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Application of the BOPPPS-CBL model in emergency chest pain management teaching for resident physicians: a randomized comparison

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Abstract

Background Chest pain is very common in emergency department. The management of chest pain is a priority for resident physicians. This study aimed to verify the teaching effects of the combination of bridge-in, objective, preassessment, participatory learning, post-assessment, and summary and case-based learning (BOPPPS-CBL) model in emergency chest pain management teaching for resident physicians.

Methods This randomized controlled trial study enrolled 118 resident physicians undergoing standardized training during their Cardiology Department rotation. They were randomized in two groups: traditional lecture-based learning (LBL) group and BOPPPS-CBL group. Pre-class test (30 points), post-class test (30 points), Mini clinical evaluation exercise (Mini-CEX), and direct observation of procedural skills (DOPS) were analyzed. The satisfaction of two teaching models and self-adjustment by two groups were further analyzed.

Results A total of 118 resident physicians were enrolled and the mean age was 26.96 years and 57.6% were males. There was no statistical difference in the pre-class test scores between two groups (17.03 ± 4.16 vs. 17.08 ± 3.87, $P = 0.945$). BOPPPS-CBL group's post-class test, Mini-CEX and DOPS total scores were significantly higher than those of the LBL group (all $P < 0.05$). Additionally, the satisfaction and self-adjustment ability of resident physicians in the BOPPPS-CBL group were significantly higher than those in the LBL group (all $P < 0.05$).

Conclusion The BOPPPS-CBL model could be an effective teaching method in emergency chest pain management teaching for resident physicians.

Keywords BOPPPS model, Case-based learning, Chest pain, Resident physician training

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Introduction

Chest pain is one of the most frequent symptoms in the emergency department (ED), accounting for 5–10% of ED visits and 16.4% emergency medical services [1]. It is estimated that the lifetime probability for developing chest pain is nearly 20–40% [2]. The causes of acute chest pain are very extensive, and differential diagnosis is a difficult point in ED and a key factor in saving the lives of patients [2, 3]. In practical clinical work, many patients with cardiovascular diseases often first present chest pain. This requires relevant doctors, especially those in the ED and cardiology department, to have a certain ability to distinguish and diagnose chest pain, which can provide valuable time for emergency treatment to patients to the greatest extent possible.

In China, medical education especially post-graduate training system is primarily based on the national standardized medical residency training program, which was established in 2014 to standardize and improve the quality of medical education. This program typically lasts 3 years and includes rotations through various departments, supervised clinical practice, and didactic training. Resident doctors are assessed through periodic exams and must pass a national standardized exam to obtain certification [4]. Although it represents a big step towards the standardization in medicine residency training, the next step should focus on shifting the learning and teaching model that is student-oriented. Traditional lecture-based learning (LBL) instruction is that the senior clinicians mainly explain, and resident physicians learn the knowledge passively, which may largely suppress resident physicians' learning initiative and enthusiasm [5]. Therefore, LBL is unable to meet the demand for improving the clinical abilities and cultivating clinical thinking of resident physicians.

Reforming the teaching mode has been the focus of medical educational innovation. Case-based learning (CBL) is a pedagogical method that restores real clinical scenarios and disseminates the knowledge via clinical cases, with resident physicians playing the core role and clinical cases providing guidance [6]. It has been shown to promote resident physicians' understanding of key concepts and enhance their ability to combine theory with practical applications in multiple medical disciplines [7–9]. However, traditional CBL often lacks a clear structure and may not actively engage all learners, limiting its effectiveness in complex topics such as chest pain management. Similarly, while flipped classrooms encourage self-directed learning, they may not provide sufficient in-class guidance or immediate feedback, which are critical for mastering the nuanced skills required in clinical practice.

The bridge-in, objective, pre-assessment, participatory learning, post assessment, and summary (BOPPPS) model, originating from British Columbia, Canada, addresses these limitations by providing a structured, goal-oriented framework that emphasizes active student participation and ensures learning objectives are met [10]. The effectiveness of the BOPPPS model has been internationally recognized, and its integration with CBL (BOPPPS-CBL) has recently gained traction in medical education, particularly in nursing and undergraduate medical training, with promising results [11, 12]. The BOPPPS-CBL model combines the strengths of both approaches: the structured, participatory nature of BOPPPS and the practical, case-driven focus of CBL. This integration ensures a more systematic and engaging learning experience, which is particularly effective for complex topics like chest pain management. Despite its potential, the BOPPPS-CBL model has not yet been applied to the training of resident physicians in cardiology. Given the high prevalence of chest pain, particularly cardiac chest pain, effective education in this area is crucial. This study investigated the effectiveness of the BOPPPS-CBL model in improving chest pain management skills among resident physicians rotating in cardiology, aiming to address gaps in traditional teaching methods and enhance clinical competency.

