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Application of BOPPPS and Flipped Classroom Joint Teaching Model into Clinical Practice Ability of Obstetrics and Gynecology Residents in Standardized Training

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Abstract

Background/Aim To explore how a teaching model that integrates bridge-in, objective/outcome, pre-assessment, participatory learning, post-assessment, and summary (the BOPPPS model) and flipped classroom teaching will affect the clinical practice abilities of obstetrics and gynecology residents in standardized training.

Methods Seventy standardized training residents from the obstetrics and gynecology training base of the First Affiliated Hospital of Chongqing Medical University from June 2023 to June 2024 were selected as research subjects. They were randomly and equally divided into an experimental group (adopting the BOPPPS model combined with the flipped classroom approach) and a control group (adopting traditional teaching methods). The effectiveness of the teaching model was assessed by comparing the performances of the two groups in Reception and clinical thinking assessment, clinical practice ability assessments, clinical thinking ability, self-directed learning ability, and satisfaction with the teaching methods.

Results The experimental group was scored significantly higher than the control group in consultation scores and clinical thinking assessment scores, and clinical practical skill assessment scores. The experimental group significantly outperformed the control group in clinical thinking ability scores, self-directed learning ability scores, and overall scores (all $P < 0.05$). The experimental group showed significantly higher satisfaction with the BOPPPS and flipped classroom teaching combined model in enhancing self-directed learning ability, learning interest, practical operation levels, teamwork, comprehensive quality, and doctor-patient communication skills, and in cultivating clinical thinking ability.

Conclusions The BOPPPS combined with flipped classroom teaching in standardized training can effectively improve the assessment scores, clinical thinking and self-directed learning abilities of obstetrics and gynecology residents, stimulate their initiative and enthusiasm for learning, meet their teaching needs, and thus enhance teaching quality and assessment passing rates.

Keywords BOPPPS teaching model, Flipped classroom, Obstetrics and gynecology, Teaching practice

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Introduction

Standardized training for residents has become an effective way to train qualified clinicians and is widely recognized by the international medical community. Through this training pattern, medical graduates can more effectively apply theoretical knowledge into clinical practice, improving their clinical thinking ability and operational skills, and ultimately become qualified clinicians [1]. Obstetrics and gynecology is a highly comprehensive discipline that combines theory with practice and requires extremely high clinical practice capabilities from clinicians. Thus, a theoretical learning method suitable for obstetrics and gynecology residents in China is particularly needed, one that can effectively improve their clinical thinking and practical abilities [2].

Recently, the BOPPPS teaching model has been widely used in Western countries. This new teaching model is student-centered and goal-oriented. It divides the teaching process into six parts: bridge-in, objective/outcome, pre-assessment, participatory learning, post-assessment, and summary [3]. In this model, interactive communication between the teacher and students in the classroom is highly valued. Students are required to study independently before classes, reflect after classes, and provide timely feedback on teaching effectiveness. The entire teaching process is a complete and rigorous closed loop and is highly operable and practical. It provides students with a systematic and reasonable theoretical and practical framework, helps teachers deliver courses more effectively, and makes the classroom teaching process logical and coherent, thus achieving excellent teaching results [4].

The flipped classroom is a student-centered teaching model aimed at breaking through the time and space limitations of traditional classrooms and enhancing students' communication and interaction abilities [5]. In view of the high requirements for students' clinical communication and operational skills in the standardized training of obstetrics and gynecology residents in recent years, effective teaching models are urgently needed to help them better master the theoretical and practical skills required for clinical practice, and to make them competent in the duties of obstetricians and gynecologists and successfully pass final examinations [6]. Therefore, we adopted a teaching pattern combining BOPPPS and the flipped classroom models in the clinical practice teaching of standardized training for obstetrics and gynecology residents, aiming to explore the impact of the combination of the two teaching models on teaching effectiveness.

