Practical exploration of BOPPPS model combined with situational teaching method in clinical training of intensive medicine

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Research Article

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Abstract

Background:
To explore the application value of BOPPPS model combined with situational teaching method in the clinical teaching of intensive care unit (ICU), and to provide experience for the reform of ICU clinical teaching and standardized training of intensive medicine specialists.

Methods:
A total of 293 residents in ICU of the Affiliated Hospital of Guangdong Medical University, Fujian Medical University Union Hospital and the Xiamen Medical College from January 2018 to September 2022 were selected as subjects, and randomly divided into control group (142) and experimental group (151). The control group adopted bedside teaching and demonstration teaching method, and the experimental group adopted BOPPPS model combined with situational teaching method. Clinical teaching performance was evaluated by ICU admission examination, and study process questionnaire (SPQ) and the critical thinking disposition inventory-Chinese version (CTDI-CV) was used to evaluate the learning motivation and critical thinking ability of the two groups. At the same time, the ICU rotation training Effect Evaluation and Satisfaction Questionnaire was used to evaluate the teaching satisfaction. In this study, SPSS 21.0 software was used to conduct t test and Chi-square test.

Results:
The scores of the test group in ICU theoretical knowledge, clinical thinking and skills, and the treatment of clinical critical cases were higher than those of the control group [(87.31±2.15), (92.86±2.35), (83.45±3.28)] vs. [(81.94±2.73), (84.37±2.61), (78.83±3.47)], the difference between the two groups was statistically significant (P<0.05). The scores of surface motivation, deep motivation, achievement motivation and SPQ total scores of the experimental group were all higher than those in control group (P<0.05), and the scores of seek truth, open mind, analytical ability, systematic ability, self-confidence of critical thinking and intellectual curiosity of the experimental group were also higher than those in the control group, and the CTDI total score was statistically significant (P<0.05). In addition, the results of the questionnaire showed that the experimental group was better than the control group in terms of learning interest in ICU, improvement of humanistic care and doctor-patient communication ability, improvement of teamwork ability, improvement of job identity, ICU rotation harvest and satisfaction with teacher style (P<0.05).

Conclusion:
The combination of BOPPPS model and situational teaching method is novel and helpful to improve the clinical comprehensive ability of ICU residents and improve the training quality of young doctors, which is worth learning and promoting.

Background
Intensive care unit (ICU), as a clinical center of diagnosis and treatment for critical diseases and a platform for intensive medicine in hospitals, is particularly necessary to train qualified ICU residents and improve the clinical comprehensive ability of young doctors due to its strong professionalism, complex clinical diagnosis and treatment process and extremely heavy daily diagnosis and treatment tasks. BOPPPS teaching method is a novel clinical teaching model, which stimulates students’ learning interest through bridge-in (B) introduction, and draws up corresponding training objectives (O) and pre-assessment (P) plans according to the actual situation of students. Various teaching methods are integrated to allow each student to participate in learning (P), and post-assessment (P) is used to evaluate the students’ mastery of knowledge and skills and make a summary (S) [1-2]. Situational teaching takes the lead in simulating and designing diagnosis and treatment scenes related to clinical teaching contents and objectives in the teaching process, so as to vividly show the complexity and diversity of clinical diseases in ICU, so as to stimulate and enhance the learning interest and motivation of trainees [3-4]. As a key clinical specialty of intensive medicine in our province, we has carried out a lot of clinical teaching practice exploration in recent years, and achieved commendable teaching practice results, which are summarized and shared as follows.

**Materials and methods**

*Design*

This study used a trial-controlled method in accordance with the ethical principles of medical research in the Declaration of Helsinki. A total of 293 residential physicians training in the ICU of the Affiliated Hospital of Guangdong Medical University, Fujian Medical University Union Hospital and the Xiamen Medical College from January 2018 to September 2022 were selected as the study subjects, and according to the random number table method, 142 residential physicians were randomly divided into the control group and 151 residential physicians in the experimental group. The baseline data of the two groups were compared, and there was no statistical significance (all \(P>0.05\)), which was comparable, as shown in Table 1.

