

# Flipped Classroom of Electrical and Electronic Technology based on Multisim Simulation

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**Abstract:** In view of the phenomenon that traditional teaching focuses on Teachers' narration and theoretical derivation, and students passively accept knowledge points. This topic introduces the flipped classroom. The results show that under the flipped classroom teaching mode, students can internalize the knowledge learned before class in limited classroom time and output a visual Multisim Simulation circuit. The results show that the students' creativity, knowledge transfer ability and practical ability are stimulated when designing the circuit. At the same time, in order to solve the phenomenon that higher vocational students generally have poor learning initiative and do not carefully watch pre class teaching videos, this paper puts forward the calculation formula of mutual learning. Practice shows that under the supervision of the formula, students basically form the habit of mutual aid learning.

**Keywords:** Multisim Simulation, Electrical and Electronic Technology, Flipped Classroom, Mutual aid Learning.

## 1. Introduction

*Fundamentals of Electrical and Electronic Technology* is a professional basic course for science and engineering majors, and an important course integrating knowledge of electrotechnics, analog electronic technology, digital circuits and other aspects [1,2]. In the traditional teaching process, teachers put more emphasis on theoretical analysis and circuit response calculation. This does not allow students to intuitively feel the working phenomenon of the circuit. Many teachers at home and abroad who teach this course introduce simulation software such as Multisim to reform the original course. Y.W. Dai[3] introduced Multisim in the experiment class in order to solve the problem that it is difficult to capture the gradual vibration process of the signal from scratch and from weak to strong. L.F. Y[4] showed the operation of motor phase loss to students through the Multisim simulation, which improved the depth and breadth of students' theoretical cognition while avoiding the damage of personnel and materials caused by destructive experiments in reality. L. X[5, 6] have improved students' hands-on ability and problem-solving ability by combining multimedia teaching and Multisim. Although the above teaching process has greatly visualized the process and improved the students' hands-on ability, the above courses are based on the simulation and verification of the book sample circuit. Students only need to change the way of the book circuit symbol expression on the computer, without in-depth thinking. Therefore, the traditional teaching mode aims at knowledge infusion, which makes students passively accept information and cannot internalize and output knowledge points. Flipped classroom can effectively solve the above problems, so it is widely cited and appreciated by schools at home and abroad after the popularity of the network [7,8]. However, flipped classes also have problems such as students' reluctance to participate in pre-class learning [9, 10]. Based on the above problems, this topic proposes Mutlisim simulation and mutual supervision learning mode based on flipped classroom, which allows students to become the leader of the classroom and cultivate students' learning habits of mutual achievement.

## 2. Take 555 Timer as An Example to Form A Simple Electronic Organ

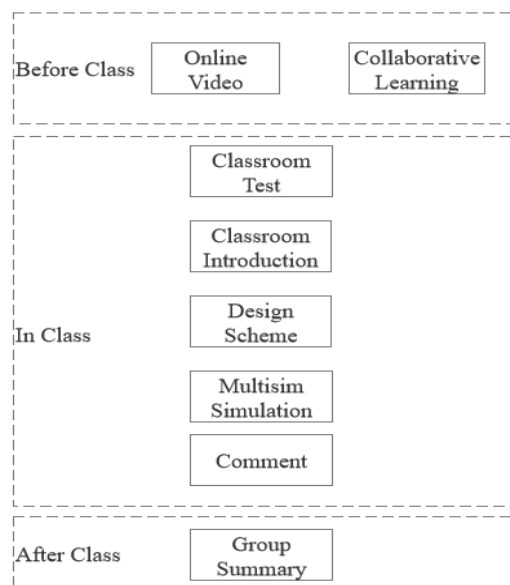


Figure 1. Teaching process

The teaching flow chart is shown in Figure 1. Correspondingly, the teaching class of 555 timer forming a simple electronic organ is as follows: before class, students will explain the circuit of 555 timer forming a multivibrator by watching the online teaching short video, as shown in Figure 2. In this process, students are required to master the line mode of 555 timer forming a multivibrator and the charging and discharging time of the multivibrator. During this period, students are required to monitor and study the teaching video content of the course in groups. In class, the teacher starts the time-limited test of online learning platform. The test content is the basic knowledge points that students will be able to answer as long as they have watched the video, and this knowledge point is the knowledge points that students may make mistakes when designing the circuit independently in the later stage or need to solve the circuit in

the classroom, such as the resistance unit conversion in Formula 1.

