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Nursing Communications 2024;8:e2024012. https://doi.org/10.53388/IN2024012

Effectiveness of the "online + offline + practice" trinity teaching model on the learning of junior nursing students: an exploratory study

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Author contributions

Liu CX and Wang L conceived and designed the study. Wang L analyzed the data. Liu CX and Wang L wrote the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare no conflicts of interest.

Acknowledgments

This research was supported by Social Science Research Project of Yichang (ysk24ybkt011).

Peer review information

Nursing Communications thanks all anonymous reviewers for their contribution to the peer review of this paper.

Abbreviations

BOPPPS, Bridge, Objective, Pre-assessment, Participatory learning, Post-assessment, and Summary; PPT, PowerPoint.

Citation

Liu CX, Wang L. Effectiveness of the "online + offline + practice" trinity teaching model on the learning of junior nursing students: an exploratory study. *Nurs Commun.* 2024;8:e2024012. doi: 10.53388/IN2024012.

Executive editor: Xiu-Jin Wei.

Received: 16 March 2024; **Accepted:** 21 June 2024; **Available online:** 26 June 2024.

Abstract

Background: Surgical Nursing is a main course of nursing specialty and a large course lasting 96 credit hours. In response to the teaching pain points such as the complicated and boring content of the surgical nursing course and the disconnection between classroom theory and clinical practice, surgical nursing is undergoing a teaching reform. **Methods:** The Surgical Nursing course builds trinity teaching model of "online + offline + practice" and implements teaching reforms by combining the Bridge, Objective, Pre-assessment, Participatory learning, Post-assessment, and Summary (BOPPPS) teaching concept. We constructed a trinity teaching model, and these teaching reform measures included building an online learning platform, offline case teaching and scenario simulation and hospital and community practice. The 50 students in the junior year of the undergraduate nursing program in the class of 2020 were used as the study subjects, and the students' comprehensive scores were compared. The questionnaire was also used to assess students' independent learning ability and to evaluate students' satisfaction with the teaching. **Results:** The students' course pass ($\geq$ 60 points) rate was 100%, and the excellence ($\geq$ 80 points) rate was 24.00%. Students' independent learning ability improved, and the scores and total scores of cognitive self-management ability, information ability and learning co-operation ability were significantly better than those of the national norm ($P < 0.01$). The satisfaction of students in the BOPPPS group with classroom teaching was also significantly higher than that of the control group. **Conclusion:** The "online + offline + practice" trinity teaching mode can effectively integrate the "Rain Classroom" online platform with the BOPPPS teaching mode. It guides students to actively participate in classroom thinking and discussion, improves students' independent learning ability, and effectively enhances the effect of classroom teaching.

Keywords: BOPPPS; Rain Classroom; Surgical Nursing; teaching

Background

Surgical Nursing is a major nursing course and a large course lasting 96 h (60 h of theory and 36 h of laboratory). The content of the course includes two major parts, the general theory and the individual theory. The general part introduces the care of patients with water electrolyte acid-base balance disorders, shock, surgical nutrition, anaesthesia and so on. On the basis of the general theory, the individual theory introduces the knowledge and skills of diagnosis and treatment of common diseases in neurosurgery, thyroid and breast surgery, and thoracic and cardiac surgery. The large volume of knowledge in the course and the scattered distribution of knowledge points of various systems of diseases are not attractive to students because they are boring and not up-to-date.

In order to change the above teaching difficulties and comply with the trend of online teaching in the context of the pandemic, the Surgical Nursing course team is now actively promoting the transformation of the teaching model. The course team actively uses modern information technology to build a combined teaching model based on the "Rainy Classroom" Bridge, Objective, Pre-assessment, Participatory learning, Post-assessment, and Summary (BOPPPS) teaching model, which is a kind of effective student-oriented teaching model proposed by the North American Instructional Skills Workshop [1, 2]. BOPPPS are six different components at the core of the instructional model [3]. The BOPPPS philosophy is specifically implemented in surgical nursing as follows.

Bridge: pre-lesson study materials are distributed through the Rain Classroom, and learning tasks are assigned.

Objective: teachers use concise language and clear and concise slides to clarify the specific objectives to be achieved in this teaching.

