

Effectiveness of Problem-Based Learning and Case-Based Learning Teaching Methodology in Vascular Surgery Internship

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Abstract: *Objective:* To investigate the practical effect of problem-based learning (PBL) combined with case-based learning (CBL) teaching method used in the teaching of vascular surgery internship. *Methods:* 60 clinical medical graduates who interned in vascular surgery in our hospital from June 2022 to June 2023 were divided into the control group and the observation group of 30 each by applying the random number division method. The control group adopted the traditional lecture mode, and the observation group adopted the comprehensive teaching mode of PBL + CBL teaching method. The indicators of students' job competence and teaching satisfaction scores in the two groups were compared. *Results:* The scores of students' job competence in basic theoretical knowledge of vascular surgery, basic operation, clinical analysis, medical records writing, etc. in the observation group were higher than those in the control group, and the scores of satisfaction with teaching method were higher than those in the control group, with statistically significant differences ($P < 0.01$). *Conclusion:* PBL + CBL teaching method used in vascular surgery internship teaching is effective and can significantly improve the students' basic theoretical knowledge and clinical practice skills, with a high satisfaction rating, thus it is worthwhile to promote the application in the field of clinical teaching.

Keywords: Problem-based learning; Case-based learning; Vascular surgery; Teaching and learning

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1. Introduction

Clinical internship is a key stage for medical students to shift from theoretical learning to clinical practice, which is of great practical significance for cultivating medical students to develop into qualified clinicians. In the stage of clinical internship, the main learning task of the students is to carry out systematic specialty learning under the guidance of the teaching staff and to transform the theoretical knowledge into clinical practice skills on the basis of further consolidation of the basic theoretical knowledge. The traditional clinical internship program often adopts a simple lecture mode, often focusing on the teaching of basic theoretical knowledge. During the teaching activities, students only passively accept the learning of specialized knowledge and lack clinical practice opportunities, resulting in poor clinical thinking and clinical practice skills. With the

deepening of clinical education reform in recent years, a variety of new teaching methods have been discovered one after another and have achieved good results in educational practice.

Problem-based learning (PBL) is a heuristic teaching model that emphasizes a problem-based, student-led, teacher-oriented approach, with the main goal of developing students' comprehensive abilities and enhancing their critical thinking and problem-solving skills. Complementary to this, the case-based learning (CBL) teaching method simulates real clinical scenarios, which can enable students to learn clinical skills in a safe environment and lay a solid foundation for their future clinical work. In recent years, there have been more studies on the application of PBL combined with CBL teaching method in clinical teaching. Lv *et al.* [1] analyzed the application of PBL combined with CBL teaching method in the residency training of child health department through clinical trials and found that this teaching mode has a significant effect in improving the clinical reasoning, critical thinking, and teamwork of medical students, which not only helps students to understand complex medical concepts but also improve their technical proficiency through practical operation. Conducting a meta-analysis, Wang *et al.* [2] analyzed the application effect of PBL combined with CBL method in clinical teaching and found that students' basic theoretical skills, practical operation skills, independent learning, and teamwork were better cultivated under this comprehensive teaching mode, which fully verified the effectiveness of this teaching mode in the application of clinical teaching of surgery. Based on the practical training-oriented "Seminar + PBL + CBL" multi-track teaching method practice research, Xiong *et al.* [3] found that through the scientific implementation of this teaching mode, the theoretical and practical assessment results of the students were effectively enhanced, and the students' self-efficacy was greatly improved.

The research results of related scholars have shown that PBL combined with CBL teaching method has shown great potential in clinical education, but its application in vascular surgery internship teaching research base is limited. Therefore, in order to deeply explore the effect of PBL + CBL teaching method used in vascular surgery internship teaching, this study innovatively applies this comprehensive teaching method in vascular surgery internship teaching practice.