Methods

Study design and participants

This was a randomized controlled trial study conducted from 2022.01.01 to 2023.12.30 in Sir Run Run Shaw Hospital, which was a large, comprehensive hospital with medical teaching and research capabilities. The participants in this study were resident physicians involving Bachelor, Doctor, and Master's Degree, undergoing standardized training during their cardiology department rotation. Participants met the following inclusion criteria: [1] Participants were resident physicians currently undergoing standardized training in the cardiology department. [2] Participants had prior exposure to basic cardiology training but limited experience in managing complex chest pain cases. [3] Participants were available to attend all scheduled teaching sessions and assessments. Exclusion criteria were listed as following: [1] Resident physicians who had completed advanced training in cardiology or had extensive experience in chest pain management were excluded. [2] Participants who were unable to attend more than two teaching sessions or missed any of the assessments were excluded from the final analysis.

Finally, 118 resident physicians were included in the study and were randomly divided into two groups of experimental group (BOPPPS-CBL group) and control group (LBL group). Randomization was performed using the R programming language. A sequence of random integers was generated and participants were allocated

to one of two groups based on the parity of the assigned number: odd numbers were assigned to LBL group, and even numbers were assigned to BOPPPS-CBL group. The randomization list was generated by an independent statistician to ensure impartiality. While blinding of participants and instructors was not feasible due to the nature of the educational intervention, outcome assessors were blinded to group allocation to minimize bias. For both groups using the same chest pain case, the instructors communicated with the patient in advance and obtained their consent.

Instructor qualifications

The instructors involved in this study were board-certified cardiologists and emergency physicians with extensive clinical experience in chest pain management. All cardiologist instructors held advanced certifications in cardiology and had a minimum of 5 years of clinical experience in diagnosing and managing cardiac chest pain. They were actively involved in teaching resident physicians as part of their academic roles. As for emergency physicians, the emergency physician instructors were board-certified in emergency medicine and had significant experience in managing acute chest pain in emergency settings. Their expertise in rapid assessment and decision-making complemented the cardiologists' focus on detailed diagnostic evaluation. In addition, all cardiologists and emergency physicians instructors have underwent rigorous training and evaluation processes. These include completing residency, obtaining board certification in both internal medicine and cardiology or in emergency medicine, and participating in continuing medical education.

LBL method for chest pain course

The traditional LBL method explained the knowledge through one-hour lecture using the slide decks. First, the teacher explained the relevant theoretical knowledge of chest pain based on the requirements of the syllabus. Then, in the class, the teacher explained cases according to the summary of medical history, initial writing, diagnostic criteria, differential diagnosis, and treatment methods. Resident physicians were given 5 min of thinking time and 20 min of answering and discussion time. Finally, the teacher summarized and reviewed the relevant knowledge points.

BOPPPS-CBL method for chest pain course

The BOPPPS-CBL model we have designed further unleashed resident physicians' autonomy and initiative. We sent the teaching outline and cases to resident physicians one day in advance, enabling them to learn cutting-edge knowledge related to the case independently and facilitating classroom discussions. The detailed steps of the BOPPPS-CBL model were as follows.

Bridge-in (B)

In this study, the chest pain-related contents were first presented by resident physicians and then the teacher gave complementary information. According to the teaching content, the teacher would connect the learning content with basic knowledge points such as pathophysiology, diagnosis, etc., so as to make the focus and application value of learning go from simple to in-depth.

Objectives (O)

The teacher needed to clarify the learning objectives while emphasizing the key points and difficulties of teaching. Specifically, resident physicians should master the symptoms, common causes, diagnosis, differential diagnosis, and treatment of chest pain.

Pre-assessment (P)

The pre-assessment composed of heuristic questions (30 multiple-choice questions), aiming to assess the cognitive level of resident physicians, which would help to adjust the teaching emphasis in the subsequent teaching (Supplementary material 1). The multiple-choice questions were developed by a team of experienced cardiologists and emergency physicians, with each question aligned to the learning objectives of the study and designed to assess a range of cognitive levels based on Bloom's Taxonomy. The questions have underwent both peer-reviewed and pilot-tested to ensure their validity and reliability.