Pre-assessment: the purpose of the pre-course test is to map the students' basic knowledge through various forms of pre-course preparation, and based on the test results, the teacher will fine-tune the implementation of the content of the teaching. Taking "student-centred" as the starting point, instead of rigidly teaching according to the lesson plan, it is easy to understand the teaching difficulties and break through the teaching key points.

Participatory learning: the student-centred participatory teaching model is a key element in the implementation of BOPPPS. According to the pre-course preparation feedback from the results of the test questions set in the "Rain Classroom" before the class, the overall mapping of the students' knowledge, and the class will focus on explaining the knowledge that the students have not mastered well. Teachers first complete the basic knowledge of the explanation, students have a certain basic knowledge of the disease mastery. In this process, the "Rain Classroom" open pop-up function, so that students can speak freely, and interspersed in the teaching process about the important knowledge points in the classroom test, to enhance the teaching effect.

Post-assessment: the purpose of the post-test is to judge whether a teaching method is reasonable and efficient. Students take post-tests through Rain Classroom to consolidate their knowledge.

Summary: the purpose of using a mind map to summarise is to emphasise the key points, help students to systematically review the key knowledge of the chapter, consolidate the effect of classroom teaching and help students to review after class. Students in the teacher's inspiration, driven by the review, sorting out the knowledge involved in this class, play the role of the first and last echo.

This study aims to promote students' mastery of the basic knowledge of surgical nursing through the innovation of teaching mode, mobilise students' enthusiasm for exploring knowledge, and improve students' satisfaction, which is reported as follows.

Method

Participants

From February to June 2023, 50 students in the third year of a four-year undergraduate nursing programme in the class of 2020 were selected for the study. There were 7 males and 43 females. Age ranged from 19 to 25 (21.34 ± 1.04) years.

Ethics approval

The study was approved by the Ethics Committee of the host institution (Ethics No. 2023-034-01). Consent was obtained from the respondents prior to the interview and it was stated that the study was completely anonymous. Respondents were allowed to withdraw from the study at any time during the interview. Interview data were used only for the purpose of this study.

Educational system

The construction of the trinity teaching model based on Rain Classroom and BOPPPS is shown in Figure 1. The version used in this study was Rain Classroom 6.2. Rain Classroom is developed by Tsinghua University to integrate sophisticated information technology tools into PowerPoint (PPT) and microcredit to connect teachers and students [4]. "Rain Classroom" transforms mobile phones into teaching tools through vivid and imaginative teaching materials, effectively stimulating students' enthusiasm for learning [5, 6]. The BOPPPS-based teaching, as an open instructional design model, could improve their thinking ability and academic performance and learning initiative [7, 8]. The BOPPPS model can be incorporated with diverse teaching methods to be more in line with medical students' psychological characteristics and cognitive law. The BOPPPS teaching model based on the "Rainy Classroom" pays more attention to classroom interaction and enhances students' participation in discussions. Take Chapter 22 "Nursing Care of Patients with Cardiac Macrovascular Disease" as an example of classroom design using the BOPPPS teaching model.

Online. Bridge: through the "Rain Classroom", we pushed the students to prepare for the class, and uploaded the mobile phone preparation courseware of Chapter 22 "Nursing Care of Patients with Cardiac Macrovascular Diseases" for students to learn the basic knowledge. In addition, "Rain Classroom" pushes the case information of aortic coarctation in the affiliated hospital of the school and the related task assignment to attract the interest of students, and the group leader is responsible for organising the group members to explore and learn in this case discussion. The group leaders were responsible for organising the group members to explore and learn. The group members discussed the division of labour within the group and chose the appropriate students to be responsible for literature review, PPT production and presentation of the report. Those who review the literature need to review the textbooks and literature, and fully summarise the relevant information to assist the group to complete the learning task. In addition to book knowledge, they need to explore the best way to solve the problem by combining with recent literature (within 5 years). The learning tasks of the five groups are distributed as follows: Group I: monitoring and management of digestive system function; Group II: monitoring and management of circulatory function; Group III: monitoring and management of respiratory function; Group IV: monitoring and management of renal function; Group V: monitoring and management of psychological state.