2. Study subjects and methods

2.1. Study subjects

60 clinical medical graduates who interned in the vascular surgery department of our hospital during the period from June 2022 to June 2023 were divided into the control group (n = 30) and the observation group (n = 30) according to the randomized numerical table method. Both classes were fresh graduates, enrolled by the National College Entrance Examination, with a mean age of 22.14 ± 1.02 years old. They had completed the theoretical study of the prescribed subjects for clinical medical students during their study period, and their graduation test scores averaged 81.26 ± 3.18 . The two groups of students were of good character, had good psychological quality, and had the willingness and confidence to engage in clinical work.

2.2. Teaching methods

The length of the internship was the same for both groups, and both groups were uniformly led by the department leaders and associate chief physicians.

The control group adopted the traditional simple teaching mode. During the teaching, the instructors carried out systematic theoretical teaching according to the teaching syllabus and the key points of cardiovascular surgery teaching internship, and patiently explained the physiology and pathology of vascular surgery-related diseases, clinical features, diagnosis and treatment programs, and auxiliary examination means. After the class, students were asked to study relevant clinical cases on their own, and deepen their understanding of classroom

knowledge through case analysis and problem thinking.

In the observation group, the PBL combined with CBL teaching method was adopted, and the specific implementation steps were as follows:

- (1) Case introduction: Before the class, teachers consolidated and reviewed the basic knowledge related to vascular surgery, and selected typical vascular surgery-related real cases from the case bank for case introduction to stimulate students' desire for knowledge. In the process of case analysis, students were allowed to summarize the clinical manifestations, physiopathology, differential diagnosis, and other contents related to vascular surgery, which helped students deepen their understanding of the characteristics of vascular surgery, prompted them to combine theoretical knowledge of anatomy and pathology with practical skills, and learned to use auxiliary means of examination for accurate diagnosis. In addition, the introduction of cases showed students the multidisciplinary comprehensive application of vascular surgery disease diagnosis and treatment process, to enhance students' grasp of theoretical knowledge and improve their ability to apply theory to practice.
- (2) Raising questions: Teachers scientifically designed the teaching program according to the syllabus, and inspired students to master the key knowledge points of vascular surgical diseases such as etiology, pathogenesis, diagnostic criteria, symptomatic manifestations, complications, prevention, and treatment through self-exploration, discovery, and summarization. Teachers also put forward a series of reflection questions and guided students to combine clinical case data for in-depth thinking and explore the answer to deeper problems, in order to further deepen the understanding of basic knowledge and problem-solving skills.
- (3) Organizing discussions: Teachers encouraged students to speak actively, share their views and insights, and closely integrate theoretical knowledge with clinical practice to further deepen their understanding of vascular surgery diagnosis and treatment knowledge while enhancing their analytical and problem-solving skills. In this process, teachers tried to create a relaxed and inclusive atmosphere for discussion, so that students could speak boldly and express their views. Teachers only acted as the organizer and supervisor of the teaching activities, responded to the questions raised by the students in a timely manner, evaluated the solutions provided by the students, and, if necessary, made appropriate comments and corrections to the students' viewpoints to ensure that the discussion activities were scientific and practical, so as to enable the students to obtain feedback and learn from them.
- (4) Summarization: After the discussion, the teacher sorted out the various viewpoints and opinions put forward in the discussion, pointed out the important ideas and innovations, guided students to see the connections and differences between different viewpoints, deepened their understanding of the problem from multiple perspectives, and helped them master the methods and strategies for solving similar problems. After that, students were asked to reflect on what they had learned, so that they could self-assess their understanding and mastery, and propose directions for further study, which achieved further strengthening of students' memory of knowledge while fully stimulating their interest in learning, and deepening their understanding of specialized knowledge in vascular surgery and clinical practice skills.

2.3. Evaluation methodology

At the end of the internship, the department leaders organized and implemented the evaluation of students' job competence, including basic theoretical knowledge of vascular surgery, basic operation, clinical analysis, writing medical records, etc., and the assessment standard of each dimension was thus 20 points, 20 points, 30 points, and 30 points. At the same time, the questionnaire survey method was used to investigate the students'

satisfaction with the teaching method in improving learning interest, active classroom atmosphere, enhancing self-study ability, exercising clinical thinking, improving teaching effect, etc., and the scoring standard of each dimension was 20 points.

