Exploration and practice of BOPPPS teaching model supported by information technology

Yan Dou [1, a], Dianlong You [2, b], Xiaoyan Wang [2, c], Dewei Kong [1,d], Yang Yu[1,e], Jianzhou Feng [2,f]

[1]School of Information Science and Engineering, Yanshan University, China;

[2] Key Laboratory of Software Engineering of Hebei Province, China.

[a] douyan@ysu.edu.cn , [b] youdianlong@sina.com , [c] wxyhmm@ysu.edu.cn

[d] xjkdw@ysu.edu.cn, [e] yuyang@ysu.edu.cn, [f] fjzwxh@ysu.edu.cn

Abstract. This paper describes the usage of various information technologies to promote students' in-depth participation in the bridge in, objective, pre-assessment, participatory learning, post-assessment, and summary (BOPPPS) teaching model. First, teachers are trained to apply Super Star before class to show the lesson objective and preview the lesson. Second, teachers learn to incorporate Rain Class for participatory learning, pre-assessment, and post-assessment. Third, apply programming teaching assistant platform(PTA) after class to do difficult post-assessment. Finally, the paper reviews the use of the model to empirically analyze the effect of training on teachers. The results show that information technology promotes active learning in the BOPPPS model.

Keywords: information technology; BOPPPS teaching model; active learning; in-depth participation.

1. Introduction

The bridge in, objective, pre-assessment, participatory learning, post-assessment, and summary (BOPPPS) teaching model is a Canadian teacher training tool known for its efficiency and efficacy. This teaching model, widely used in North American universities[1], first appeared in Chinese publications as part of an exploration of its use in a plant reproductive ecology course in 2011[2]. The BOPPPS teaching model has been studied more and more in many subjects, including network operating systems[3], signal analysis and processing[4], engineering drawing[5], and evidence-based medicine[6]. The outbreak of Covid-19 in 2020 resulted in a rapid increase in technology use in education; using BOPPPS in conjunction with virtual learning and other technology has yielded good results. Fu[7] used the Cloud Class teaching platform in electronic technology to stimulate learning motivation and interest. Dong[8] achieved positive results using Rain Class platform with BOPPPS. Guo[9], based on BOPPPS and QQ，used WeChat and other online tools to teach successfully. However, thus far, research is insufficient to demonstrate the efficacy of BOPPPS in programing courses. In 2021, author participated in training to use BOPPPS teaching model at York University, Canada. In addition, the author also obtained ISW and Facilitator Development Workshop qualifications with BOPPPS as the core teaching model. The author also organized and implemented training for new teachers to use BOPPPS as the core teaching model in university and had a deeper understanding of the effective use of BOPPPS. This paper explains the usage of three kinds of information technologies together with BOPPPS to improve pedagogy.

2. BOPPPS teaching model integrated with information technology

2.1 Three kinds of information technology used in this model

The first program is Super Star[10]. Super Star allows teachers to store learning resources, publish learning activities, and assign homework before and after class. Students can preview learning resources, complete homework before and after class, get teacher's approval, and conduct other learning activities.

The second information technology is Rain Class[11]. It can create and send teaching materials to students via WeChat, send questions and view students' answers in real-time, encourage students to participate in discussions, and add more fun to class through instant, personalized analysis.

The third information technology is PTA[12]. Students can submit program source code, and the PTA system can automatically compile data, judge right and wrong, and check code duplication. It suits the programming design classes to provide more training to improve the programming ability.

2.2 Teaching system design

The BOPPPS teaching model focuses on students, centering students in the learning process and attaching importance to students' participatory learning experience. However, the programming course is a highly practical course, and it is difficult to achieve the teaching goal of improving programming ability only by classroom learning. Therefore, it is necessary to combine in- and out-of-class learning, especially to strengthen students' programming practices, which requires creating a good learning environment for students. This system introduces a programming teaching assistant platform (PTA) to let students do program experiments and automatically evaluate the running results of the program, which can provide students with a large number of exercises and timely feedback. Rain Class can promote high-quality interactions with students and collect the learning feedback of each student so that teachers can understand students' learning situations and adjust learning strategies. The teaching system design is shown in Figure 1.
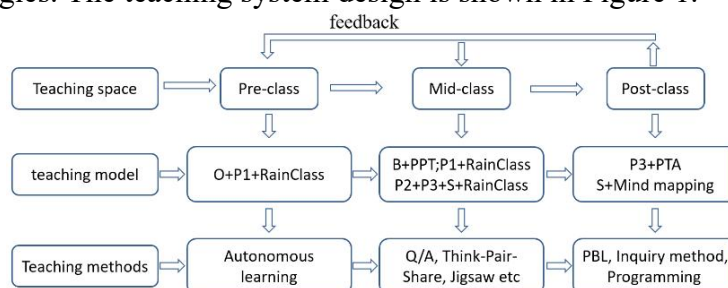
Fig. 1 Structure Chart of Teaching System Design

2.2.1 Pre-Class

In pre-class, the teacher can provide the objective and part of learning content in Super Star platform. The other part of learning content can be chosen on Mooc of China university platform.