Methods

Participants

The research participants were 70 residents who were trained in their first year from June 1, 2023, to June 1, 2024, at the standardized physician training base of the Department of Obstetrics and Gynecology, the First Affiliated Hospital of Chongqing Medical University. They were then equally and randomly divided into an experimental group and a control group, with 35 participants in each group. The control group included 25 females and 10 males, while the experimental group consisted of 24 females and 11 males. No significant differences between the two groups were found in age, gender, enrollment time, or unified academic performance by the base ($P > 0.05$). Both groups of teaching staff consist of attending physicians and associate chief physicians with more than three years of teaching experience, who have undergone examiner training and examinations organized by the Chongqing Residency Training Office and possess qualifications for residency training and examination. Residents were allocated via the envelope method. Exclusion criteria included: (1) serious disciplinary violations during the study period; (2) unwillingness to participate in this study.

Before the training began, the base conducted a unified simulated examination of clinical practice abilities for obstetrics and gynecology residents, which was evaluated by supervising physicians. According to the "Standard Assessment Plan for Clinical Practice Abilities at the End of Residency Training (2023)" from Chongqing, the examination content included clinical thinking ability stations (Station 1: patient interview and communication; Station 2: case presentation, diagnosis, differential diagnosis, and treatment plan) and a practical operation station (Station 3) (Assessment Plan and Evaluation Scoring sheets were performed in S1 and S2 in the supporting information). The thinking ability scores of the experimental group before teaching ranged from 45 to 75 points, with an average score of 63.43 ± 4.17 points; the clinical operation scores ranged from 57 to 76 points, with an average score of 58 ± 6.06 points. The thinking ability scores of the control group before teaching ranged from 47 to 72 points, with an average score of 62.09 ± 4.33 points; the clinical operation scores ranged from 56 to 75 points, with an average score of 57.2 ± 5.58 points. Comparison of thinking and clinical operation scores between the two groups before teaching showed no significant differences ($P > 0.05$), indicating that the data were comparable.

Teaching models

The traditional teaching model was adopted in the training and teaching of residents in the control group. (1)

Two weeks before the courses, the teacher distributed relevant materials about clinical practice ability assessment of standardized obstetrics and gynecology physician training, including consultation, clinical thinking, and skill operation (Self-Directed Learning Plan was shown in S3). A total of 9 items were included, such as: neonatal asphyxia resuscitation, fetal heart electronic monitoring technology and interpretation, normal delivery and midwifery, four-part palpation, perineal incision and suturing, obstetric history collection and emergency consultation, gynecological examination, vaginal bleeding, abdominal pain diagnostic and treatment approach, posterior fornix puncture, etc. (2) The teaching objectives of standardized obstetrics and gynecology physician training were clarified, and filmstrips and videos were provided to explain theoretical knowledge and practical operations in combination with cases. In the classroom, the teachers guided residents to master the key points and difficulties of the lesson and conducted on-site demonstrations.

As shown in Fig. 1, the teaching pattern combining BOPPPS and flipped classroom was adopted in the experimental group. (1) Bridge-in: The teachers distributed assessment materials two weeks before the course and required the residents to preview relevant theoretical knowledge and operation videos, and prepare filmstrips. The teachers guided each group ($N = 5$) and answered questions. (2) Objective/outcome: The teachers clarified the teaching objectives of standardized obstetrics and gynecology physician training and asked the residents to combine theory and practice to make filmstrip presentations and to master the key points and difficulties of the course. (3) Pre-assessment: The teachers evaluated the residents' filmstrips and preparations, and asked questions to understand the

residents' mastery of theoretical knowledge. (4) Participatory learning: Combining the flipped classroom format, with the presentation and skill operation of residents as the main focus, a group of slides was selected for reporting and discussion. Each resident is required to independently complete various operations of the practical course, while teachers participate in monitoring the discussion, timely supplementing theoretical knowledge and correcting any issues in the operations of the residents. (5) Post-assessment: The teachers simulated an assessment of the clinical practice ability of standardized physician training before residents left the department and filled in the evaluation form of independent learning ability, clinical thinking ability, and satisfaction with the teaching effect (Satisfaction Survey Questionnaire was shown in S4). (6) Summary: The teachers guided the residents to summarize their teaching and learning experiences, deepening their understanding of the key points and difficulties of practical skills.