Objective: the teaching objectives are divided into three levels: knowledge objectives, ability objectives and quality objectives. Take "aortic coarctation" as an example, according to the requirements of the syllabus, set out the teaching objectives of this class. Knowledge objectives: master the principles of treatment of aortic coarctation, be familiar with the etiology of aortic coarctation, clinical manifestations, auxiliary examination, and understand the concept of aortic coarctation. Ability objective: to be able to apply nursing procedures to implement holistic nursing care for patients with aortic coarctation. Qualitative Objectives: to develop a sense of teamwork and first aid in caring for patients with cardiac and macrovascular diseases, to respect colleagues and other health care professionals to respect patients' values, cultural practices, personal beliefs, and rights, to protect patients' privacy, and to care for, and love, patients.

Pre-assessment: The Surgical Nursing Curriculum Group has unified the corresponding scores and question types for the pre-course test,

in-course test and post-course test, so as to facilitate the fairness of formative evaluation, as shown in Table 1.

Offline. Participatory learning: in addition, the classroom is also designed to flip the classroom, before the class published the task, students prepare in advance, look for relevant literature, the group team division of labour and cooperation to produce PPT, by the five major groups from the five major systems to report. The mode of summary report enables students to master the required knowledge points of the course within the limited classroom teaching time, encourages students to actively participate in the enthusiasm, and also stimulates students' active thinking ability.

Practice. Post-assessment: the purpose of the post-test is to judge whether a teaching method is reasonable and efficient. Students take post-tests through Rain Classroom to consolidate their knowledge.

Summary: the purpose of using a mind map to summarise is to emphasise the key points, help students to systematically review the key knowledge of the chapter, consolidate the effect of classroom teaching and help students to review after class. Students in the teacher's inspiration, driven by the review, sorting out the knowledge involved in this class, play the role of the first and last echo.

Practical applications: in clinical practice, students go into the clinic, contact patients, and practice nursing operations. The theoretical knowledge learned in the classroom is verified in practice. By communicating, assessing, observing, analyzing, and discussing with patients, students improve their competency in assessment, communication, clinical thinking, and knowledge application.

Evaluation of teaching and learning

Overall performance. With regard to the content of teaching evaluation, learning input is included in the formative evaluation indicators to affirm students' input in programme learning. With regard to the subject of evaluation, students are appropriately given the opportunity to evaluate others, forming an evaluation mechanism that promotes learning through evaluation. The course results are composed of two parts: formative evaluation (basic assessment results and inquiry learning assessment results) and summative evaluation (final examination results). The basic assessment result consists of chapter tests on the Rain Classroom learning platform (including pre-course tests, in-class tests and post-course tests), accounting for 10% of the total grade. The assessment result of inquiry learning consists of 20% of the experimental class results, 10% of the group report results (5% teacher evaluation + 5% mutual evaluation of group members), 10% of a book report results, accounting for 40% of the total grade. The final examination is a closed-book theoretical examination, and the final paper grade accounts for 50% of the total grade, see Figure 2. The objective learning behaviour data of students are included in the formative assessment. Diversified formative assessment can form a good incentive mechanism to effectively enhance the enthusiasm and autonomy of students' classroom learning.

Instrument of competencies of autonomous learning of nursing students. The scale was developed by Lin, which consists of 28 questions and is divided into 3 subscales and 8 dimensions based on the relevant competencies of self-directed learners [9]. The 3 subscales are: self-management competence subscale, information competence subscale and learning co-operation competence subscale. The scales were rated on a 5-point Likert scale, with a Cronbach's coefficient of 0.86 for the total scale of the questionnaire, and an absolute goodness-of-fit index > 0.9 for the overall and subscales.

Satisfaction. Student satisfaction rates were surveyed by the faculty at the end of each course during the semester. A self-administered satisfaction rate questionnaire was used, containing seven items, each of which included four items: very satisfied, satisfied, fair, and dissatisfied.

Table 1 Chapter tests

Stage	Objective number of questions	Subjective question volume	Instructions	Points
Pre-class	6 objective questions Each question is worth 5 points	2 subjective questions Each question is worth 5 points	6 * 5 = 30 2 * 5 = 10	40
In class	3 objective questions Each question is worth 10 points	No	3 * 10 = 30	30
After-class	6 objective questions Each question is worth 5 points	No	6 * 5 = 30	30