$$T = 0.7(R_1 + 2R_2) C \quad (1)$$

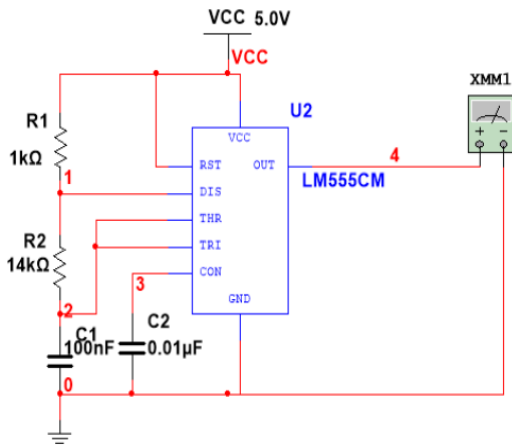


Figure 2. Multivibrator

The introduction part of the project mainly tells that the different scales are caused by the vibration frequency of the object, and uses heuristic teaching to guide students to use the multivibrator to complete the simple electronic organ; In the Design Scheme stage, guide students to change the feasible scheme of frequency according to formula 1): For example, it can change the values of resistance R1, resistance R2 and capacitance C1, and even make the multi-vibrator output different frequency signals to drive the horn through series, parallel combination and other methods. In the circuit design stage, students use Multisim to design by themselves Circuit, and circuit simulation. At the same time, teachers and team leaders help students with difficulties to solve problems encountered in the design process. After the completion of the work, we will find that students will design different circuits, of which two typical circuits are shown in Figure 3. Finally, the teacher will comment on the students' works and analyze the advantages and disadvantages of the circuit.

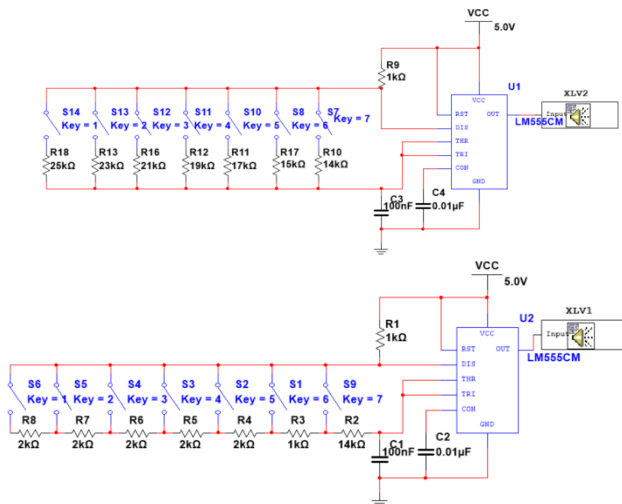


Figure 3. Simple electronic organ circuit built by students

### 3. Evaluation Feedback

Because vocational students generally have poor self-sufficiency learning ability, if students are only required to watch videos by themselves, there will be a phenomenon that

students turn on videos and actually do not watch them. Therefore, I put forward the formula of mutual learning, Formula 2, to calculate the students' performance in a class. This method is mainly used to evaluate the final score of the student by encouraging mutual assistance, reducing the individualism score of the outstanding student, and comprehensively considering the average score of the group.

$$K_i = \frac{\sum_{i=1}^N s_i}{N} + \beta_i s_i \quad (2)$$

Where,  $K_i$ : the final score of the  $i$ th student;

$N$ : The number of members of the student's group;

$S_i$ : the  $i$ th student's online evaluation result;

$\beta_i$ : is the contribution coefficient, and the group leader coefficient is 0.3, the team member coefficient is 0.2.

Since the teacher will feed back the scores calculated by formula 2 to the students after each class, the students will consciously form a trend of unity and cooperation within the group. Figure 4 shows the statistics and variance of students' average scores in the simulation experiment this semester, where the abscissa is the number of tests. From the variance curve in Figure 4, it can be seen that at the beginning, students tend to take care of their own learning habits, and later the variance gradually decreases, which reflects the students' united and cooperative learning behavior; The average score in Figure 4 can also be seen that the students' overall knowledge points tend to rise, and the later maintenance of a certain level is due to the increased difficulty of the course.

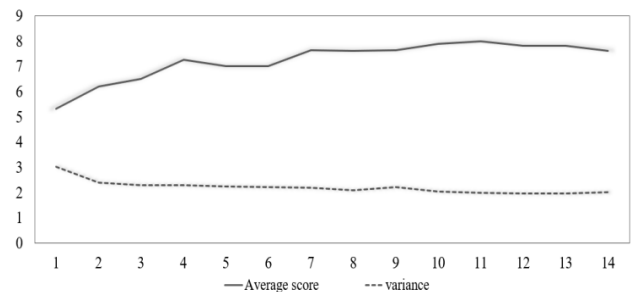


Figure 4. Average score and variance of classroom test

### 4. Conclusion

This curriculum reform, based on the principle that everyone can become a talented person and everyone can make full use of their talents, encourages students to learn independently and supervise each other's learning, and realizes the visual display of learning results in the classroom. In general, the following results have been achieved:

Through the form of flipped classroom, students can input knowledge points before class, output knowledge in class, and summarize after class, so as to firmly grasp the application of knowledge points;

Through the use of Multisim simulation, it can be seen that students will design different circuits according to the theory, which shows that this curriculum reform has fully activated students' creativity, knowledge transfer ability and hands-on ability;

By using the calculation formula of mutual learning to calculate the average score of students, the outstanding learners will assist the underachievers independently, and the underachievers will also study hard in consideration of the

interests of the team, so as to achieve the learning effect of mutual promotion and mutual supervision.

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