**Inclusion criteria:** (1) Resident physician who participating in the standardized training of residents in ICU; (2) Those who have certain clinical professional skills and good language expression ability and organization and coordination ability, accept guidance and compliance is applicable. **Exclusion criteria:** (1) Those who did not complete the standardized training task of intensive medicine residents and quit midway; (2) Those who participate in this teaching research but lack relevant data; (3) There is no guarantee that learning or training will be conducted in strict accordance with the pedagogy involved in this study; (4) Participating in other teaching training or teaching researchers in our institute. The subjects included in the study all agreed to this study and volunteered to participate in this teaching research.

**Table 1** Comparison of general baseline data indicators of resident physician in two groups
<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Gender</th>
<th>age (year)</th>
<th>Pre-training test scores</th>
<th>Have the medical certificate (yes/no)</th>
<th>Educational Background (Bachelor/Master)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group</td>
<td>151</td>
<td>74/77</td>
<td>26.09±2.83</td>
<td>84.23±6.24</td>
<td>106/45</td>
<td>87/64</td>
</tr>
<tr>
<td>Control group</td>
<td>142</td>
<td>63/79</td>
<td>25.52±2.47</td>
<td>82.96±5.78</td>
<td>88/54</td>
<td>95/47</td>
</tr>
<tr>
<td>χ²/t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>χ²</td>
<td>t</td>
<td></td>
<td></td>
<td>χ²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.633</td>
<td>1.832</td>
<td></td>
<td>1.804</td>
<td>2.214</td>
<td>2.681</td>
</tr>
<tr>
<td>P value</td>
<td>0.426</td>
<td>0.068</td>
<td>0.072</td>
<td>0.137</td>
<td>0.102</td>
<td></td>
</tr>
</tbody>
</table>

**Research Methods**

The control group adopted the traditional teaching and demonstration teaching method, and the experimental group adopted the situational teaching method guided by the BOPPPS model. All kinds of critical and severe diseases admitted in ICU and ICU routine operation skills were integrated into the daily training and graduation assessment as training items. The training content of the two groups of students in this study takes “Deep vein puncture and catheterization of ICU” as an example. The training cycle is 3 to 5 physicians in each team, and the teaching time is 3 hours each time. For details, please refer to **Figure 1** “The practice application model diagram of BOPPPS model combined with situational teaching method in clinical Practice. training of intensive medicine”.

**Research and Implementation**

**Teaching method of Control group** The control group adopted the traditional bedside teaching, explaining and demonstrating the operation mode of ICU skills, namely: First, the teacher explained the operation process, points of attention and relevant knowledge points of “Skills operation and scoring criteria for deep vein puncture and catheterization of ICU”, so that each student had a preliminary understanding and understanding of this operation training; Secondly, after the teaching and explanation is completed, multimedia skill operation videos can be used to simulate patients on site. After that, simulate patients (SPs) can be used to simulate the operation. Then let the trainees ask questions one by one, answer by themselves, and then decompose the action and demonstrate the standard for the difficult, key and error-prone points of the operation, and the trainees watch next to them; Finally, the students trained independently, the teachers conduct inspection and answer questions.

**Teaching method of experimental group** The experimental group adopted the situational teaching method guided by the BOPPPS model, that is, a new teaching mode guided by clinical teaching goal and centered on students, actively creating specific clinical ICU diagnosis and treatment or first aid situations. The BOPPPS model consists of six links: teaching introduction (bridge), teaching objectives, pre-assessment, participatory learning, post-assessment and summary. The details are as follows:

(1) **Teaching introduction (Bridge):** At the beginning of clinical teaching, the teaching secretary of the department will introduce the situation of vivid and interesting clinical cases, problem analysis, skill
operation videos and new progress of diagnosis and treatment. In order to attract students’ attention and interest, the introduction method pays attention to appropriate methods and techniques, and pays attention to the lively and interesting nature. At the same time, the introduction should be as concise as possible, focusing on the effective connection between this training content and students’ existing theoretical knowledge of ICU or problems that may be encountered in future clinical practice.

(2) **Teaching Objective**: The purpose of this stage is to make young doctors clear about the learning objectives of ICU rotation, so as to facilitate them to grasp the focus of ICU clinical knowledge. Teaching objectives include knowledge, literacy and skills. The objectives should be set from the perspective of training students. The objectives should be clear (what clinical knowledge points need to be mastered), appropriate (related to the topic of ICU), accessible (within the scope of students’ ability), and measurable (setting evaluation indicators).