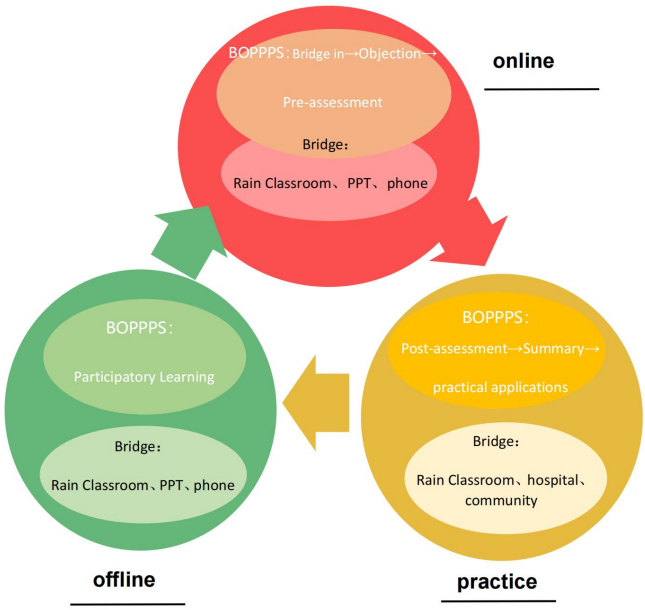

Figure 1 Trinity Teaching Model

BOPPPS, Bridge, Objective, Pre-assessment, Participatory learning, Post-assessment, and Summary; PPT, PowerPoint.

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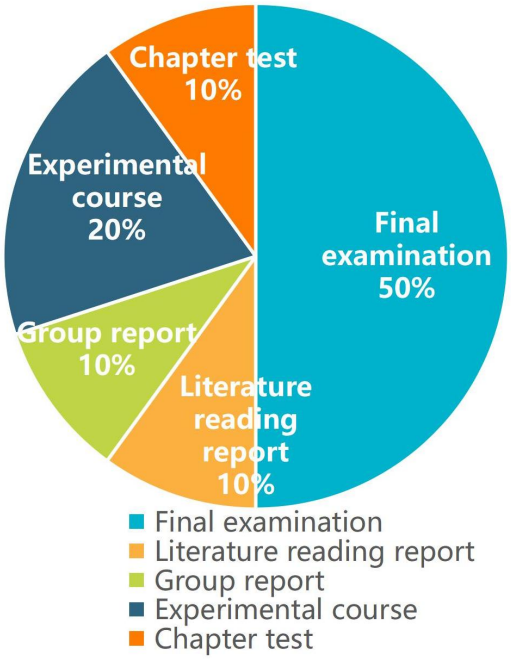

Figure 2 Teaching evaluation system

Statistical analysis

The Statistical Program for Statistical Product and Service Solutions version 21.0 for Windows was used for the statistical analysis, and a statistical significance level (α) of 0.05 (two-tailed test) was applied. Descriptive statistics of the comprehensive score of the study participants were calculated, and the results are presented as mean, and standard deviation. Subsequently, single sample T test were performed to understand the difference in the autonomous learning ability between the experimental groups and national norms.

Results

Overall performance

In previous traditional teaching, the distribution of students' overall grades tended to be polarised. Using classroom teaching based on the rainy classroom and BOPPPS model, the 50 students in the class of 2020 had better course learning. The course pass (≥ 60 points) rate was 100%, the excellence (≥ 80 points) rate was 24.00%, and the distribution of surgical nursing grades is shown in Table 2.

Students' capacity for self-directed learning

K-S test using Statistical Product and Service Solutions 21.0 software showed that the total scale and subscale scores conformed to normal distribution. The scores of self-management ability, learning co-operation ability, information ability and total score were higher than the norm. In the subscales, the differences in time management ability, learning monitoring ability, information acquisition ability, ability to broaden information channels, information analysis and processing ability, and communication ability were all statistically significant ($P < 0.001$), see Table 3.

Evaluation of teaching satisfaction

At the end of the eight theoretical lectures in this semester, students evaluated the quality of teaching and teaching satisfaction in the classroom through questionnaire star, and the results are shown in Table 4. Surgical Nursing course organised students to evaluate the course, in addition to ≥ 90% of the satisfaction of the school evaluation of teaching in February, March, April, and May.