Both groups of residents received 12 weeks of training, with one session per week, each lasting 2 class-hours and involving 3 teachers during the training.

Observation indices

The overview of our research design and training process is shown in Fig. 2. After all courses were completed and before the residents left the department, the teaching effect was evaluated by combining standardized simulation assessment of clinical practice ability of standardized obstetrics and gynecology physician training with a questionnaire. The evaluation time, method, and standard were the same for the two groups.

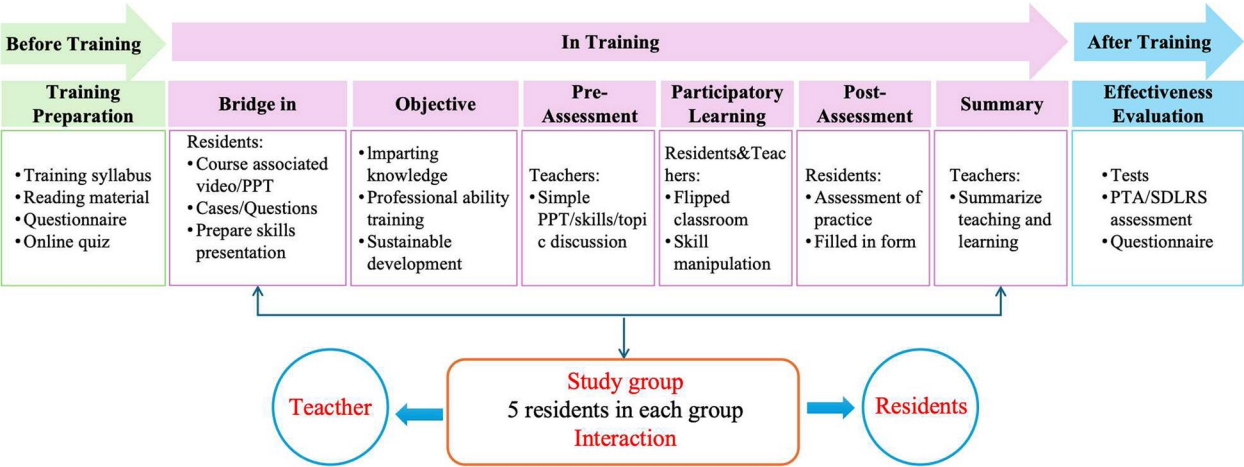


Fig. 1 Overall design of teaching pattern combining BOPPPS and flipped classroom for Obstetrics and Gynecology Residents