Participatory learning (P)

This was the core section of the BOPPPS-CBL model, dominated by the resident physicians, with each class lasting one hour, consistent with LBL group. Firstly, resident physicians were divided into groups and classic chest pain cases were prepared based on the discussed teaching content. Then, each group member conducted simulated consultations based on typical cases of chest pain, summarized the current medical history, and listed the necessary examinations and treatments. If there were any missing contents, the teacher would supplement it in a timely manner. Finally, the resident physicians discussed and summarized the cases, and the teacher commented on the results of each group's answers, explaining the key points and difficulties in the case.

Post-assessment (P)

Post-assessment was designed with 30 choice questions, with a focus on clinical knowledge related to chest pain. Teachers could adjust the subsequent teaching content based on the results of post-assessment to improve teaching efficiency.

Summary (S)

Resident physicians were encouraged to summarize the course content of chest pain. And further, the teacher refined and summarized the key and difficult points. In particular, providing a learning outline and a flowchart for diagnosing and treating chest pain in the form of an outline.

Evaluation

The resident physicians' performance (grades) on assessments consisted of four parts: before-class test, after-class test, Mini clinical evaluation exercise (Mini-CEX), and direct observation of procedural skills (DOPS). Mini-CEX involved seven parts: medical interviewing skills, physical examination skills, humanistic qualities/professionalism, clinical judgment, counseling skills, organization efficiency and overall clinical competence. Each item was scored from 1 to 9. The scores of 1–3, 4–6, and 7–9 were regarded as unsatisfactory, satisfactory, and superior, respectively [13]. DOPS was a method of assessing technical skills. The specific evaluation contents included indications and contraindications, obtaining informed consent, preparation of pre-procedure, technical ability, communication skills, humanistic qualities/professionalism and overall ability to perform the procedure. The scoring criteria was similar to Mini-CEX [14].

In addition to the theory examination, participants were asked to complete a questionnaire on satisfaction and self-assessment of abilities at the end of rotation (Supplementary material 2). Likert five-level score method was used for scoring, ranging from l to 5 points with 1 being the best and 5 the worst.

Standardization of teaching delivery

To ensure consistent teaching delivery across groups, several measures were implemented. First, all instructors underwent a comprehensive training program that covered the BOPPPS-CBL model, the standardized curriculum for chest pain management, and the use of teaching materials. Second, a standardized curriculum was developed, including lesson plans, case scenarios, and assessment tools, all aligned with the BOPPPS framework. Finally, standardized teaching aids such as slide decks and handouts were used to further enhance consistency.

Statistical analysis

Categorical variables were presented as unweighted count (weighted percentage), and sued chi-square test for comparison. Continuous variables with normal distribution were presented as weighted mean ± standard error, and used T-test for comparison. Continuous variables with non-normal distribution were presented as weighted median [interquartile range], and used Mann-Whitney U test for comparison.

All statistical analyses were conducted using SPSS version 22.0 (SPSS Inc, Chicago, USA) and R version 4.0.5 (The R Foundation for Statistical Computing, Vienna, Austria), with all tests being two-tailed, and significance set at $P < 0.05$.

Results

Population characteristics

A total of 118 resident physicians were enrolled in the final analysis. The mean age was 26.96 years and 57.6% were males. According to the teaching model, all resident physicians were divided into two groups: BOPPPS-CBL group ($n = 59$) and LBL group ($n = 59$). In Table 1,

Table 1 Baseline characteristic of two groups

Character	Overall *N* = 118	LBL *N* = 59	BOPPPS-CBL *N* = 59	*P* values
Sex, %	68 (57.6)	38 (64.4)	30 (50.8)	0.192
Age, years	26.96 (2.37)	26.88 (2.32)	27.03 (2.43)	0.728
Educational background, %				0.28
Bachelor	98 (83.1)	51 (86.4)	47 (79.7)	
Doctor	9 (7.6)	5 (8.5)	4 (6.8)	
Master	11 (9.3)	3 (5.1)	8 (13.6)	
Clinical practice, %				0.293
the first year	56 (47.5)	27 (45.8)	29 (49.2)	
the second year	41 (34.7)	24 (40.7)	17 (28.8)	
the third year	21 (17.8)	8 (13.6)	13 (22.0)	
Self-evaluation grade, %				0.266
1	51 (43.2)	27 (45.8)	24 (40.7)	
2	38 (32.2)	22 (37.3)	16 (27.1)	
3	21 (17.8)	7 (11.9)	14 (23.7)	
4	8 (6.8)	3 (5.1)	5 (8.5)	
5	0 (0)	0 (0)	0 (0)	