Discussion

Surgical Nursing course is based on the BOPPPS teaching concept, with the help of the Rain Classroom network teaching platform, adopting the teaching forms of theoretical lectures, practical skills and case analysis to build a trinity teaching mode. Students are encouraged to master the basic knowledge, basic theories and basic skills of surgical nursing. This course aims to cultivate students' clinical thinking and scientific inquiry spirit, and to train students' interpersonal communication ability, teamwork ability and job competence.

In recent years, the BOPPPS model, which pays more attention to the role of students' initiatives in the teaching process and fully mobilizes their initiatives in the learning process, has been widely considered in China [7]. A large amount of the literature has shown the advantages of the BOPPPS model in various fields in health care and economics, such as dentistry, histopathology, and accounting education [8, 10–12]. Teaching surgical nursing based on the rainy classroom and the BOPPPS model incorporates students' objective learning behaviour data into the process assessment. Diversified formative assessment forms a good incentive mechanism, effectively enhancing students' motivation and autonomy in learning. Abandoning the single assessment method of determining grades by a single paper in the past, we have changed from the result assessment to the formative evaluation of the whole process. Through the recording and collection of students' daily learning behaviour data on the Rain Classroom platform, students' learning is quantitatively evaluated. Increase the proportion of usual grades to 50%. Students follow the teacher's rhythm throughout the learning process and have a moderate sense of urgency to arrange the learning time and intensity in a balanced way. The results of Table 2 show that the overall performance of students is good, and the average assessment score of students is (77.65 ± 4.46), and the pass (≥ 60 points) rate is 100%. Therefore, under this course system, the final grade of the course can also reflect students' mastery and application of relevant knowledge more objectively and accurately.Self-management skills are at the centre of self-directed learning skills. Learners with self-management ability regard themselves as the main body of learning in learning activities. They have clear learning goals and conscious and positive learning attitudes, and are able to self-direct, self-regulate and control their learning activities [13]. In this study, the ability to determine learning needs scored 2.93 on the self-management ability scale, the ability to monitor learning scored 4.03, and the ability to manage time

Table 2 Distribution of performance in Surgical Nursing, Class 2020 ($\bar{x} \pm s$)

Grade	Chapter test (10%)	Experimental course (20%)	Group report (10%)	Literature reading report (10%)	Final examination (50%)	Total score
2020	92.08 ± 4.30	95.99 ± 1.42	81.07 ± 5.26	72.00 ± 6.3438	68.69 ± 8.76	77.65 ± 4.46

Table 3 Comparison of competencies of autonomous learning of nursing students with norms ($\bar{x} \pm s$)

Items	Observation group (n = 50)	Normality (n = 4309)	t	*P*
Totals	3.51 ± 0.36	3.10 ± 0.35	8.18	0.00
Self-management skills	3.57 ± 0.39	3.12 ± 0.44	8.19	0.00
Ability to learn to work together	3.41 ± 0.46	3.15 ± 0.48	4.05	0.00
Information capacity	3.52 ± 0.44	3.04 ± 0.44	7.68	0.00
Competencies for identifying learning needs	2.93 ± 0.62	3.04 ± 0.58	−1.22	0.28
Time management skills	3.60 ± 0.53	3.10 ± 0.63	6.72	0.00
Learning to monitor competence	4.03 ± 0.65	3.19 ± 0.63	9.07	0.00
Ability to seek help	2.71 ± 0.63	2.84 ± 0.75	−1.50	0.13
Communication skills	3.94 ± 0.61	3.39 ± 0.63	6.40	0.00
Access to information	3.26 ± 0.78	2.79 ± 0.57	5.06	0.00
Capacity to broaden information channels	3.97 ± 0.62	3.45 ± 0.66	5.91	0.00
Information analysis and processing capacity	3.51 ± 0.49	3.04 ± 0.62	6.81	0.00

Table 4 Classroom teaching satisfaction (n = 382)