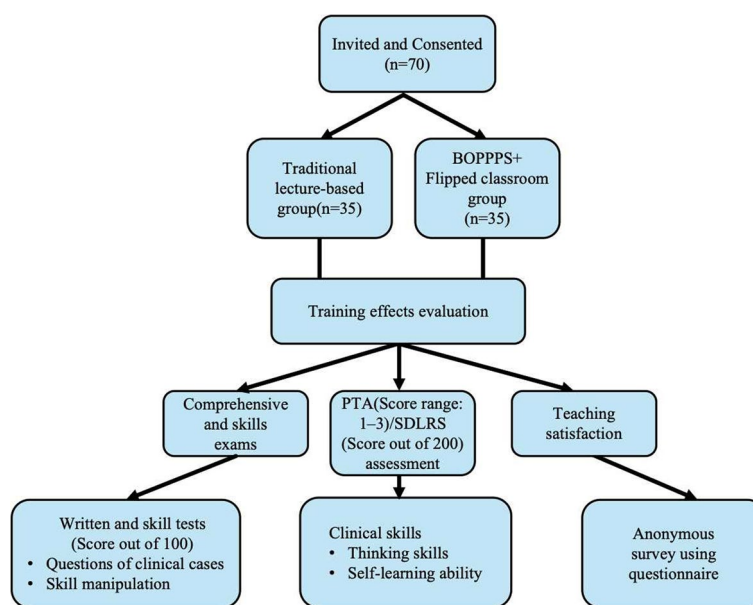


Fig. 2 Overview of research design and training process

Reception and clinical thinking assessment

A unified mock examination was set up according to the standardized training outline for obstetricians and gynecologists. Residents in the experimental group and the control group were given simulation assessments. The assessment content for clinical diagnosis and clinical thinking includes two case histories each from obstetrics and gynecology, with one case selected for evaluation. Each item is scored out of 50 points, with a passing score of 30, for a total of 100 points.

Clinical practice skill assessment

The test was based on the practical operations required by the standardized training outline for obstetricians and gynecologists, including gynecological examination, four-step palpation, perineal suture, and curettage. Select one item for scoring. Each operation has detailed scoring criteria, and the difficulty and scoring criteria should remain consistent. The full score is 100 points, and the passing score is 60 points.

Primary trait analysis (PTA) assessment of clinical thinking skills

As shown in Fig. 3, both the experimental and control groups were evaluated with PTA, which covered logical thinking ability, systematic thinking ability, evidence-based thinking ability, critical thinking ability, imaginative thinking ability, network thinking ability, vertical thinking ability, and lateral thinking ability. Based on the downtrend of clinical medical thinking ability, a stepwise 3–2–1 method was used to assign points [7]. For example:

In the evaluation of logical thinking ability, a score of 3 points is awarded for a strong logical sequence in clinical medicine diagnosis and treatment; 2 points are given for understanding the logical sequence of clinical medicine but not being able to apply it well; and 1 point is assigned to those who have only a basic understanding of logical thinking in clinical studies. Based on this, the number of individuals in each score range and the average score for different indicators are calculated.

Self-learning ability assessment

The learning ability of residents was assessed using the Self-directed Learning Readiness Scale (SDLRS), which includes three aspects: self-management, learning enthusiasm, and self-control. The total score of the SDLRS is 200 points, and a higher score reflects a stronger self-directed learning ability in capability [8].

Teaching satisfaction evaluation

The teaching satisfaction of the two groups of training residents was evaluated using a questionnaire, and 70 valid questionnaires were collected [9]. A self-made satisfaction questionnaire was used to evaluate residents' teaching satisfaction in enhancing independent learning ability, learning interest, teamwork spirit, practical operation level, comprehensive quality, and doctor-patient communication ability, and in cultivating clinical thinking ability. The questionnaire has been tested for reliability and validity. The Cronbach α coefficient of the total questionnaire is 0.917, the split-half coefficient is 0.819, and the coefficients of each subscale are between

PTA Assessment Scale for Medical Students' Clinical Thinking Abilities		
Factor	Assessment Content	Score
Systematic Thinking Ability	Can systematically construct clinical knowledge	3
	Can apply clinical medical knowledge, but systematic knowledge ability is average	2
	Can only apply clinical medical knowledge, systematic construction of clinical knowledge is very rigid	1
Logical Thinking Ability	Has strong logical sequence in clinical medical diagnosis and treatment	3
	Understands the logical sequence of clinical medicine, but cannot apply it well	2
	Only possesses simple logical thinking in clinical studies	1
Critical Thinking Ability	Dares to boldly question existing knowledge	3
	Follows routines, occasionally has doubts	2
	Unfamiliar with critical thinking concepts	1
Evidence-Based Thinking Ability	Can effectively establish the concept of medical evidence	3
	Occasionally relates to relevant medical evidence	2
	Unfamiliar with the concept of medical evidence	1
Network Thinking Ability	Possesses strong network construction thinking in clinical studies	3
	Sometimes has network thinking ability in clinical medicine	2
	Very vague network perspective in clinical studies	1
Imaginative Thinking Ability	Strong ability to associate related symptoms with clinical patients	3
	Occasionally able to associate symptoms related to patients	2
	Very rigid ability to connect and apply	1
Lateral Thinking Ability	Possesses strong ability to construct related knowledge in clinical studies	3
	Average ability to construct related knowledge in clinical studies	2
	Rarely exhibits lateral thinking in clinical studies	1
Vertical Thinking Ability	Strong ability to link knowledge in the clinical field	3
	Average ability to link related clinical knowledge	2
	Rarely links related clinical knowledge	1

