



Blended Teaching Model of Offline-Online Based on the Mutual Promotion of Teaching and Learning

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Abstract. In order to give full play to the advantages of offline-online teaching, this paper explores the blended teaching model of offline-online based on the mutual promotion of teaching and learning. First, it studies the traditional offline teaching model and points out some problems existing in offline teaching. Second, it studies the online teaching model and explores the main problems that need to be considered in online teaching. And then, it also studies the blended teaching model of offline-online based on the mutual promotion of teaching and learning, and gives the design process of blended teaching model. Relying on the course of data structure and algorithm, it explores the blended teaching model of offline-online to stimulate students' interest, mobilize students' learning enthusiasm and initiative, and comprehensively improve the construction quality and teaching effect of relying course.

Keywords: Offline-Online Teaching · Mutual Promotion of Teaching and Learning · Blended Teaching Model · Data Structure and Algorithm

1 Introduction

Data structure and algorithm is an important professional foundation and backbone required course in computer science. It is the foundation of subsequent professional courses, and has strong theoretical and practical [1, 3, 5]. This course introduces linear structure of linear list, stack and queue, the nonlinear structure of generalized list, tree and graph, the typical application of basic data structure. Through the study and practice of this course, students can understand and master the typical data structure and related algorithms. Furthermore, it can cultivate the ability of analyzing and solving problems in the professional field, improve the ability of algorithm analysis and design, and lay a solid foundation to further study the follow-up professional courses.

In the traditional offline teaching process, teachers' teaching and students' learning form a complete closed loop, but there are still some problems in practical application, algorithm evaluation, preview before class, tutoring and answering questions. However, these problems can be solved perfectly through online teaching [2, 4]. Therefore, in order to give full play to the advantages of offline-online teaching, this paper puts forward a

blended teaching model of offline-online teaching. Firstly, the traditional offline teaching model is studied, and some problems existing in offline teaching are pointed out; then, the online teaching model is studied to explore the main problems that need to be considered in online teaching; finally, the research on the blended teaching model of offline-online based on the mutual promotion of teaching and learning is studied, and the design process of blended teaching model is given. Relying on the course of data structure and algorithm, this paper explores the blended teaching model of offline-online based on the mutual promotion of teaching and learning to stimulate students' interest, mobilize students' learning enthusiasm and initiative, and comprehensively improve the construction quality and teaching effect of relying course.

2 Research on Traditional Offline Teaching Model

The teaching implementation of traditional offline teaching model consists of four stages: investigation before class, theoretical teaching, practical guidance, tutoring and answering questions after class. In the stage of investigation before class, it usually learns about the learning situation through the teaching joint meeting and inquiries before class. During the theoretical teaching stage, it observes the students' state at all times, conducts questions and answers in a timely manner, carefully designs questions for classroom questioning, encourages students to show their opinions on the blackboard, conducts regular classroom tests to grasp the students' learning situation of knowledge, and so on. During the practical guidance stage, teachers intuitively understand the students' questions, and demonstrate the operation process. They can guide the students' questions one-to-one, which is convenient for communication and efficient in answering questions. In the stage of tutoring and answering questions, teachers can intuitively judge whether the students really understand through one-to-one tutoring and answering questions, and the communication is smooth. Through the implementation of these four stages, teachers' teaching and students' learning form a complete closed loop, as shown in Fig. 1.

However, the traditional offline teaching model also has some problems, mainly in four aspects.

- (1) In the learning pyramid, the average retention rate of practice is 75% and the learning efficiency is high. However, the practice of 60 h in the course only takes 10 of the time, accounting for less than 17%. The number of practical hours is small. And the conversion of theoretical knowledge to applied practice is not strong enough, resulting in the practical application ability weak or even poor and reducing the practical ability.
- (2) There are many algorithms, and some algorithms are difficult. Traditional teaching uses the way of submitting electronic source code, and the evaluation is not timely, resulting in delayed evaluation, and even wrong evaluation, which reduces students' learning initiative.
- (3) Preview before class is a mere formality, and the teacher's supervision of preview can't really be implemented, resulting in poor listening effect and even incomprehension, which reduces learning interest.



Fig. 1. Traditional offline teaching model.

- (4) Offline tutoring time is limited, and problems encountered in learning are difficult to solve in time, resulting in weariness, even abandoning learning, which reduces learning enthusiasm.

3 Research on Online Teaching Model

In order to ensure the effect of online teaching model, according to the teaching activities of traditional offline teaching model, online teaching model is mainly considered from the following five aspects.