Items	Very satisfied	Satisfied	Fair	Dissatisfied
Evaluation of the overall delivery of the lesson	362	20	0	0
Vivid teaching language and clear explanations	362	19	1	0
Highly focused and difficult lectures	360	22	0	0
Enrichment of teaching and learning materials	362	19	1	0
Delivered at the right pace	357	24	1	0
Lively atmosphere in the classroom	359	22	1	0
Guiding students' independent enquiry	363	18	1	0

scored 3.60. This indicates that the ability to monitor learning is the strongest among the self-management abilities, and the ability to determine learning needs is the weakest. With the help of the "Rain Classroom" platform and the BOPPPS teaching mode, students have the correct guidance of goals and task lists, and their learning monitoring and time management skills have increased. However, the ability to identify learning needs still needs to be cultivated. The ability to determine learning needs refers to the ability of learners to identify their learning deficiencies and transform them into learning goals and activities in the process of learning and life [13]. At this stage, students are confused about determining their learning. Jansen et al pointed out that it is important that students develop skills to identify self problems because it also allows students to evaluate the problems, discuss, and decide which problems to take on [14]. In the next step of the teaching programme, the self-assessment questions before class will be strengthened, so that students will know where their problems lie and be able to actively demand the correct answers before class through online and offline channels. In addition, teachers can teach nursing students how to self-test their learning results in the process of guiding students in the learning process, so as to enhance their awareness of self-testing.

Learning co-operation ability is a necessary aid to independent learning. It determines whether undergraduate nursing students can find solutions to problems encountered in learning in a timely and effective manner [13]. It is also the key for undergraduate nursing students to be able to objectively and effectively apply human resources for learning in team work. In the Learning Collaboration Competency subscale, the communication competency dimension and each entry were above the mean score. The teaching model based on the rainy classroom and BOPPPS uses teamwork as the cornerstone to optimize the division of labour and collaboration among group members, and the atmosphere of the group is active and ideas collide during the discussion. This shows that the students' communication ability has been greatly improved, which strengthens their coordination and organisation ability and communication and expression ability. However, the dimension of help-seeking ability is lower than the average score, with only 2.84 points. Help-seeking ability refers to the learner's ability to obtain hints and help from those who are more knowledgeable and competent when facing a complex and difficult task [13]. The low score of students at this stage indicates that currently students are more likely to communicate and share their learning experiences with their peers and less likely to seek help from their teachers. It is possible that some teachers have to juggle administrative work, research experiments and clinical practice and have limited energy to pay attention to their students [13]. In a study by Cheng it was pointed out that not all students take the initiative to ask for help from their teachers, and that the students who need the most help tend to be the ones who seek the least help [15]. In the study by Bai it was pointed out that in addition to providing a channel for students to seek help and encouraging them to do so, teachers can also use assessments to determine which students need help and reach out to them [16]. In the study by Longobardi indicate that a favorable educator-learner rapport, marked by good communication, help, and personal connections, minimizes learners' tension [17]. The next step in the teaching programme will be to strengthen faculty development, promote mentorship, and encourage teacher-student information communication by adopting more teaching methods such as problem-based learning and Team-Based Learning as well as organising professional-related activities [18–20].

Information competence is the ability to use tools in self-directed learning, mainly in the selection and utilisation of learning objects by undergraduate nursing students. Learners with information competence are able to effectively identify the availability of information, interpret and decipher it, and then selectively receive, process, integrate and transform it [13]. In this study, the dimensions and entries in the information competence subscale were above the

mean score. This indicates that using the model of pre-class pre-study and pre-class task assignment, the students' ability to seek the correct answers as well as to produce a debriefing on the process of acquiring the required information, knowledge points, and expanding the information has been improved. Students' ability to broaden information channels and their ability to analyse and process information were enhanced.

Rain Classroom is a new and different classroom atmosphere through a variety of interactive methods. Before class, the Rain Classroom teaching platform conveniently pushes the pre-reading courseware and pre-course tests to students, which enlightens students' thinking and guides them to self-exploration. In the classroom, the use of the Rain Classroom teaching platform scanning code sign-in, random roll call, anonymous pop-up interaction, anonymous discussion, classroom random test, classroom red envelopes and other functions, so that the classroom atmosphere is more active, and the communication and interaction between the students is more vivid and novel. After class, by using the Rain Classroom teaching platform to push the post-class test, the latest guidelines and consensus, students have deepened their understanding and memory of knowledge, as well as expanding the knowledge horizons of the relevant chapters. Based on the "Rain Classroom" BOPPPS teaching mode greatly enriches the teaching means and improves the classroom teaching effect and learning achievement, so it is welcomed and praised by the students and has a high degree of teaching satisfaction. Research by Hu shows that BOPPPS model more than the traditional instructional approach in course satisfaction, learning initiative, analytical ability, clinical thinking ability, and self-study ability are consistent with this study [3].

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