



# Application of Case-based Teaching Based on Flipped Classroom in C++

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## ABSTRACT

Among programming languages, C++ programming language is relatively difficult to learn. In order to help students learn C++ language better, two solutions is proposed in this paper. The first solution is to introduce the idea of flipped classroom into C++ teaching. Because of the many difficulties in C++, students can watch and discuss with their classmates anytime and anywhere through the video explanation of the flipped classroom. Teachers explain the key points and difficulties in offline classrooms, which will help students quickly master C++ knowledge points.

The second solution is to design a case based on a real project and then integrate the case into daily C++ teaching. In this way, students can quickly transition from the level of knowledge mastery to the level of knowledge application, which helps to cultivate students' coding ability based on real project.

## 1. Introduction

Among programming languages, C++ programming language is relatively difficult to learn. Because it not only has C++ language pointers, but also includes an understanding of object-oriented modeling. So it is very necessary for the research on C++ teaching<sup>[1]</sup>. In traditional C++ teaching, the C++ textbooks on the market are written according to the knowledge points. Generally speaking, each knowledge point in C++ textbooks is presented with a small example. The advantage of doing so is that students can have a better grasp of the specific application of the knowledge point, but the disadvantage is that it is difficult for students to grasp the role of the knowledge point in specific practice from a more general and macroscopic perspective<sup>[2]</sup>. Our solution to the above problem in this

article is to use a case to run through all the knowledge points of C++. In this way, students can understand the usage of each knowledge point in specific actual projects. This is more conducive for students to master the knowledge points.

On the other hand, in order to ensure the effect of students' learning C + +, we introduce flipped classroom into our daily teaching<sup>[3]</sup>. Before class, students can learn the video of the course first. In the class, the teacher introduces project examples, puts forward the specific needs of the project according to the knowledge points of the class, guides the students to think step by step, and finally completes the mastery of the knowledge points while completing the specific project. This teaching mode has two advantages. The first is that flipped classroom gives students more preparation time for learning before class, and the second is

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to strengthen students' understanding of knowledge points in specific practice with the method of case teaching. Practice has proved that this is a better method.

## 2. Introduction to Flipped Classroom Teaching Method

The idea of a flipped classroom was initially attributed to two chemistry teachers in American high schools, Jon Bergmann and Aaron Sams<sup>[4]</sup>. Around 2007, they encountered the situation that students were unable to attend class for a long time due to their illness. In order to help these students who can't come to school for a long time to keep up with the teaching progress. The two teachers made videos of the course and uploaded them to the Internet for students to watch. After a period of time, many other students also like this way of learning by watching videos. The two teachers changed their teaching methods so that students in the class watched videos after class. During class, the teacher was responsible for completing homework or difficult problems in the experiment. In this way, the traditional teaching habit of "teachers explain in class, students do homework after class" has changed to "students preview by video before class and teachers guide students to complete homework or experiment in class". This is the origin of flipped classroom.

The development of the flipped classroom is divided into two stages. The first stage is related to the Khan Academy promoted by Salman Khan. When the concept of flipped classroom was first put forward, due to few excellent video sources, the concept of flipped classroom did not get large-scale promotion. Salman Khan founded the Khan Academy and launched a large number of public service video courses. This makes the impact of flipped classrooms expand rapidly. The second stage of flipped classroom development is closely related to the rise of MOOC<sup>[5]</sup>. The full name of MOOC is "Massive Open Online Courses". The difference between the MOOC and the previous online courses is more emphasis on two points: one is to emphasize "interaction and feedback"; the other is to advocate the establishment of an "online learning community". Before the MOOC, teachers put video on the Internet for students to browse and learn. Basically, there is no interaction teachers and students and feedback from student. The video in the MOOC encourages students to add interactive questions and quizzes in the video. At the same time, students are encouraged to learn deeply by searching various resources on the Internet.

