use SolidWorks software to carry out 3D modeling, give the parts drawing and assembly drawing of clutch redesign to solve the problem of the clutch defect. Fig. 7 shows the three-dimensional model of the clutch redesign of some groups.



Figure 7. Clutch redesigned 3D modeling

In addition to the above three groups, the other groups sorted out the reports according to the optimal scheme and showed them in class. At this point, the fourth internalization of knowledge has been completed. Therefore, this teaching mode makes the participation of students reach 100%, at the same time, it improves the enthusiasm of students.

4. RESULTS AND DISCUSSION

Taking the knowledge internalization and construction as the core, this paper uses the “Tries-Tries” flipped classroom teaching mode established by the research group, and takes the teaching process of automobile clutch as an example to discuss and practice the specific methods of three-ones and three-steps. The following conclusions are obtained:

- 1) “Tries-Tries” flipped classroom teaching mode can effectively solve the problem of difficult teaching in mechanical courses.
- 2) Through the internalization and construction of knowledge for four times, students' comprehensive quality is greatly improved in the implementation stage after class.
- 3) This teaching mode makes the participation of students reach 100% and improves the enthusiasm of students.

The flipped classroom model needs to be adjusted according to the characteristics of the course because of the great difference among different subjects. The “Tries-Tries” flipped classroom teaching mode proposed in this paper is still in exploration and practice. It has the advantages of a specific implementation process and strong operability, and the wider implementation effect still needs to be explored.

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