Table 2 Test scores before and after class of two groups

Character	Overall	LBL	BOPPPS-CBL	*P* values
Before-class test				
A1	6.29 (1.85)	6.36 (1.86)	6.22 (1.86)	0.693
A2	5.80 (1.61)	5.83 (1.53)	5.76 (1.70)	0.82
A3	4.97 (1.59)	4.90 (1.58)	5.05 (1.61)	0.605
Total	17.06 (4.00)	17.08 (3.87)	17.03 (4.16)	0.945
After-class test				
A1	7.92 (1.77)	7.42 (1.64)	8.42 (1.77)	0.002
A2	8.49 (1.55)	7.86 (1.57)	9.12 (1.26)	< 0.001
A3	8.35 (1.83)	7.29 (1.87)	9.41 (0.98)	< 0.001
Total	24.76 (3.91)	22.58 (3.56)	26.95 (2.90)	< 0.001

the results displayed found that there was no significant difference between two groups when comparing general variables involving gender, age, educational background, clinical practice and self-evaluation (all $P > 0.05$).

Comparison of teaching effectiveness between BOPPPS-CBL and LBL groups

Table 2 showed the test scores before and after class of two groups. There was no statistical difference between BOPPPS-CBL and LBL groups in the before-class test scores (17.03 ± 4.16 vs. 17.08 ± 3.87, $P = 0.945$). After teaching, the BOPPPS-CBL group's after-class test scores were significantly higher than those of the LBL group (26.95 ± 2.90 vs. 22.58 ± 3.56, $P < 0.001$).

The results of Mini-CEX and DOPX scores were displayed in Table 3. Mini-CEX comprised seven dimensions. Compare with LBL group, the BOPPPS- CBL group showed higher Mini-CEX scores in the dimensions of medical interviewing skills, humanistic qualities/professionalism, clinical judgment, counseling skills, organization efficiency and overall clinical competence (all $P < 0.05$), while there were no statistical differences in the dimension of physical examination skills (7.19 ± 1.83 vs. 6.75 ± 1.48, $P = 0.154$). As for DOPS, significant differences were observed between the BOPPPS-CBL and LBL groups in the dimensions of indications and contraindications, technical ability, communication skills, humanistic qualities/professionalism and overall ability to perform the procedure (all $P < 0.05$). Anyway, no differences were found in the dimensions of obtaining informed consent and preparation of pre-procedure (both $P > 0.05$).

Additionally, we also analyzed the satisfaction of two teaching models and self-adjustment by two groups of resident physicians (Table 4). Compared to those in LBL group, resident physicians in BOPPPS-CBL group were reported significantly higher satisfaction (involving study time, student–teacher interaction, education mode, course satisfaction and self-satisfaction) and greater self-adjustment (including learning motivation, analytical ability, self-learning ability, clinical thinking ability and helpful) (all $P < 0.05$).

Discussion

To the best of our knowledge, this study represents one of the earliest applications of the BOPPPS-CBL model in the training of resident physicians rotating in cardiology, particularly in the context of chest pain management. While the BOPPPS model and CBL have been widely used in other medical education settings, their combined application in this specific context has not been extensively reported in the literature. The results found that compared to the control group using LBL method, the experimental group using BOPPPS-CBL method had made significant progress in grades, involving after-class test, Mini-CEX and DOPS scores. This indicated that BOPPPS-CBL model had more advantages, which could promote the comprehensive quality improvement

Table 3 Mini-CEX and DOPS scores of two groups

Character	Overall	LBL	BOPPPS-CBL	*P* values
Minicex				
Medical interviewing skills	7.35 (1.19)	6.93 (0.83)	7.76 (1.34)	< 0.001
Physical examination skills	6.97 (1.67)	6.75 (1.48)	7.19 (1.83)	0.154
Humanistic qualities/professionalism	8.18 (1.15)	7.97 (1.27)	8.39 (0.98)	0.045
Clinical judgment	7.20 (1.56)	6.83 (1.42)	7.58 (1.61)	0.009
Counseling skills	7.11 (1.15)	6.88 (1.04)	7.34 (1.23)	0.031
Organization efficiency	6.89 (1.53)	6.54 (1.45)	7.24 (1.54)	0.013
Overall clinical competence	7.19 (1.60)	6.86 (1.63)	7.51 (1.51)	0.028
Dops				
Indications and contraindications	7.41 (1.06)	7.17 (0.89)	7.64 (1.17)	0.015
Obtaining informed consent	7.95 (0.70)	7.83 (0.42)	8.07 (0.89)	0.066
Preparation of pre-procedure	7.54 (0.88)	7.41 (0.59)	7.68 (1.09)	0.096
Technical ability	6.92 (1.63)	6.63 (1.54)	7.22 (1.67)	0.047
Communication skills	7.80 (1.22)	7.56 (1.32)	8.03 (1.08)	0.035
Humanistic qualities/professionalism	8.06 (0.80)	7.90 (0.82)	8.22 (0.74)	0.028
Overall ability to perform the procedure	7.51 (0.61)	7.39 (0.49)	7.63 (0.69)	0.034