2.2.2 Mid-Class

In mid-class, the Rain Class + PPT + Programming environment way can be used in the six modules of BOPPPS.

- B (Bridge in) is the introduction before entering the topic. The teacher can input the lesson contents into the Super Star platform before class, perhaps starting with pictures, video, or hotspots related to this class topic for attract students.
- O (Objective) establishes the objectives for the mastered knowledge, cultivated ability, and acquired emotion of each lesson. The objectives are announced to students before class, preview in advance, establish expectations, present to students in class, and strengthen expectations before class.
- P (Pre-assessment) is to understand students' knowledge reserve of the content to be learned in this lesson. According to the teaching objectives of this lesson, the teacher may design

some questions to understand the student's comprehension. Teacher can get all the answers from students through Rain Class. Teacher can adjust some of the contents of the class according to these pre-assessments.

● P (Participatory Learning) is the core of BOPPPS. The pyramid learning principle tells us that the effect of active learning is more than 20% than that of passive learning. Therefore, teacher should give students more time to take part in lessons. Our class is programming, so to read program, write program can be used in the class.

● P (Post-assessment) is to test whether students achieve the objectives of this class. Due to the short class time, the test knowledge objectives can be designed and completed, but for the programming abilities objectives, it must only be tested after class. Rain Class can be used in mid-class, and PTA is suitable for programming abilities objectives.

● S (Summary) is summarizing the content of this lesson and assigns follow-up assignments. Close to class, students' attention is reduced, so summary can attract students to come back to class. The teacher can use mind mapping to sort out the contents of the class. The teacher can also let students organize their thoughts with mind mapping.

2.2.3 Post-Class

The classic BOPPPS model is limited to duration of the class, but some content requires more time to grasp. Information technology can enlarge the period of time. For example, students can complete program design and implementation on PTA platform after class. Teachers can see students' completion of homework through PTA platform. A bridge between the teacher and student is built to communicate to each other. This way can solve the space-time problem.

● Before class, teacher can provide the learning objectives and part of learning content in Super Star platform. Students study these contents according to the objective by themselves. This work can cultivate students' autonomy in learning. This part does not require students to fully achieve the learning objectives, students only need to understand part of the learning content.

● After class, the teacher posts the programming tasks in the PTA platform. PTA can automatically judge whether the program is correct. In order to ensure the quality of education, the homework PTA system provides the duplicate check function, which can effectively check the repetition rate of code and plain text files.

3. Teaching effect evaluation

To understand the impact of BOPPPS, the author conducted a questionnaire survey. There are 62 students in the author's class, and 58 questionnaires were collected, qualifying as a valid survey. The results are shown in Table 1.

Table 1 Survey results

Questions	A	B	C	D
Does the teaching objectives presented by the teacher in the classroom help the learning of this lesson?	52	5	1	0
Are you willing to interact with the teacher in class?	45	13	0	0
Do you think the teacher is paying attention to all the students in the class?	32	25	1	0
Can you follow the teacher's pace throughout the class?	22	31	4	1
Are you satisfied with your study status?	22	17	18	1

There is a high degree of satisfaction in teaching objectives, student participation, attention to students, and other aspects, but satisfaction is lower regarding teacher's pace and satisfaction, which is a problem worth pondering.

The author teaches two classes, and other two teachers teach two classes each. In addition to the use of BOPPPS in classroom teaching, the other weekly tests, experiments, and other teaching

contents are completely consistent, so the other two and a half classes can be used as control classes. Figure 2 shows the scores, which demonstrate stronger results in the class using BOPPPS.
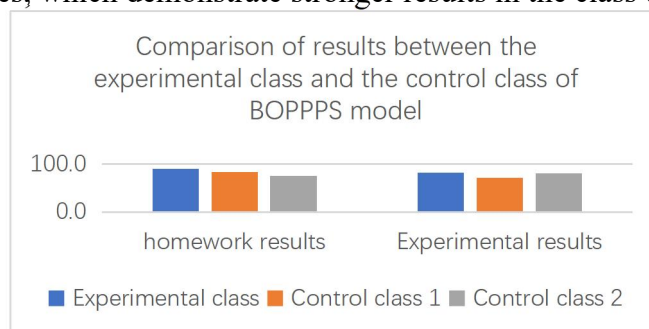

Fig. 2 Comparison of results between the experimental class and control class of BOPPPS model

4. Summary

BOPPPS is an effective teaching model to increase students' active learning opportunities. Teaching practice shows that deep integration of information technology and BOPPPS can make every student participate in the learning activities and feedback. Although you may have achieved all the above in time, not every learning objective can be achieved in class. In this paper, Super Star, Rain Class and PTA are applied to BOPPPS teaching model, which is proved efficiently.

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