- (1) How to understand the learning situation and teach students in accordance with their aptitude?
- (2) How to ensure the attendance rate and improve the online rate of students?
- (3) How to carry out classroom interaction and improve students' participation in class?
- (4) How to carry out practical training to stimulate students' interest in learning and improve students' practical ability?
- (5) How to tutor and answer questions to improve communication efficiency?

Through the comprehensive consideration of the above five aspects, it forms a perfect closed loop online teaching model, as shown in Fig. 2.

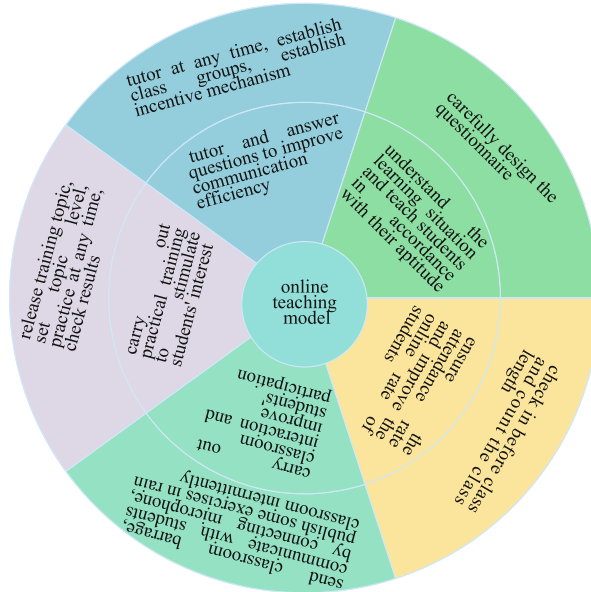


Fig. 2. Closed loop online teaching model.

4 Offline-Online Blended Teaching Model Based on the Mutual Promotion of Teaching and Learning

With the development of education and teaching technology, online teaching will tend to be normalized, and offline-online teaching model will become the development trend. Therefore, during the non-epidemic period, the advantages of online teaching should also be brought into play to form a blended teaching model in which offline-online teaching and learning are mutually beneficial. In order to give full play to the advantages of offline-online teaching and better implement teaching activities, it designs online teaching activities, offline realistic classroom teaching activities and assessments based on the main offline-online teaching activities, as shown in Fig. 3.

Online teaching activities include MOOC online learning, online homework, online testing, online discussion, online tutoring, learning situation investigation, etc. Offline realistic classroom teaching activities include heuristic teaching, offline-online blended training based on the mutual promotion of teaching and learning, flipped classroom guidance, etc. Assessments include process online assessment and summative offline assessment. Through the research, it explores the blended teaching model of offline-online, and applies it in the teaching activities relying on the course.

