



# Teaching Reform and Exploration of Computer Network Course Oriented to Output and Blended Method

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**ABSTRACT.** The traditional offline classroom teaching method of Computer Network is difficult to effectively improve students' learning interest and independent learning ability, and it is not easy to track or analyze students' learning progress as well. Combined with the advantages of online teaching and the output-oriented concept, blended curriculum teaching reform and exploration are carried out to enhance students' participation, enthusiasm and initiative in learning, and promote the continuous improvement of teaching quality.

**Keywords:** Output oriented, Blended method, Teaching reform of Computer Network course, Participation and initiative.

## 1 INTRODUCTION

In recent years, due to the impact of COVID-19, many universities had carried out online-only teaching methods. Online teaching is flexible, while traditional offline teaching is intuitive and face-to-face interaction is more vivid and cordial. Online teaching and traditional offline teaching have their own advantages, combining with the construction of top-quality course [1], the blended online and offline teaching model [2-4] has begun to develop continuously in many universities [2-4].

Computer Network is a compulsory course for undergraduates of computer majors. This course mainly trains students to master the relevant theories, basic principles, hierarchical structure and important protocols of computer networks, and lays a certain foundation for learning other network and information courses. The content of this course is more abstract, and difficult to learn, therefore some students are not interested and have low enthusiasm in learning.

The concept of Outcome Based Education (OBE) [2,5-7], namely output-oriented [6], is an advanced educational concept [2,5-7]. Blended teaching has received a lot of attention in recent years [2-4]. The application of OBE, the integration of online and traditional offline teaching, to explore the teaching reform of the Computer Network course in our college, has certain educational value, which can cultivate students' self-learning ability, mobilize students' learning initiative, participation enthusiasm, etc.

## 2 BACKGROUND OF CURRICULUM REFORM

Computer Network is a compulsory course for software engineering, spatial information and data science majors in our college. This course plays an important role in training students to understand the basic theories and principles of computer networks, and improve the ability of analyzing and solving network problems. It also lays a foundation for learning other courses and doing future research and work in networks.

In the spring of 2020, many teachers and students were unable to return to school on time due to the COVID-19 pandemic, whereupon a lot of universities started an online teaching model. With the attempt of online teaching and the continuous development of China's information-based education and teaching reform, hybrid teaching has attracted much attention. Meanwhile, various online teaching platforms (or tools) and teaching resources (such as MOOC, micro class) also begin to emerge and rise rapidly.

The rapid development of Internet and widespread application of various intelligent devices, such as smart phones and tablets, have brought great convenience to people. Rapid instant communication (such as Wechat, QQ), interesting network or single-player games, convenient online shopping, and multifarious web news or videos are easy to attract the majority of college students, and may even distract their attention in class. And some problems of traditional teaching of Computer Network are as follows:

(1) Students mainly learn the relevant protocols and working principles corresponding to the five-layer system structure in this course. There are many relevant theories and strong principles. Traditional face-to-face teaching is mainly taught by teachers, and students' active participation is insufficient.

(2) Contents of this course, such as multi-layer structure and protocols, are more abstract, but the class hours are only 48. In order to complete the contents, the interactions with students have to be reduced in class, and students have insufficient time for active thinking and practice, which leads to difficulties in understanding the protocols, structures and working principles of each layer.

(3) Face-to-face teaching place and time are limited, once the schedule is set, it is not easy to change the classroom and time. students' learning methods and assessment patterns are also single, which cannot fully stimulate students' interest in learning, and students lack of active learning ability.

Compared with pure online teaching, offline classroom teaching can provide better, more vivid and concrete interactions, communications and discussions. For example, when discussing the classification of network and introducing traditional telecommunication network, mobile network and computer network, the intuitive feeling between teachers and students is more direct and obvious, the classroom learning atmosphere is better, and the team discussion is easier and convenient. However, online teaching is not limited by time and space, and various online platforms like Rain Classroom, Tencent Classroom, Ding Talk, etc., are booming in recent years, which make the teaching more convenient. In addition, learning resources such as MOOC, SPOC, etc. become more abundant, thereby providing support for the reform of teaching.

OBE is an advanced educational concept [2,5-7]. In order to make full use of all kinds of smart phones, tablets, personal computer and Internet technology, etc., combine the advantages of online and offline teaching, the construction and reform of

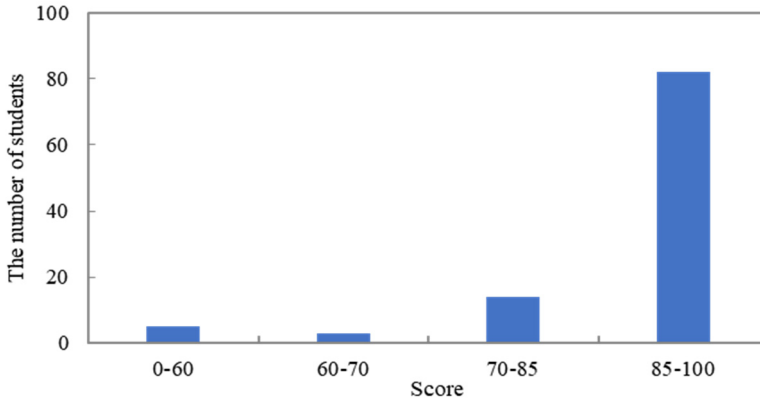
blended curriculum teaching of Computer Network based on output and online resources such as MOOC and Rain Classroom have been carried out gradually.