Fig. 3 PTA Assessment Scale for Medical Students' Clinical Thinking Abilities

0.712 and 0.843, indicating that the questionnaire and subscales of this experiment have high internal consistency and meet the standards.

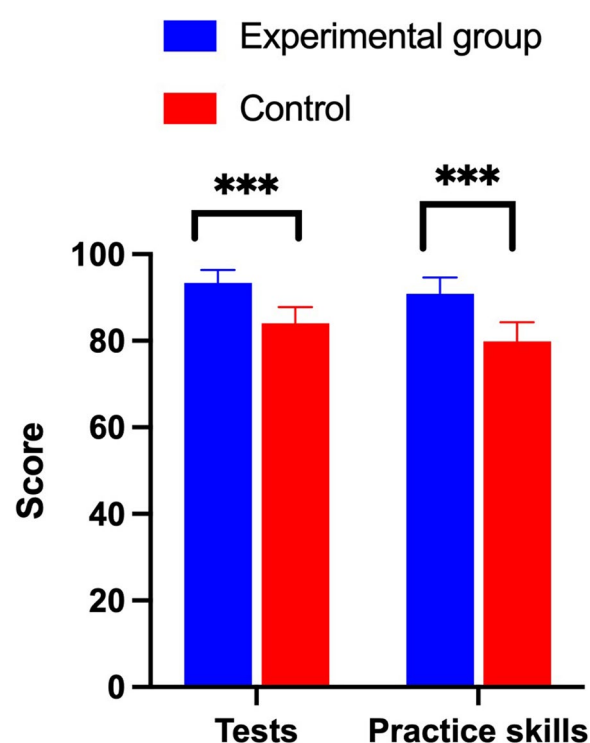
Statistical analysis

The relevant data were sorted in Excel, and statistical analysis was performed using SPSS 23.0. The measured

data were expressed as $\bar{x} \pm s$ and analyzed using two-independent-sample mean t-test. Counting data were expressed as n(%) and examined via χ^2 test. $P < 0.05$ indicates statistical significance.

Table 1 Comparison of test scores between the experimental group and the control group (scores, $\bar{x} \pm s$)

Group	Reception	Clinical thinking assessment	Clinical skill assessment
Experimental	36.51 \pm 5.13	41.11 \pm 4.886	90.69 \pm 3.841
Control	33.43 \pm 3.86	33.69 \pm 5.251	79.77 \pm 4.426
<i>t</i>	2.844	6.127	11.02
<i>P</i>	0.0059	< 0.0001	< 0.0001
Effect size (Cohen's <i>d</i>)	0.690	1.486	2.673

**Fig. 4** Comparison of comprehensive and skills exams between the two groups

Results

Comparison of medical consultation and clinical thinking assessment scores between groups

The consultation score of the experimental group (36.51 \pm 5.13 points) was significantly higher than the control group (33.43 \pm 3.86 points) ($t = 2.844$, $P = 0.0059$). The clinical thinking assessment score of the experimental group (41.11 \pm 4.886 points) also significantly exceeded that of the control group (33.69 \pm 5.251 points) ($t = 6.127$, $P < 0.0001$, Table 1).