2.4. Statistical methods

SPSS22.0 statistical software was applied to analyze and process the relevant data. Measured data were expressed as mean \pm standard deviation (SD) and compared with *t*-test; count data were expressed as *n* and compared with χ^2 test. $P < 0.05$ was used to indicate that the difference was statistically significant.

3. Results

3.1. Comparison of job competencies between the two groups

The job competency scores of students in the observation group were higher than those of the control group in terms of basic theoretical knowledge of vascular surgery, basic operation, clinical analysis, and writing medical records, and the difference was statistically significant ($P < 0.01$), as shown in **Table 1**.

Table 1. Results of the job competency assessment for the two groups of students (mean \pm SD, points)

Groups	Basic theoretical knowledge scoring	Basic operation scoring	Clinical analytical skills score	Scoring of medical record writing skills
Control group (n = 30)	17.25 \pm 0.52	15.12 \pm 0.71	19.45 \pm 2.13	20.42 \pm 1.76
Observation group (n = 30)	18.65 \pm 0.61	17.69 \pm 0.65	27.84 \pm 1.69	27.03 \pm 1.81
<i>t</i>	9.5665	14.6234	16.9010	14.3406
<i>P</i>	0.0000	0.0000	0.0000	0.0000

3.2. Comparison of pedagogy satisfaction measures between the two groups

Students in the observation group had significantly higher satisfaction scores with PBL + CBL teaching method than those of the control group in terms of increasing learning interest, activating the classroom atmosphere, enhancing self-study ability, exercising clinical thinking, and improving teaching effect, and the difference was statistically significant ($P < 0.01$), as presented in **Table 2**.

Table 2. Comparison of the results of students' satisfaction with pedagogy measures of the two groups (mean \pm SD, scores)

Groups	Increasing interest in learning	Vibrant classroom atmosphere	Enhancement of self-learning skills	Exercise clinical thinking	Improving the effectiveness of teaching and learning
Control group (n = 30)	14.14 \pm 1.22	13.78 \pm 1.27	15.13 \pm 1.32	14.12 \pm 1.61	14.63 \pm 1.37
Observation group (n = 30)	16.36 \pm 1.26	17.34 \pm 1.32	17.86 \pm 1.49	17.33 \pm 1.79	16.85 \pm 1.44
<i>t</i>	6.9330	10.6450	7.5117	7.3029	6.1177
<i>P</i>	0.0000	0.0000	0.0000	0.0000	0.0000

4. Discussion

As a key stage in the development of medical students' comprehensive clinical quality, the quality of clinical internship teaching must be improved through the innovation of teaching mode, so that the comprehensive

quality of the students can be effectively enhanced, thus providing assistance for the development of their future clinical job competence. PBL + CBL teaching method is an emerging teaching mode that combines the advantages of the two teaching methods in a single entity. In this teaching mode, teachers guide students to analyze clinical cases, independently find problems, and solve problems. Throughout the teaching activities, students always occupy the leading position, the implementation of diversified teaching methods such as situational simulation, problem discussion, and case analysis effectively promotes students' independent learning and practical skill development, helps students gladly accept their future professional role, thus greatly enhancing students' learning motivation.

The results of this study showed that the scores of students in the observation and control groups on basic theoretical knowledge of vascular surgery (18.65 ± 0.61 vs. 17.25 ± 0.52), basic operation (17.69 ± 0.65 vs. 15.12 ± 0.71), clinical analytical skills (27.84 ± 1.69 vs. 19.45 ± 2.13), and medical record writing skills (27.03 ± 1.81 vs. 27.03 ± 1.81), the difference between the groups was statistically significant ($P < 0.01$); the satisfaction scores of the observation group students with the PBL + CBL teaching method were significantly higher than that of the control group in terms of improving learning interest, enlivening the classroom atmosphere, enhancing self-study ability, exercising clinical thinking, and improving the effectiveness of the teaching, the difference was statistically significant ($P < 0.01$).