## 3. Introduction to Case Teaching Methods

The "case teaching method" we are discussing now is a

teaching method proposed by the former Dean of Harvard University, Christopher Columbus Langdell. It was first used in the teaching of law major and is the main teaching method in the law schools of common law countries. Later it is widely used in medicine and management and other disciplines<sup>[6]</sup>.

Case teaching method means that teachers carefully design a case that can cover all the knowledge points, and then guide students to discuss the knowledge points involved in the case, thus students can master the knowledge points and skillfully use them in specific actual case<sup>[7]</sup>. The transformation of students from knowledge transfer to knowledge understanding and then to knowledge application is completed. Case teaching can string all the knowledge points of the course together, so that students have a general grasp of what they have learned. Because the cases used in case teaching are real examples in reality, it is of great help to improve students' practical ability.

## 4. The Application of Flipped Classroom In C++ Teaching

In the teaching of C++, we use the video of the flipped classroom from the national-level excellent course of Xuetang Online. The C++ excellent course is divided into two courses, one is basic knowledge course and the other is advanced knowledge course. Limited to the teaching plan and content of the course, part of the C++ content taught in our class is in the basic knowledge part of the excellent course, and part in the advanced knowledge part. Generally speaking, since the textbooks of the excellent course are basically the same as the content of the textbooks used in our class, which makes it more convenient for students to use the textbooks we used for learning.

The essence of flipped classroom is from the traditional teacher-centered learning model to student-centered, which makes students' learning time more flexible, and students can even use fragmented time to learn, which greatly improves students' freedom. In addition, students can pause while listening to the video, and then go to the Internet to search for information related to the knowledge point and have a detailed in-depth understanding. At the same time, we set up a QQ group for course discussion to guide students to discuss in the group. Students can help each other, and teachers can also participate in student discussions and explain the key and difficult points of the course. When conducting classroom teaching, teachers should organize classroom teaching well, guide students to group discussion on key points and difficulties. As for grouping, it is recommended to set a limit on the number of students about every group first, and then let the stu-

dents choose group freely. When grouping, the students should know that the teacher should evaluate the situation of the group discussion in the future. The teacher will set up a group discussion assessment form, and then score the contents of the form according to the group discussion, which can stimulate the students' learning enthusiasm. In this way, the original teacher-centered teaching model can be changed to a new student-centered teaching model, which can greatly stimulate students' independent learning ability and increase students' enthusiasm for participating in classroom interaction.

### 5.Design Ideas of Case Teaching Method in C++

After pre-learning and classroom discussions, students should have a good grasp of the relevant knowledge points. The next step is to deepen the relevant knowledge points and complete the internalization of knowledge. This article mainly uses case teaching to realize the process of knowledge internalization. According to the main knowledge points of C++, this paper designs a case that can cover all the knowledge points of C++. If students have mastered the content of the case, the relevant knowledge points of C++ can basically be mastered<sup>[8]</sup>.

The specific requirements of the case are as follows. In this case, we simulate a college student management system. The system has the following functions. All the data of undergraduates and graduate students are saved in the data file, and now all students need to be organized to hold meetings. Student must use the idea of C++ object-orient-

ed programming to accomplish the above tasks. It should be noted that the extensibility of the program should be considered when the class is designed. Specifically, there may be many student classes added in the future. Such as doctoral students, international students may be added in the future. The requirements of the system are basically corresponding to the knowledge points of C++ and the corresponding relationship is shown in table 1.

The implementation relationship of the above system can be drawn with UML. The specific class diagram is shown in figure 1.