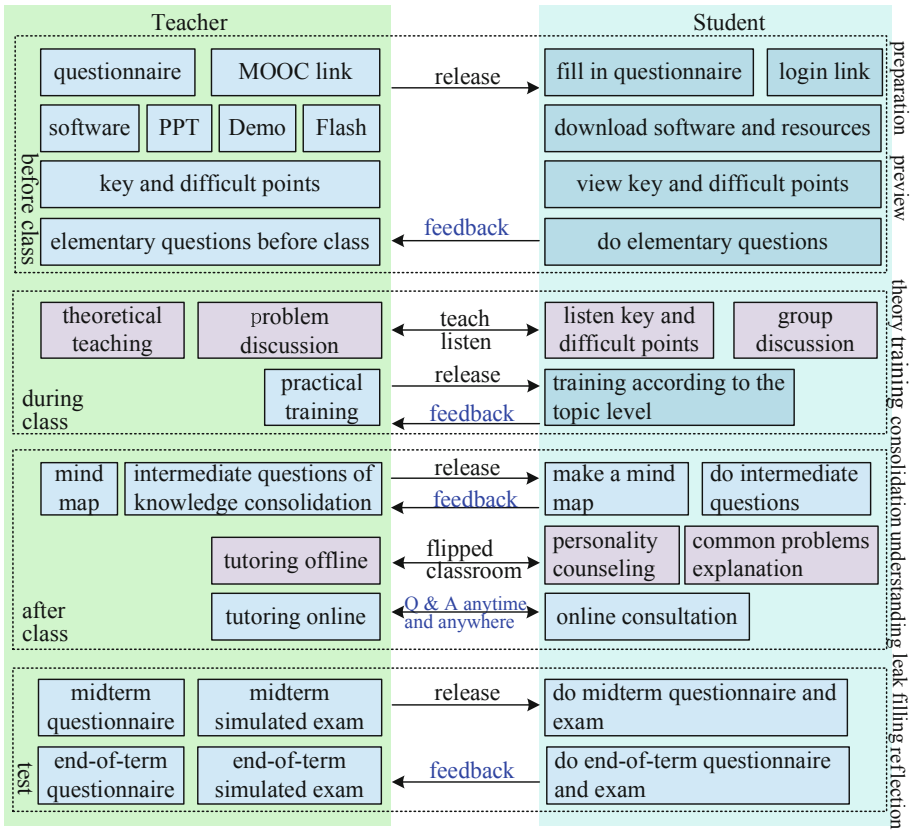


Fig. 3. Design of offline-online blended teaching model based on the mutual promotion of teaching and learning.

4.1 Design of Online Teaching Activities

The convenience of the Internet and abundant network resources provide a good auxiliary means for the implementation of teaching. In order to make full use of these advantages, online teaching activities are mainly designed from MOOC online learning, online homework, online testing, online discussion, online tutoring, and learning situation investigation.

- (1) MOOC online learning. Carefully select MOOC online courses, and encourage students to actively preview before class and review after class.
- (2) Online homework. Set up the class group, submit homework in the class circle, encourage students to judge each other, and find out the shortcomings of their own homework through comparison.
- (3) Online testing. Organize knowledge points, form various types of exercises, conduct online unit test regularly, and master the learning effect of students according to the statistical results.

- (4) Online discussion. Encourage students to ask questions at any time in the class group, drive students to actively carry out discussions, give play to the exemplary role of excellent students, and form a good learning environment.
- (5) Online tutoring. At any time, online tutoring and answering questions can help students feel that teachers are paying attention to their own learning, and provide counseling services for them, so that learning becomes a habit.
- (6) Learning situation investigation. Carefully set up a questionnaire to understand students' basic knowledge before class and after class, and accurately grasp students' learning situation by using software statistical results.

4.2 Design of Offline Realistic Classroom Teaching Activities

Offline teaching has the characteristics of convenient and smooth communication. In order to give full play to the advantages of offline realistic classroom teaching, teaching activities are mainly designed from the aspects of theoretical teaching, practical training and guidance.

- (1) Implementing realistic classroom teaching with heuristic teaching model. The teaching concept of taking students as the main body and teachers as the leading role is to teach the course knowledge from simple to deep, explain the key points, difficulties and common problems, and require students to make a mind map and upload them to the class circle, so as to stimulate students' interest in learning.
- (2) Carrying out practice training by the blended teaching model of offline-online based on the mutual promotion of teaching and learning. It adopts the methods of offline on-site guidance, online upload of training source code and operation results to mobilize students' learning initiative.
- (3) Using flipped classroom teaching model for guidance. For the common problems, encourage the students who have mastered the knowledge to explain on the platform, and establish the corresponding incentive mechanism to stimulate the enthusiasm of students.

4.3 Design of Assessments

In order to bring this process learning into the assessment and evaluation system, the assessment includes formative assessment and summative assessment, accounting for 30% and 70% respectively, and the former includes preview, review, mind map, midterm simulated exam, end-of-term simulated exam, training, and final exam, as shown in Fig. 4. Formative assessment mainly aims at learning knowledge, so that students can understand the knowledge points, test type and difficulty, so as to arouse students' attention to online learning and lay a good foundation for final offline assessment.

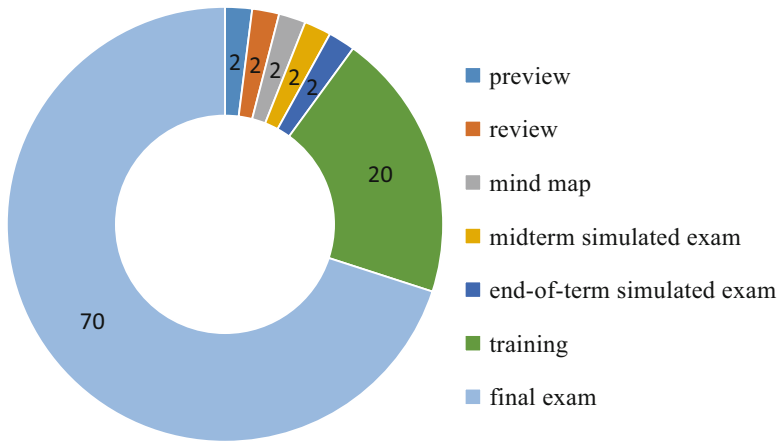


Fig. 4. Design of assessments.