(3) **Pre-assessment**: The purpose of pre-assessment is to master the training ability of rotating young doctors, understand their interest in ICU clinical knowledge and skills and prior knowledge, so as to facilitate the subsequent adjustment of the depth and progress of clinical teaching, and make clinical teaching objectives more focused. It can usually be conducted in the form of quizzes, questions and answers, or group discussions.

(4) **Participatory Learning**: focusing on the idea of “students as the main body”. After teaching the concepts, key points and difficulties of the knowledge points of a clinical situation in ICU, rich and interesting forms such as personal report, group discussion, clinical practice, role play, special discussion and case analysis can be used to fully stimulate the learning enthusiasm of young doctors and guide students to actively participate in the clinical teaching and training of ICU. In order to deepen the understanding of the training content, it also strengthens the cultivation of young doctors’ doctor-patient communication ability, teamwork ability, clinical skills and other qualities.

(5) **Post-assessment**: Post-assessment can also be understood as a course assessment, which aims to judge whether young doctors have achieved the expected results of ICU clinical teaching. It is required to evaluate the clinical teaching effect in the course assessment or teaching process, and the clinical teaching effect can be evaluated through the examination questions, clinical questionnaires, skill assessment, special reports and other ways, and according to the evaluation results, clinical teaching reflection and rectification, timely adjustment of teaching design and teaching content form, so as to better achieve the teaching objectives of ICU.

(6) **Summary**: To further deepen the impression of students by summarizing the key points of clinical knowledge and the context of skill assessment during ICU rotation. Different from the traditional teaching mode, BOPPPS combined with situational teaching emphasizes that young doctors should summarize, summarize and reflect on their own clinical knowledge and skills. In the summary process, the young resident doctors should be the main body, and the clinical superior doctors should be the guidance role, so that each student can summarize, share and supplement, and then the clinical superior doctors will emphasize the key points and difficulties.
Therefore, according to the steps of the BOPPPS model combined with the situational teaching method, the teaching course design and implementation of “ICU deep vein puncture Skill Operation and scoring standards” are set up. The specific implementation steps and processes are shown in Table 2.

**Table 2** Skills operation and scoring criteria for deep vein puncture and catheterization of ICU (BOPPPS model combined with situational teaching version)
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Method and significance</th>
<th>Teaching implementation and technical route</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge</td>
<td>Set up vivid situations, introduce clinical cases, stimulate students’ interest in learning, and refine training objectives</td>
<td>A 25-year-old patient was admitted to the emergency department due to pelvic fracture and hemorrhagic shock caused by a car accident, and was referred to our department for physical examination: blood pressure 60/40mmHg, heart rate 130 beats/min, SPO₂ 98%. What is the first aid that the doctor should do before doing clinical treatment?</td>
<td>10</td>
</tr>
<tr>
<td>Objective</td>
<td>List at least 3 operational objectives and learning objectives, so that the trainees can understand the purpose of training and the significance of clinical rescue work in the future</td>
<td>1. Determine the patient’s consciousness and evaluate vital signs; 2. Clean up respiratory secretions, maintain airway patency, and avoid pulmonary complications; 3. Perform sputum aspiration as soon as possible to ensure smooth breathing and avoid asphyxia.</td>
<td>10</td>
</tr>
<tr>
<td>Pre-assessment</td>
<td>Design and order at least 3 questions to examine the students’ knowledge reserve and skill level</td>
<td>1. What are the common causes of hemorrhagic shock? 2. What are the indications for deep vein puncture and catheterization? 3. What are the complications of deep vein puncture and catheterization?</td>
<td>10</td>
</tr>
<tr>
<td>Participatory Learning</td>
<td>Senior doctors teach and train through explanation, demonstration, guidance, question-and-answer, etc. Students consolidate and improve the skills of “deep vein puncture and catheterization” by means of operation practice and skill simulation</td>
<td>(1) Preoperative preparation 1. Preparation of materials (demonstration + training simulation): stethoscope, disposable sterile kit (containing sterile operating gown + sterile towel + sterile towel), disposable sterile gloves, saline, heparin sodium 1, 2% glucolorhexidine skin disinfectant, 2% lidocaine, central vein puncture kit, treatment cart, waste tank 2. Personal preparation (demonstration + training simulation) : check the identity of the patient, obtain the consent of the family and sign; Clean environment; Prepare the materials and check the date of production; 3. Assess and monitor patient’s vital signs and consciousness, auscultate respiratory sounds in both lungs, and adjust ventilator PEEP level to 0 if necessary; 4. Position preparation: pillow supine, head 15° ~ 30° lower, shoulder cushion, exposed neck, turn the head to the opposite side of the operator;</td>
<td>30</td>
</tr>
</tbody>
</table>
5. Bedside ultrasound was used to probe the position of internal jugular vein for anatomic variation.