Comparison of clinical practice skills between groups

The clinical practice skill assessment scores of the experimental group (90.69 \pm 3.841) were significantly higher than that of the control group (79.77 \pm 4.426) ($P < 0.0001$; Fig. 4).

PTA evaluation of clinical thinking ability

The residents in the experimental group had significantly better clinical thinking ability scores than the control group ($P < 0.001$, Table 2, Fig. 5A&B).

Table 2 Clinical thinking ability PTA

Group	Logical thinking ability	Systematic thinking ability	Evidence-based thinking ability	Critical thinking ability
Experimental	2.486 \pm 0.6122	2.343 \pm 0.5913	2.314 \pm 0.6311	2.229 \pm 0.5983
Control	1.543 \pm 0.5054	1.629 \pm 0.5983	1.600 \pm 0.6039	1.486 \pm 0.5621
<i>t</i>	7.026	5.024	4.838	5.353
<i>P</i>	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Effect size (Cohen's <i>d</i>)	1.704	1.218	1.173	1.298
Group	Imaginative thinking ability	Network thinking ability	Vertical thinking ability	Lateral thinking ability
Experimental	2.429 \pm 0.6547	2.371 \pm 0.6456	2.400 \pm 0.5531	2.543 \pm 0.5606
Control	1.914 \pm 0.6122	1.857 \pm 0.6482	1.829 \pm 0.6177	1.886 \pm 0.5827
<i>t</i>	3.395	3.326	4.077	4.808
<i>P</i>	0.0012	0.0014	0.0001	< 0.0001
Effect size (Cohen's <i>d</i>)	0.823	0.807	0.989	1.166

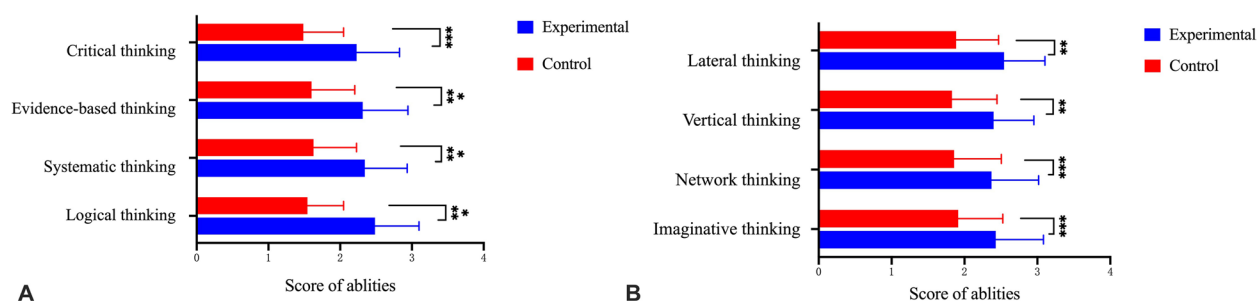


Fig. 5 Comparison of clinical thinking ability scores between the two groups

Table 3 Self-learning ability SDLRS

Group	Self-management	Passion for learning	Self-control	Total score
Experimental	50.86 ± 3.397	51.06 ± 4.014	52.40 ± 3.704	154.3 ± 9.084
Control	47.09 ± 3.641	46.00 ± 4.022	46.34 ± 3.629	139.4 ± 10.41
<i>t</i>	4.481	5.265	6.910	6.374
<i>P</i>	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Effect size (Cohen's <i>d</i>)	1.087	1.277	1.676	1.546

Table 4 Comparison of teaching satisfaction

Group	Enhancing independent learning ability	Improving learning interest	Increasing teamwork	Cultivating clinical thinking ability
Experimental	30(85.71%)	30(85.71%)	32(91.43%)	32(91.43%)
Control	18(51.43%)	20(57.14%)	17(48.57%)	16(45.71%)
<i>P</i>	0.0041	0.0161	0.0002	< 0.0001
Group	Improving practical operation level	Improving comprehensive quality	Improving doctor-patient communication ability	
Experimental	34(97.14%)	30(85.71%)	30(85.71%)	
Control	19(54.29%)	16(45.71%)	12(34.29%)	
<i>P</i>	< 0.0001	0.0009	< 0.0001	

Comparison of self-learning ability between groups

The SDLRS scores of the experimental group were significantly higher than those of the control group ($P < 0.0001$; Table 3).