Table 4 Satisfaction of two teaching models and self-adjustment by two groups of students

Character	Overall	LBL	BOPPPS-CBL	*P* values
Satisfaction				
Study time	3.95 (0.92)	4.12 (0.72)	3.78 (1.07)	0.046
Student–teacher interaction	3.73 (1.09)	3.25 (0.94)	4.20 (1.03)	< 0.001
Education mode	3.96 (0.60)	3.83 (0.42)	4.08 (0.73)	0.022
Course satisfaction	3.98 (1.06)	3.78 (1.16)	4.19 (0.92)	0.037
Self satisfaction	3.62 (0.92)	3.37 (0.79)	3.86 (0.99)	0.003
Total points	19.24 (1.98)	18.36 (1.76)	20.12 (1.80)	< 0.001
Self-adjustment				
Learning motivation	3.48 (1.13)	3.25 (0.99)	3.71 (1.22)	0.027
Analytical ability	3.95 (0.81)	3.59 (0.59)	4.31 (0.86)	< 0.001
Self-learning ability	3.73 (0.82)	3.44 (0.60)	4.02 (0.92)	< 0.001
Clinical thinking ability	3.76 (0.84)	3.29 (0.59)	4.24 (0.80)	< 0.001
Helpful	4.08 (0.77)	3.64 (0.48)	4.53 (0.75)	< 0.001
Total points	19.01 (2.37)	17.22 (1.49)	20.80 (1.61)	< 0.001
Grade				0.029
1	9 (7.6)	8 (13.6)	1 (1.7)	
2	9 (7.6)	6 (10.2)	3 (5.1)	
3	18 (15.3)	10 (16.9)	8 (13.6)	
4	41 (34.7)	21 (35.6)	20 (33.9)	
5	41 (34.7)	14 (23.7)	27 (45.8)	

of resident physicians, rather than just theoretical assessment scores. In addition, BOPPPS-CBL teaching model was also an effective method for improving teaching satisfaction and self-adjustment. This teaching model might be worth additional promotion and application among resident physicians in the training relating to the management of chest pain.

Chest pain is a common and urgent medical symptom, accounting for 8–10 million visits per year [15]. Although chest pain occurs frequently, the evaluation and diagnosis of patients with chest pain are complex and challenging [16]. The causes of chest pain are complex, involving multiple organs and systems, and the severity of the condition varies. Among them, the cardiac chest pain, is a life-threatening condition requiring emergency treatment [17]. With the implementation of standardized training for residents, resident physicians have become an important part of the frontline medical workers [4]. Resident physicians have sufficient opportunities to interact with patients with acute chest pain during clinical rotations, especially in the ED and cardiology. Mastering the diagnostic management of chest pain is a necessary skill for resident physicians, and teaching this skill is one of the important contents of medical education [18]. Of note, however, it has not been long since the standardized training for residents in China officially started, and the construction of the training system and the formulation of relevant residency training rules are relatively late. There are still many problems that need to be improved, such as vague clinical training content, lack of popularization of basic theoretical knowledge, and insufficient scientific research training [19]. At present, the training of resident physicians in cardiology on chest pain management is mainly based on lectures, supplemented by teaching word rounds, clinical lectures, case discussions, and other methods. Such traditional training method is usually teacher centered, focusing on imparting knowledge while neglecting the initiative of resident physicians [20]. In fact, after undergraduate studies, resident physicians have already acquired certain self-learning abilities and theoretical knowledge related to chest pain when entering standardized training for resident physicians. At this stage, imparting basic knowledge and training clinical skills are certainly important, but how to stimulate resident physicians' enthusiasm and train their ability to assess and manage chest pain is also an important goal of cultivation [21].