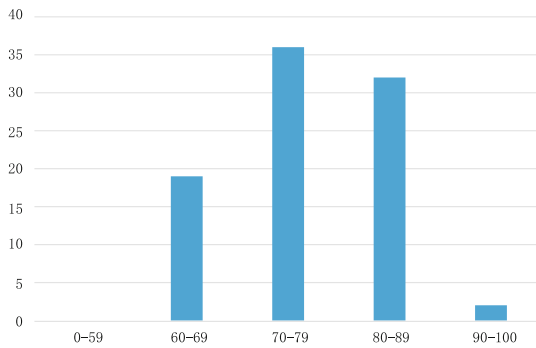


Fig. 5. Distribution of students' number in each score interval.

5 Analysis of Teaching Effect

Through 60 h of offline teaching, including 50 h of theoretical teaching and 10 h of practical training, and at least 120 h of online studying and tutoring, students' ability to use data structure to solve practical problems has been greatly improved. If students' scores are divided into five score ranges of 0-59, 60-69, 70-79, 80-89 and 90-100, the distribution of students in each score interval is shown in Fig. 5. Among them, 2 students are excellent, 32 students are good, 36 students are medium, 19 students are passing and none is failing, accounting for 2.25%, 35.96%, 40.45%, 21.35% and 0% respectively. According to the final closed examination data, fewer students are with low scores, more students are with medium scores and high scores. The results are relatively ideal and the teaching effect is good.

In order to compare the teaching effect, a comparative experiment was carried out between the two classes. For class B, teachers implement teaching according to the traditional offline teaching model. For class A, teachers implement teaching according to

the blended teaching model of offline-online based on the mutual promotion of teaching and learning. At the end of the course, the knowledge points involved in the course are tested. If the percentage of the number of students in a certain score interval to the total number is defined as the ratio, the ratio of class A is 21.35%, 40.45%, 35.96% and 2.25%, and the ratio of class B is 19.15%, 46.81%, 31.91% and 2.13%. In the passing, good and excellent range, the ratio of class A is significantly higher than that of class B, which improves by 2.2%, 4.04% and 0.12% respectively. Moreover, in terms of average score, class A is 75.8, class B is 75.3, and the former is 0.5 higher than the latter. These results indicate that the students in class A have better mastery of knowledge than those in class B.

In addition, the course group conducted a survey on the students of class A, asking about the advantages and disadvantages of the blended teaching model of offline-online based on the mutual promotion of teaching and learning. All students think that the blended teaching model of offline-online can help them preview, study and review very well. It can be seen that students are extremely in favor of the blended teaching model of offline-online.

6 Conclusions

Based on the course of data structure and algorithm, this paper puts forward a blended teaching model of offline-online based on the mutual promotion of teaching and learning, which can better solve the problems existing in offline teaching.

- (1) In the way of continuous practice after class, the training is released online according to the chapters, which is not limited by the class hours, so that the key algorithms in each chapter can be applied in practice. This way can improve the practical ability.
- (2) The method of code automatic evaluation is adopted to automatically evaluate the code immediately after submitting the code online, which not only reduces the workload of teachers, but also makes judgment on the code in time. This method can not only improve the training efficiency, but also improve students' learning initiative.
- (3) In the way of releasing preview questions, key and difficult points according to chapters before class, it gives full play to the role of preview, makes the preview really come into effect, and builds a solid classroom foundation. This way can not only improve the teaching effect of the realistic classroom teaching, but also stimulate learning interest.
- (4) Adopting the method of tutoring anytime and anywhere, whether it is 12 o'clock in the night, at home, on the road, or even in the hospital, teachers can help and answer students' questions, and they can discuss and communicate with each other anytime and anywhere. This method can make students feel that teachers are paying attention to their own learning all the time, which can not only shorten the distance between teachers and students, but also improve their learning enthusiasm.

These four aspects better solve the problems existing in traditional teaching, fully combine the advantages of offline and online teaching, and form a double closed loop

teaching model of offline-online based on the mutual promotion of teaching and learning. Adopting this teaching model, teachers and students have invested more than twice the energy of traditional teaching. Through the joint efforts of teachers and students, it will achieve a good teaching effect, and it is worth promoting in the future.

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