(2) Specific operation steps

1. Aseptic operation (standard hand washing, wearing masks, hats, gloves);
2. Disinfection and towel covering of the operative area;
3. Check the quality of puncture supplies and pre-fill catheters with heparin water;
4. Confirm the puncture site again: the tip of the sternocleidomastoid triangle is used as the puncture point, about the level of cricoid cartilage and the lateral side of carotid artery; The needle is at a 45° angle to the skin, pointing directly to the ipsilateral papilla;
5. Local infiltration anesthesia;
6. Venipuncture, make sure the needle tip is in the central vein;
7. Insert guide wire;
8. Insert the expander along the guide wire;
9. Insert the catheter to a depth of 12 ~ 13cm;
10. Flush catheter with heparin water
11. Catheter fixation
12. Post-operative treatment (instrument treatment, sharp instrument treatment, medical waste treatment)
13. Wash your hands regularly and listen to the breathing sounds of both lungs again
14. Medical advice creation, writing records
15. Imaging confirms catheter depth (catheter tip is located near right atrium of superior vena cava)
16. Young trained doctors practice in small groups to ensure that each student operates independently for 2 to 3 times. Other students present observe mistakes, and the training teachers inspect the training situation and answer questions in time.

| Post-assessment | Through operation exercises, systematic question | About 60% of the trainees in each group were selected for operation assessment, 20 min |
answering, practical training simulation, consolidation and improvement and other links, evaluate and assess whether each student has a solid grasp of deep vein puncture and catheterization and other trainees watched quietly. After the operation was completed, the remaining 40% of the trainees who did not get the selection made comments on the problems in the operation process one by one, and finally the trainers made comments.

<table>
<thead>
<tr>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review the training objectives, precautions, key points and operation procedures in the situational cases, summarize the practical training skills, and deepen the value of the training skills in clinical work</td>
</tr>
</tbody>
</table>

1. Wear a mask, medical hat and gloves before operation. 20 min

2. Wash hands strictly and disinfect the operative area.

3. Strict aseptic operation.

4. The position of central vein was investigated by bedside ultrasound for anatomic variation.

5. Avoid multiple piercings (≥3).

6. Avoid puncture of arteries by mistake.

7. Avoid false paths.

8. Both lung respiratory sounds were ausculted before and after puncture.

**Summary**

1. Wear a mask, medical hat and gloves before operation.
2. Wash hands strictly and disinfect the operative area.
3. Strict aseptic operation.
4. The position of central vein was investigated by bedside ultrasound for anatomic variation.
5. Avoid multiple piercings (≥3).
6. Avoid puncture of arteries by mistake.
7. Avoid false paths.
8. Both lung respiratory sounds were ausculted before and after puncture.

**Evaluation of teaching effect**

**Clinical teaching results** The clinical teaching results in this study were composed of three parts: ICU theoretical knowledge assessment, ICU clinical thinking and skills assessment and clinical critical case management assessment. Both groups of students were evaluated from Wednesday to Friday of the last week after the training of ICU. The examination items were all in the percentage system, including ICU theoretical knowledge, medical history collection, physical examination, medical record writing, discussion and analysis of medical examination results, ICU operation skills and rescue skills. Among them, the assessment of ICU theoretical knowledge is based on the “Medical theoretical test paper of ICU (A/B paper)” which is independently ordered by my department in accordance with the latest edition of the teaching syllabus, and the higher the score, the better the theoretical performance. Besides, the assessment of ICU clinical thinking and skills and the assessment of clinical critical cases are the focus of ICU clinical thinking and skills assessment. By sorting out the quantitative question Bank of ICU clinical Skills Operation Assessment, each student is allowed to select 2 to 3 items for assessment and evaluation. To examine the degree of mastery of common clinical skills and rescue techniques in ICU among the young residents (students).