Comparison of teaching satisfaction between groups

The residents in the experimental group were significantly more satisfied with the teaching than those in the control group ($P < 0.05$, Table 4).

Discussion

The traditional teaching model of clinical medicine often emphasizes too much on residents' theoretical knowledge and test scores, resulting in insufficient mastery of clinical practice skills. This situation causes a disconnect

between theory and practice for medical students entering clinical practice due to their unfamiliarity with the diagnosis and treatment process, which affects their ability to adapt to clinical settings. In serious cases, this situation may lead to diagnostic and treatment errors and medical disputes. In addition, the passing rate of training examinations directly affects residents' career prospects and is crucial to their future development [10].

In the clinical teaching of obstetrics and gynecology students in the past, teachers were usually the main bearers of skill transfer and used a one-way information transmission method, which lacked feedback from the students or a summary of educational effects. The learning outcomes and clinical practice skills of students were often evaluated through final examinations. Such a lag

made it impossible for teachers to correct students' mistakes and solve their problems in a timely manner [11]. Thus, how to more effectively integrate the learned theoretical knowledge into clinical practice, encourage residents to prepare sufficiently, stimulate their enthusiasm for learning, improve their learning outcomes, help them acquire good clinical skills, and successfully pass the graduation examination of regular training are challenges that need to be urgently addressed in regular training and teaching for obstetrics and gynecology [12].

The BOPPPS teaching model is relatively mature in the world, but is still being gradually improved in China. This model can effectively enhance learners' interest and train their independent learning, clinical thinking, and teamwork abilities [13–15]. Traditional teaching methods cannot cope with changes in the teaching environment, which brings severe challenges to clinical teaching. Herein, the characteristics of obstetrics and gynecology are combined with the two teaching models of BOPPPS and flipped classroom, aiming to improve the passing rate of clinical practice ability assessment of regular training residents, enhance their self-learning and clinical thinking abilities, and achieve good teaching results.

In terms of the distribution of assessment scores, the residents in the experimental group had significantly higher scores than the control group in various aspects, such as reception, clinical thinking, and skill assessment ($P < 0.05$). Our research confirms that compared with the traditional teaching model, the BOPPPS combined with the flipped classroom teaching model can effectively improve doctor-patient communication, as well as the clinical thinking and skill operation abilities of obstetrics and gynecology regular training residents.

The BOPPPS and flipped classroom teaching model distributes teaching-related materials and assigns preview homework before each class and guides residents to learn independently and complete the preview. In class, the teacher evaluates and asks questions based on residents' preparations and presentation filmstrips, helping them gradually and deeply understand the key points and difficulties of the learning content, and guiding them to set learning goals and actively participate in the teaching process. In addition, the residents' opportunities to practice their skills are enhanced, and they are encouraged to actively demonstrate their operations. The teacher organizes residents into discussions, analysis, participatory learning, and mutual questioning, so that they learn skill operations more purposefully and enthusiastically. This combined method also helps improve the clinical skills and teamwork abilities of residents. Before residents leave the department, their teacher will conduct a simulated assessment of the clinical practice abilities of standardized obstetricians and gynecologists.

The teaching effect is evaluated based on the assessment results and student feedback. The teacher guides residents to search for books and related materials, and to summarize the theoretical content, skill operations, and examination points of each session to ensure that all teaching content is mastered [16, 17].