The reason for this is mainly because of the following significant advantages of the PBL + CBL teaching method.

- (1) Enhancing the students' job competence: The combination of PBL and CBL teaching method is not only a change of teaching mode, but also a profound innovation of the traditional medical education concept. The application of PBL + CBL teaching method is mainly based on disease problems and closely linked to clinical practice, which makes the learning process more in line with the needs of actual clinical work. Under this comprehensive teaching mode, students are given more initiative and space for independent learning. By independently analyzing problems and finding solutions to them, they not only improve their learning motivation but also exercise their clinical thinking and problem-solving skills. The cases selected in the teaching activities are all from the vascular surgery case bank, the content is comprehensive and typical, covering the common diseases of vascular surgery, and most of them are mixed, complex, and critical cases. Each case involves the basic theories of the department, practical skills, and professionalism, which has a high degree of match with the professional competence of the clinicians' positions. As an enlightening mode guided by the teacher and explored by the students independently, it can fully reflect the organization and guidance function of the teacher and the subject position of the students. In the PBL teaching stage, with the specific case diagnosis and treatment process as a guide, students are guided to start from specific problems, and the whole process of teaching such as questioning, hypothesizing, collecting information, arguing hypotheses, summarizing, etc., aims at the development of the students' comprehensive ability and enhancing the students' critical thinking and problem-solving skills^[4]. In this teaching mode, the teacher is no longer the traditional knowledge transmitter, and the role has been changed into a guide and helper, while the students become the dominant players in the learning process. In the CBL teaching stage, based on typical clinical cases, the teacher provides students with specific case scenarios around specific teaching objectives and guides students to use their mastered theoretical knowledge through independent thinking by simulating real clinical scenarios. In the process of vascular surgery clinical internship teaching, students need to apply the theoretical knowledge in the books to the clinical diagnosis and treatment situation, simulate the real diagnosis and identification of diseases through

group discussion under the guidance of the teacher, and finally formulate the treatment plan. This active learning process can fully stimulate students' interest in learning, improve their independent thinking and problem-solving skills, and make the learning process more exploratory and active.

- (2) Enhancing students' clinical thinking skills: The application of PBL + CBL teaching method in the teaching of vascular surgery clinical internship not only greatly enhances the students' learning interest, but also fully stimulates the students' subjective initiative, which plays a positive role in promoting the cultivation of students' clinical thinking ability. As most vascular surgical diseases have prolonged and comprehensive characteristics, the traditional simple lecture mode will make students feel bored and tedious, and then lose the initiative to learn, but through the implementation of the integrated teaching mode, students can observe and analyze real cases, intuitively understand the content of the study; coupled with the discussion-based cooperative teaching method, it not only enhances the relationship between teachers and students, but also greatly promotes the development of students' distributed thinking and clinical thinking skills. In addition, the combination of PBL + CBL teaching method encourages students to actively seek solutions to problems instead of passively accepting knowledge^[5]. In dealing with real cases, students can analyze them and understand the learning content intuitively. When dealing with actual cases, students need to use critical thinking to analyze and solve problems, which not only enhances their clinical judgment but also stimulates their desire for exploration and innovation. Students learning under the combined mode of PBL + CBL teaching method for a long time will gradually develop good habits of independent thinking and exploration. With the passage of time, this habit of independent thinking and active exploration will penetrate deep into students' learning methods and working attitudes, laying a solid foundation for their later medical studies and careers^[6].

5. Conclusion

In summary, the PBL combined with the CBL integrated teaching mode application in the teaching of vascular surgery clinical internship not only enhanced the students' mastery of theoretical knowledge but also promoted the students' clinical thinking, problem-solving, teamwork, and other aspects of clinical skills, to achieve the overall improvement of the students' comprehensive quality. Thus, it is worthwhile to be widely used in the practice of clinical education.

Disclosure statement

The authors declare no conflict of interest.

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