**Comprehensive quality evaluation** The comprehensive quality evaluation in this study includes two parts: learning motivation and critical thinking ability. Among them, study process questionnaire (SPQ) is used to evaluate learning motivation, which mainly includes surface motivation, deep motivation and achievement motivation, with a total of 24 items. Likert 5-level scoring method was used for evaluation. The higher the
score, the stronger the learning motivation. As for the evaluation of critical thinking ability, the Chinese version of Critical Thinking disposition Inventorie-Chinese version (CTDI-CV) is used to evaluate the critical thinking ability of the two groups of students, which mainly includes 7 dimensions. A total of 70 projects. Each item is scored from 0 to 5, with higher scores indicating stronger critical thinking.

**Teaching satisfaction survey**

The questionnaire on Effect Evaluation and Satisfaction of ICU Training with a total of 10 items was issued to the two groups of students in an anonymous manner. Its content generally includes eight dimensions, such as training objectives and learning interests, training atmosphere, improving humanistic care and doctor-patient communication ability, improving team cooperation ability, improving job identity, ICU rotation harvest and satisfaction with teacher style. The questionnaire options are divided into three gradients of “very satisfied, satisfied and dissatisfied”, satisfaction = (number of very satisfied cases + number of satisfied cases) / total number of cases ×100%. The resident students are evaluated objectively and anonymously throughout the whole process, without external interference such as human factors, and timely recovery and statistical analysis.

**Statistical Analysis**

SPSS 21.0 software was used for statistical analysis of the data in this study. Measurement data were expressed as (mean ± standard deviation), and T-test was used to compare the mean of two groups. The counting data were expressed in use cases and percentages, and chi-square test was adopted. Test level α=0.05.

**Results**

**Comparison of clinical teaching results**

The scores of the experimental group in ICU theoretical knowledge, clinical thinking and skills assessment and the management of clinical critical cases were significantly better than those of the control group, with statistical significance (P<0.05) (Table 3).

**Table 3.** Comparison of assessment results between the two groups [("x±s"), scores]
Comparison of SPQ scores of learning motivation

The surface motivation, deep motivation, achievement motivation and SPQ total scores of the experimental group were all higher than those of the control group, and the differences were statistically significant ($P<0.05$) (Table 4).

**Table 4.** Comparison of SPQ scores between the two groups (x±s, scores)

<table>
<thead>
<tr>
<th>Group</th>
<th>Assessment item</th>
<th>Total scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>surface motivation</td>
<td>deep motivation</td>
</tr>
<tr>
<td>Experimental group ($n=151$)</td>
<td>33.14±3.69</td>
<td>20.56±2.91</td>
</tr>
<tr>
<td>Control group ($n=142$)</td>
<td>29.78±4.12</td>
<td>18.73±2.34</td>
</tr>
<tr>
<td>t value</td>
<td>7.362</td>
<td>5.949</td>
</tr>
<tr>
<td>P value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Comparison of CTDI scores for critical thinking

The scores of seek truth, open mind, analytical ability, systematic ability, self-confidence of critical thinking and intellectual curiosity of the experimental group were higher than those of the control group, and the CTDI total score was statistically significant ($P<0.05$) (Table 5).

**Table 5.** Comparison of CTDI scores between the two groups (x±s, scores)
<table>
<thead>
<tr>
<th>Evaluation item</th>
<th>Experimental group (n=151)</th>
<th>Control group (n=142)</th>
<th>t value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seek truth</td>
<td>38.98±3.12</td>
<td>37.75±4.04</td>
<td>2.904</td>
<td>0.004</td>
</tr>
<tr>
<td>Open mind</td>
<td>43.23±4.97</td>
<td>39.14±5.21</td>
<td>6.877</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Analytical ability</td>
<td>40.87±4.53</td>
<td>37.26±4.15</td>
<td>7.099</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Systematic ability</td>
<td>41.95±3.74</td>
<td>38.08±4.09</td>
<td>8.459</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Self-confidence of Critical thinking</td>
<td>40.28±4.02</td>
<td>36.99±4.83</td>
<td>6.316</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Intellectual curiosity</td>
<td>38.61±4.97</td>
<td>34.94±4.36</td>
<td>6.702</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cognitive maturity</td>
<td>38.05±3.75</td>
<td>37.23±3.67</td>
<td>1.890</td>
<td>0.060</td>
</tr>
<tr>
<td>Total scores</td>
<td>281.97±10.23</td>
<td>261.59±11.45</td>
<td>16.068</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Teaching satisfaction questionnaire survey