The cultivation of clinical thinking ability is the top priority of obstetrics and gynecology teaching. Only medical residents who master the correct clinical thinking mode can effectively respond to various clinical phenomena and carry out standardized diagnosis and treatment [18]. We used the PTA scale to evaluate residents' clinical thinking ability from multiple perspectives. The test scores of the experimental group were significantly higher than those of the control group. Through the joint teaching model, residents can systematically construct clinical knowledge. The discussions between teachers and residents and among residents in the flipped classroom helped residents further understand the logic of diagnosis and treatment of obstetrics and gynecology diseases and guided them into practice. During the preparation and teaching process, residents can boldly question the existing theoretical knowledge, gradually establish the concept of medical evidence, build networked thinking in obstetrics and gynecology, and fully connect theoretical knowledge with clinical skills. Finally, during regular training, they can establish a complete obstetrics and gynecology clinical knowledge system to better apply it to clinical work [19].

Moreover, the self-learning ability scores of the experimental group were higher than those of the control group, indicating the combined teaching model of BOPPPS and flipped classroom that more effectively improve the self-learning ability of regular training residents compared to traditional teaching. This joint teaching model requires residents to prepare with questions in mind, which helps them clarify their learning goals and recognize their shortcomings, thereby significantly improving their enthusiasm for learning. The teachers and residents conducted flipped classroom learning and discussions in the classroom, which improved the learning effect and helped residents consolidate the key points of skill operation and correct deficiencies [20]. At the same time, this process improved the coordination and cooperation ability among residents and enhanced their doctor-patient communication skills [21, 22]. Therefore, the combination of the two teaching modes effectively improves residents' independent learning ability.

Finally, we evaluated teaching satisfaction. The overall satisfaction of the experimental group with the teaching was significantly higher than that of the control group, suggesting the combined teaching model of BOPPPS and flipped classroom that significantly improve the

recognition of teaching by residents in obstetrics and gynecology training. This combined teaching model is different from traditional teaching. It emphasizes residents' active thinking and practical operations and helps them effectively improve their learning interest, teamwork, clinical thinking, operational skills, doctor-patient communication, and comprehensive quality. Overall, the combined teaching model of BOPPPS and flipped classroom shows good teaching effects [23–25].

Limitations

However, owing to certain constraints, the findings of this study should be approached with prudence. Firstly, the research encompassed only a limited number of residents, which may not entirely capture the perspectives of all Obstetrics and Gynecology Residents across the nation. Secondly, the questionnaire survey did not incorporate quantitative analysis; its primary aim was to gauge the acceptability and perceptions of all participants.

Conclusions

In summary, the combined teaching model of BOPPPS and flipped classroom in the teaching of clinical practice ability in standardized training of obstetrics and gynecology residents can effectively promote residents to combine theoretical knowledge with clinical practice, improve their independent learning ability, clinical thinking ability, and skill operation level, while simultaneously amplifying the effectiveness of educators, thus considerably improving teaching satisfaction. During the application of this combined teaching model, we organized the participating physicians to conduct a simulated final examination of clinical practice skills. The residents in the experimental group achieved a better pass rate, and the overall score was higher than that of the control group, which further verified the effectiveness of this combined teaching model. Therefore, the combined teaching model of BOPPPS and flipped classroom is expected to benefit the residents, improving their clinical competence and final examination passing rate, while providing innovative demonstrations for clinical teaching in resident training bases, thereby promoting the continuous optimization and improvement of obstetrics and gynecology teaching models.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12909-025-07246-z>.

Supplementary Material 1

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Authors' contributions

Conceptualization: Writing-original draft preparation: N.S. and L.W.; Writing-review and editing: N.S. and Y.W.; Visualization: X.Y.; Supervision: Y.W.; Project administration: Y.W.; Funding acquisition: L.W. and X.Y. All authors have read and agreed to the published version of the manuscript.

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Data availability

Data is provided within the manuscript or supplementary information files.

Declarations

Ethics approval and consent to participate

The research was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Board of The First hospital of Chongqing Medical University. Informed consent was obtained from all participants involved in this study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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