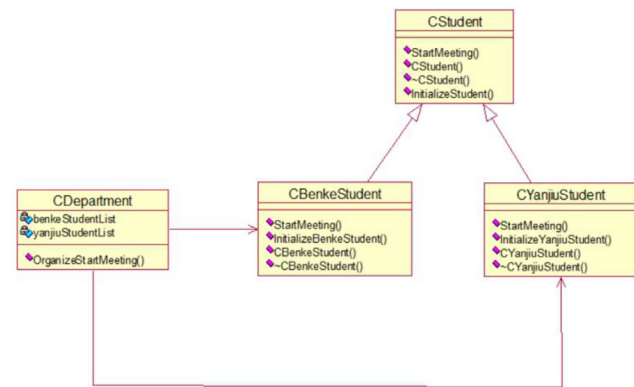


Figure 1. The specific class diagram

### 6.Effect Analysis of New Teaching Method

In order to evaluate the teaching effect of the case-based teaching method in the flipped classroom, we distributed questionnaires to the students majoring in software engineering and computer science and technology in

Table 1. knowledge points of C++ and the corresponding relationship

Classes and objects	Class, member function, constructor, encapsulation, destructor	Design and implementation of CStudent class. It contains the definition of class, the definition and implementation of member function, and the implementation of constructor and destructor.
Inheritance and Derivation	Derived classes, constructors and destructors of derived classes, member functions of derived classes, and combinations of classes	The design and implementation of CBenke Student (undergraduate class) and CYanjiu Student (graduate class) are introduced. Undergraduate and graduate students need to inherit the relevant content of CStudent. The implementation of constructor and destructor of CBenkeStudent (undergraduate class) and CYanjiuStudent (graduate class). The implementation of member function of CBenkeStudent (undergraduate class) and CYanjiuStudent (graduate class). The definition and implementation of CDepartment class(class describing the department).
Polymorphism and virtual functions	Virtual function, virtual destructor	Set the member function StartMeeting in the CStudent class as a virtual function, and the implementation of the StartMeeting function of the CBenkeStudent (undergraduate class) CYanjiuStudent (graduate class) class.
Input and output stream	Reading and writing of text files, ASCII files and binary files.	Put the data of all students into a file, read the data of all undergraduate and graduate students from the department, and then initialize all the undergraduate and graduate objects in the CDepartment with the read-out data. Finally, all undergraduates and graduate students will be organized in the CDepartment to complete the meeting.