The “Satisfaction Questionnaire of ICU training” was issued in secret form, and 109 valid questionnaires were collected and statistically analyzed by group. The experimental group was superior to the control group in terms of learning interest in ICU, enhancement of humanistic care and doctor-patient communication ability, enhancement of team cooperation ability, enhancement of job identity, ICU training harvest and satisfaction with teacher style (all \( P<0.05 \)) (Table 6).

<table>
<thead>
<tr>
<th>Evaluation item</th>
<th>Experimental group (n=151)</th>
<th>Control group (n=142)</th>
<th>( \chi^2 ) value</th>
<th>( P ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear training objectives</td>
<td>133 (88.08)</td>
<td>115 (80.99)</td>
<td>2.833</td>
<td>0.092</td>
</tr>
<tr>
<td>Increase interest in ICU learning</td>
<td>139 (92.05)</td>
<td>109 (76.76)</td>
<td>13.165</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Active training atmosphere</td>
<td>127 (84.11)</td>
<td>111 (78.17)</td>
<td>1.692</td>
<td>0.193</td>
</tr>
<tr>
<td>Enhancement of humanistic care and doctor-patient communication ability</td>
<td>131 (86.75)</td>
<td>101 (71.13)</td>
<td>10.843</td>
<td>0.001</td>
</tr>
<tr>
<td>Enhancement of team Cooperation ability</td>
<td>134 (88.74)</td>
<td>103 (72.54)</td>
<td>12.433</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Enhancement of job identity</td>
<td>121 (80.13)</td>
<td>95 (66.90)</td>
<td>6.613</td>
<td>0.010</td>
</tr>
<tr>
<td>ICU training harvest</td>
<td>138 (91.39)</td>
<td>112 (78.87)</td>
<td>9.157</td>
<td>0.002</td>
</tr>
<tr>
<td>Satisfaction with teacher style</td>
<td>144 (95.36)</td>
<td>119 (83.80)</td>
<td>10.643</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Discussion
As a closed-loop feedback course design model that focuses on teaching interaction and teaching reflection, BOPPPS is one of the most effective and attractive practice models for clinicians in the process of teaching design and clinical teaching [5]. Of course, on the basis of the application of BOPPPS teaching mode, the combination of situational teaching method, according to the conditions of the time and local conditions, without adhering to the fixed theoretical knowledge of ICU, can better reflect the complexity and urgency of the daily practical diagnosis and treatment activities in ICU. Compared with the traditional clinical teaching method, BOPPPS model combined situational teaching method can better stimulate the training enthusiasm and thirst for knowledge of ICU residents in different stages and processes of clinical teaching by implementing the teaching process of daily ICU diagnosis and treatment activities and skill items in steps. For example, with the help of the “Bridge-in (introduction)” part, the ICU clinical situation cases are vividly described and discussed, and the “pre-assessment” is used to deepen the students' cognition of the sudden, complexity and difficulty of the ICU clinical work, which better stimulates the students' desire to strengthen their own skills and effectively mobilizes the subjective initiative. While in the “post-assessment” link, the teacher can randomly select the trainees for demonstration and evaluation, enhance the interaction between teachers and students and students, enhance their subjective initiative and enhance the learning motivation of students, extremely effectively improve the quality and teaching effect of ICU clinical teaching.

Generally speaking, the daily clinical teaching practice of ICU is mostly taught by senior and experienced associate chief physicians, often including “explanation”, “demonstration”, “independent practice” and “summary” and other steps. However, due to the heavy work of daily diagnosis and treatment in ICU, the residents lack effective supervision in the process of independent training, and some residents are prone to be lazy and unwilling to operate. The lack of innovation and flexibility is not conducive to improving the training of team cooperation ability of young residents. By introducing the BOPPPS model combined situational teaching method into ICU clinical teaching, residents are “double supervised” by peers and teachers in the training process, and in the process of “participatory learning”, the same group of residents are more cohesive, and the team cooperation ability and critical thinking are better cultivated. It is also conducive to the cultivation of team consciousness and the construction of team spirit in the future complicated clinical diagnosis and rescue work, which is conducive to the harmony between doctors and patients in the long run.