### 3 CONSTRUCTION OF BLENDED CURRICULUM TEACHING

The blended teaching reform of Computer Network includes online learning and traditional offline teaching. The online learning of this course is mainly based on the resources of Computer Network of South China University of Technology. According to the actual situation of our college, the question database and chapter test are constructed and adjusted. The sojump and Rain Classroom developed by Xuetao Online and Tsinghua University are used, consequently students can be more flexible and convenient to complete the relevant course content and chapter tests in their spare time through personal computers or smart phones or various tablets. Rain Classroom and sojump can also provide more complete data and intelligent support for the teaching process. Students can do fragmented online self-study more freely, and then come into the classroom with questions, furthermore they can review and consolidate knowledge after class. Teachers could adjust teaching process timely based on online tests. The sojump is used to design and analyze some online questionnaires concerning teaching and students' learning, so as to better help teachers regulate subsequent teaching design and content, etc., and it can also be used to carry out some online tests. The offline course report is organized in groups. After searching for materials for a topic and having group discussion, the corresponding report is written. Offline classroom teaching mainly adopts diversified blended learning methods such as flipped class mode, problem-based learning, case study, discussion, in-class practice and teaching.

#### (1) Online self-learning before class or after class

Before class, the teacher will input tests in the Rain Classroom, and release the online video and graphic contents of each chapter in advance. Students could conduct online independent learning in their spare time, then come to class with questions. Rain Classroom can record the duration of students' online learning, which can also be recorded into the process assessment. According to the teaching progress, students should complete the online chapter test, after-class exercises or homework on time. As for the questions raised by the students, the main way is face to face, QQ, E-mail and telephone are also adopted additionally. The online score of a class is shown in Fig. 1.



**Fig. 1.** A class online score statistics

(2) Adjust the teaching plan timely according to the learning situation

Based on the results of online learning, tests and after-class exercises, teachers adjust the teaching plans for students' fallible topics and knowledge, and further consolidate the relevant content in offline teaching. For example, the subnetwork division in Chapter 4 is easy for students to make mistakes. In offline teaching, case teaching, problem-based mode, discussion, exercises and group reports are adopted to strengthen students' understanding this content.

(3) Diversified Teaching

Case teaching, problem-based learning, random questioning, testing, practice, discussion, flipped classroom, teaching and other methods are mainly adopted in the class. For instance, when we study the definition and classification of computer network, the telecommunication network, cable television network and Internet are as cases, then their advantages and disadvantages are discussed in groups. Through the familiar contents about network, it is easier to improve students' learning enthusiasm and participation. Another example, in the planning and design of network after learning IPv4, and in the study of network space security and other content, students should firstly proceed group discussion, and then they should summarize and explain relevant content by flipped classroom or problem-based learning. Meanwhile, some course reports are formed after class. This student-centered and blended diversified teaching can exercise students' expression ability and enhance their participation.

(4) The inclusion of some ideological educations

Some ideological educations are as shown in Table 1.

**Table 1.** Some ideological educations

Location	Content
In definition and classification of Networks	Three types of telecom network, cable TV network and computer network are introduced and discussed to inspire students' study interest and patriotism.

In network planning and design	Some security problems existing in the current network and our coping strategies, etc. are appropriately added to enhance students' self-consciousness and national pride in serving and reciprocating the society.
In an overview of cybersecurity issues	Without network security, there will be no national security [8], and the importance of cybersecurity is introduced. Guiding students to establish correct network security concept.

(5) Multiple assessment and evaluation methods

The learning analysis of this course includes online learning statistics, attendance, class participation, chapter test or homework completion, discussion and group report, questionnaire survey statistics and the final examination. For example, for the course objective 4 in the questionnaire: be able to describe an IP layer protocol, formulate a subnet division plan, and propose a reasonable network address usage plan. The statistic of objective 4 is shown in Fig. 2.