Traditional teaching methods focus on using LBL as the teaching center and emphasize the transmission of teaching syllabus and concepts. In this mode, students passively receive knowledge, causing the decrease of learning initiative. Therefore, traditional teaching models can no longer meet the needs of contemporary medical education [22]. New and improved teaching models are thus urgently needed. In recent years, various new teaching models have emerged, such as problem-based learning (PBL), CBL, BOPPPS model, etc [23–25]. The research results have shown that these new teaching models can significantly improve the quality of teaching [26, 27]. Alley et al. found that PBL was an effective method in teaching chest pain risk stratification [28]. Gholami et al. reported that the scores of chest pain management were

significantly improved after CBL intervention [29]. In recent years, BOPPPS-CBL, as a new educational model, has achieved good results mainly in nursing education [30]. One of the latest pieces of research demonstrated that BOPPPS-CBL model was an innovative and effective method for promoting nursing students' electrocardiogram interpretation capabilities, effectively stimulating students' learning enthusiasm and initiative [11]. With this in mind, this study applied the BOPPPS-CBL model to the chest pain teaching in resident physicians as an attempt and a transformation. The results demonstrated that compared with LBL model, resident physicians performed better on the examination of chest pain after implementing the BOPPPS-CBL model, which lead to higher satisfaction and self-adjustment. The results also found an insignificant difference in physical examination skills, obtaining informed consent, and preparation of pre-procedure between the two groups. It also reminded us that both teachers and resident physicians should place more emphasis on these aspects.

This study summarized and discovered some advantages in the practical teaching process of BOPPPS-CBL. Firstly, the BOPPPS teaching model originated in Canada [10]. It perfectly integrates Western and Eastern teaching ideas, complements each other's strengths and weaknesses, and therefore transforms the traditional indoctrination teaching model into a new participatory and heuristic teaching method. Secondly, the role of the teachers and students has changed. In the traditional teaching process, teachers occupy a dominant position, while students are in a passive state of acceptance. Differently, both BOSSSP and CBL emphasize student-centered approach, with teachers providing guidance and assistance [31]. Thirdly, under this teaching mode, students engage in self-directed learning before, during, and after class, which helps cultivate good study habits. Fourth, based on the particularity of medical education, integrating clinical case into teaching enables students to acquire the ability to solve practical clinical problems.

Anyway, there are also certain drawbacks of BOPPPS-CBL that need to be taken seriously. On the one hand, the BOPPPS-CBL model requires teachers not only to master cutting-edge knowledge proficiently, but also to have rigorous classroom design and select appropriate clinical cases. Considering that in practice, teachers are usually staffed by experienced clinical doctors busy clinical work, the implementation of such teaching model is challenging [32, 33]. To ensure consistent teaching delivery across groups, in this study, all instructors underwent a comprehensive training program and standardized curriculum was developed, all aligned with the BOPPPS framework. On the other hand, in order to ensure the best teaching effect, the new blended learning also requires students to do sufficient preparation before class, actively consult literature and textbooks, and actively participate in discussions in class, which also imposes higher requirements for students.

This study also had some limitations. First, it was a single-center study, and a larger multi-center study was warranted to verify our findings. Secondly, although the study population were from one large tertiary hospital, the sample size was relatively small. Thirdly, this study only evaluated short-term effects of BOPPPS-CBL on learning outcomes and the long-term effects were not evaluated. Therefore, future research could conduct a longitudinal study to validate the present study outcomes.

Conclusion

The BOPPPS-CBL model was an effective teaching model in the teaching of chest pain for resident physicians, with the improvement of both clinical practice and theoretical knowledge. Additionally, it also enhanced resident physicians' satisfaction and self-adjustment with the teaching mode, which was worth applying in clinic education.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-025-06939-9.

Supplementary Material 1

Supplementary Material 2

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Author contributions

FJ and MW conceived and designed the study. WBZ provided the administrative support to this study. FJ organized these data and drafted the manuscript with the help of QBL, DBL and HPJ. QBL and DBL analyzed the data. HP J drew the pictures. WBZ and GSF detected any errors in the whole process. All authors reviewed the manuscript.

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Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was an educational evaluation without patient-related clinical interventions or health data and it was determined that ethics approval was waived by the Institutional Review Board of the Sir Run Run Show Hospital according to "ethical review measures for life sciences and medical research involving human beings" (Order No. 11 of the National Health and Family Planning Commission of China, December 2016). All the participants in the study has obtained informed consent.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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