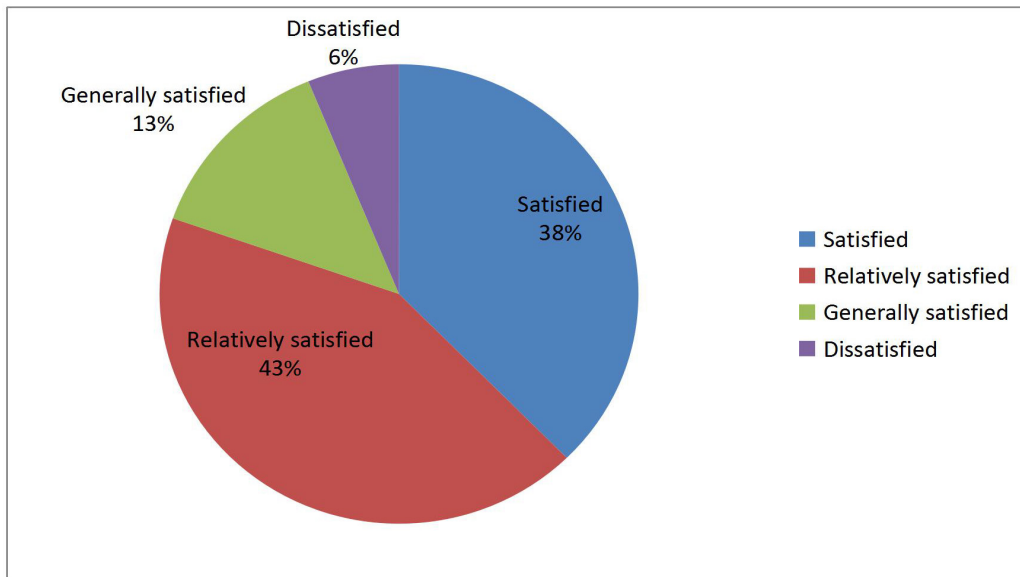


Figure 2. Students' satisfaction with teaching methods

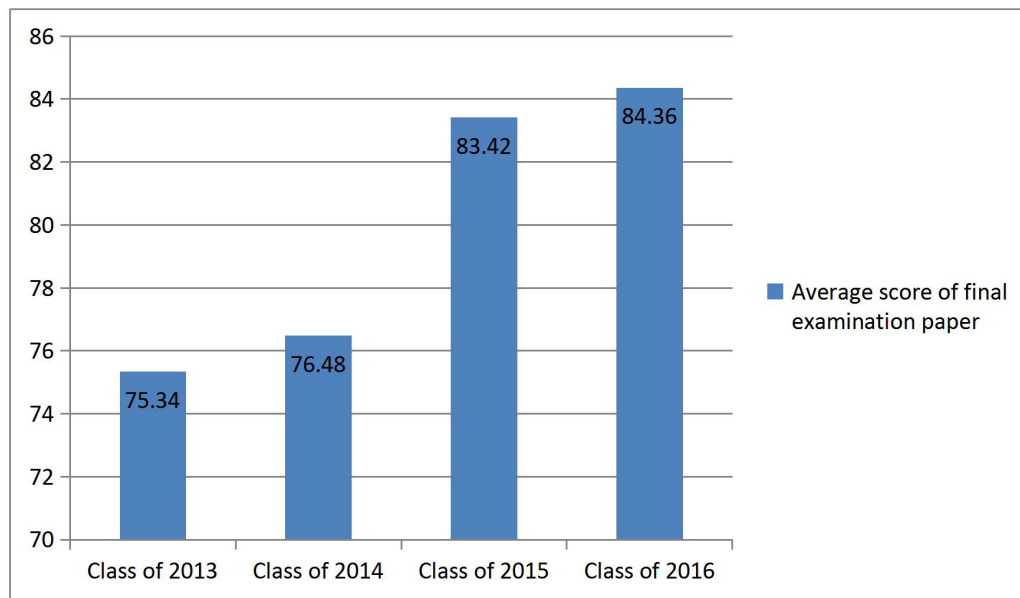


Figure 3. Average score of final examination paper

the class of 2016<sup>[9]</sup>. A total of 178 students participated in the questionnaire and the results of the questionnaire are shown in the figure 2. Most of the students are satisfied with this new teaching method. 85% of the students are satisfied with the new teaching method. The main reason why students are satisfied with this teaching method is that they can participate in the classroom by themselves, which not only gives full play to students' initiative, but also arouses their thirst for knowledge. Thus the students' ability to solve problems has been improved.

In terms of learning effect, we made statistics on the

final examination paper scores of 2013 and 2014 software engineering majors and computer science and technology majors who did not carry out the new teaching method. At the same time, we also made statistics on the final examination paper scores of students of software engineering major and computer science and technology major of 2015 and 2016 who carried out the new teaching method. The results are shown in the figure 3 below.

It can be seen from the above figure that the scores of grade 2015 and grade 2016 students have been greatly improved after the implementation of the flipped class-

room case teaching method. The average score increased by about 7 points. This fully shows that the case teaching method based on flipped classroom has a very good effect.

## 7. Conclusion

After the ideas of the flipped classroom and case teaching are applied to C++ teaching practice, it can effectively improve students' practical ability in C++. Flipped classroom video allows students to learn and review at any time. The case teaching and the teacher's targeted explanation in class enable students to quickly grasp the key points of knowledge. At the same time, because the case comes from a real project, students will have the ability to develop real projects after mastering the case. It is proved that after the two teaching methods are integrated together, students' ability to master knowledge has been greatly improved. In the next step, we want to allow students to participate more in the design of the project, and strive to design more practical and interesting projects.

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