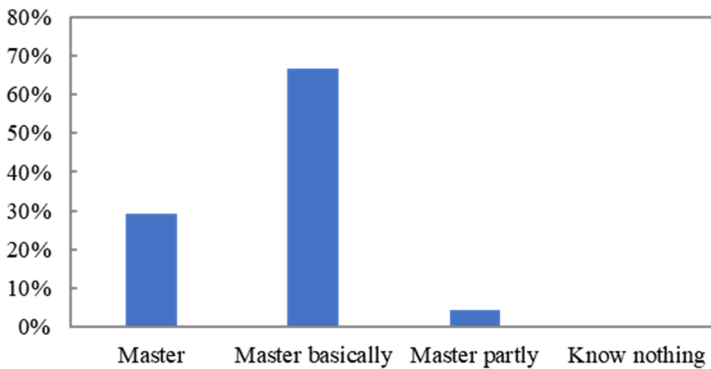


Fig. 2. The statistic of objective 4

The final grade distribution of a class last year and the analysis of course goal attainment is shown in Fig. 3 and Fig. 4 respectively.

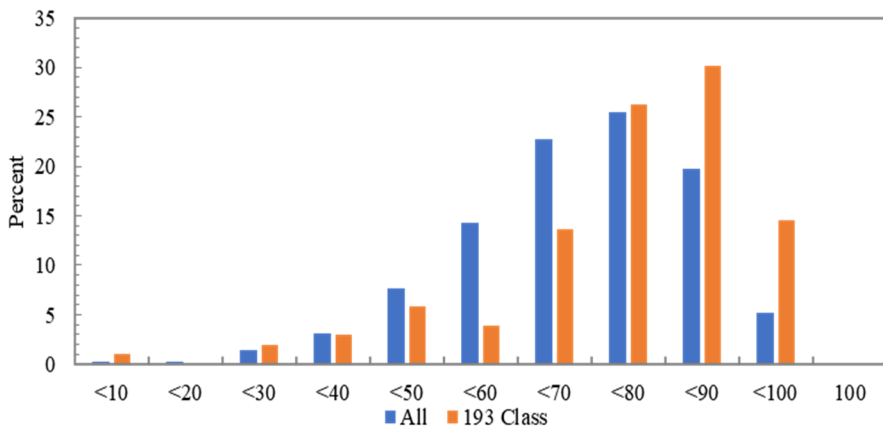


Fig. 3. Final grade distribution of 193 class

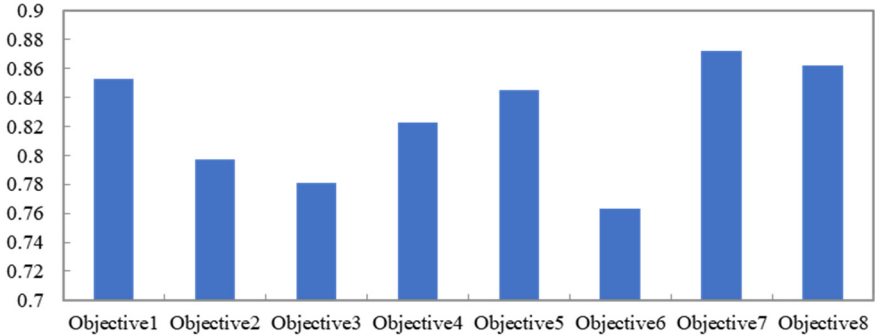


Fig. 4. Analysis of achievement of course objectives of 193 class

The change of final grades of three classes in three semesters is shown in Fig. 5.

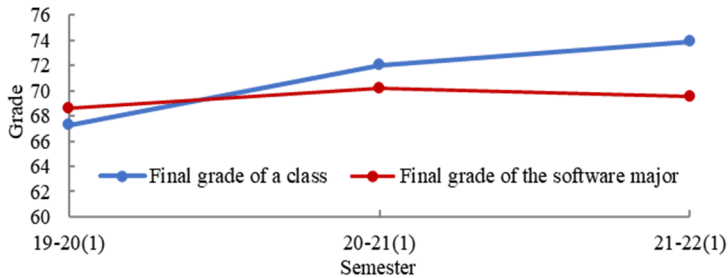


Fig. 5. Grades of three classes in three semesters

In three semesters, 20-21(1) and 21-22(1) adopt blended teaching, while the semester 19-20(1) adopts traditional offline teaching. From Fig. 6, the final grades of students in 20-21(1) and 21-22(1) have been improved.

## 4 CONCLUSION

The teaching of Computer Network is reformed and explored oriented to output and blended method, whereupon the teaching time and space are expanded and extended, the classroom teaching effect has been greatly varied, the students' participation has been improved, and the learning interest and initiative have also changed significantly. The use of Rain Classroom and sojump tools facilitates online learning, testing, statistics and feedback learning. According to students' output, the teaching methods, organization and quality of this course have been constantly adjusted and improved, and the teaching process has become more vivid and harmonious. This course is also in the construction of experiments, curriculum ideological contents, and online question database, so as to create a better teaching atmosphere, environment and learning effect.

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