Through the evaluation of ICU training effect and the investigation and analysis of teaching satisfaction of the two groups included in this study, we were surprised to find that compared with the traditional clinical teaching mode, the experimental group using the BOPPPS model combined with situational teaching method was significantly better than the control group in terms of ICU theoretical knowledge, operational skills, humanistic care and doctor-patient communication. Moreover, the evaluation and satisfaction of the training effect of the experimental group were also higher than that of the control group, indicating that the introduction of the BOPPPS model combined with the situational teaching method into the clinical teaching practice of ICU not only correlated the design of clinical teaching links with the daily diagnosis and treatment activities of ICU, but also had strong operability and good effect in the actual clinical teaching process of ICU. In addition, it can improve the satisfaction of young residents for learning in ICU.
training, and improve the teaching enthusiasm and enthusiasm of ICU clinical teachers to a certain extent, so as to achieve the goals and tasks of ICU clinical teaching and training.

The clinical work in ICU is complicated, laborious and risky, and requires high knowledge reserve and clinical skills of young physicians [6-7]. To this end, the BOPPPS model combined with situational teaching method is introduced into the clinical teaching practice of ICU, and young residents are allowed to think from the perspective of patients and their families through some fresh case scenarios, helping them to establish a good sense of professional identity and responsibility. And in the ICU skills training process to master and consolidate knowledge and skills, enhance the spirit of saving the dead and healing the wounded, experience their own responsibilities as an angel in white and other aspects have played a good role in promoting. Correspondingly, the “participatory learning” and “post-assessment” links in the BOPPPS model of the combined situational teaching method can enable resident students to experience the team friendship of partners who enter ICU training at the same time, deepen their feelings and identification with the hospital, and at the same time, through certain evaluation and demonstration means in the “summary” link. In the process of interaction, exercise, teaching and thinking, the residents’ sense of belonging to the unit is constantly enhanced, which is conducive to the career development of the students in the future clinical posts in the hospital.

As an important way for the growth of every young doctor, the standardized training of residents is also the key to the training of young qualified doctors [8-9]. As ICU is a highly specialized clinical department that plays a special role, it is also an important reflection of the treatment level and core competitiveness of general hospitals [10]. In addition, with the spread of the novel coronavirus epidemic so far, China has begun to pay attention to the training of applied medical talents and the construction of high-level treatment teams in the field of critical care medicine [11-12]. By introducing the BOPPPS model and situational teaching method into the clinical teaching practice of ICU, it improved the learning motivation and enthusiasm of residents, but also effectively improve their doctor-patient communication ability, clinical comprehensive ability and rescue level, and help young doctors to establish good medical ethics and humanistic literacy, it also helped young residents to develop good critical thinking.

**Conclusion**

This study shows that the BOPPPS model combined with situational teaching method has significant practical effect in ICU clinical teaching in the new era, and is a novel and valuable ICU clinical teaching model, which is worthy of reference and promotion in teaching hospitals.

**Declarations**

**Ethics approval and consent to participate**

This study used a trial-controlled method in accordance with the ethical principles of medical research in the Declaration of Helsinki. All experimental protocols of this study were approved by the ethics committee of Guangdong Medical University, Fujian Medical University and the Xiamen Medical College. Informed
consent was obtained from all individual participants included in the study. All participants were voluntary and anonymized. All the methods and procedures carried out in this study were in accordance with relevant guidelines and regulation.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this published article.

Competing interests

All the authors had no any personal, financial, commercial or academic competing interests separately.

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Authors’ contributions

Yanquan Liu contributed to the study design and wrote the manuscript. Minjuan Zeng, Yue Yin, Xiaomei Hong and Shimei Wang contributed to collection of data. Yanquan Liu, Minjuan Zeng, Shimei Wang and Huanwen Tang planned the clinical teaching courses and consulted the relevant literature to analyze the research. All authors contributed to the article and approved the submitted version.

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References


Figures
Figure 1

The practice application model diagram of BOPPPS model combined with situational teaching method in clinical training of intensive medicine