Application of CBL Combined with PBL Teaching Model in Teaching Medical Imaging to Undergraduate Students Majoring in Clinical Medicine

Yu Zhang, Lihong Xing, Yan Hou, Yanan Yu, Yongxia Zhao, Jianing Wang

Department of Radiology, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China.

Abstract: *Objective*: To explore the application effect of Case-based Learning (CBL) combined with Problem-Based Learning (PBL) in the teaching of medical imaging to undergraduate students majoring in clinical medicine. *Methods:* Undergraduates of clinical medicine majoring in the School of Clinical Medicine of Hebei University were selected as the research subjects and divided into the experimental group (CBL combined with PBL teaching mode) and the control group (traditional teaching mode), and the teaching effect was evaluated by the examination results and questionnaires. *Results*: The test scores of the experimental group were significantly better than those of the control group ($P < 0.05$), and the satisfaction of the students in the experimental group reached more than 90%. *Conclusion*: CBL combined with PBL teaching mode can effectively improve the teaching quality of medical imaging in clinical medicine specialty.

Keywords: CBL; PBL; Medical imaging; Clinical medicine; Teaching models

1. Introduction

Medical imaging is an important pillar of clinical medicine, but the traditional teaching mode exists "heavy theory light practice", "image analysis ability is insufficient" and other problems, need to further improve the teaching mode, from the actual needs of students, mobilize students' enthusiasm and cultivate clinical diagnostic thinking, to improve the quality of teaching [1]. Case-based Learning (CBL) emphasizes clinical context reduction, and Problem-Based Learning (PBL) focuses on independent inquiry, and the combination of the two may make up for the shortcomings of the traditional teaching mode, providing a new hybrid teaching mode reference for the teaching of medical imaging to undergraduate students of clinical medicine [2, 3]. This study aims to investigate the teaching effect of CBL combined with PBL teaching mode applied in medical imaging for undergraduate students of clinical medicine.

2. Subject and methodology of the study

2.1. Subjects of study

Class 4 ($n=80$) of the undergraduate clinical medicine program of Hebei University in the class of 2020 was selected as the experimental group, and class 1 ($n=80$) is selected as the control group. There is no statistically significant difference in the comparison of general information (gender and age) between the two groups of students ($P < 0.05$).

2.2. Teaching methods

The control group adopts the traditional teaching mode, which is mainly the theoretical lecture method. The experimental group used CBL combined with PBL teaching mode, CBL link selected typical clinical cases for analysis and interpretation, PBL link teacher put forward clinical problems, students group discussion, independent review of information, and report the results of the analysis, and finally the teacher summarized the imaging features and differential diagnosis points.

2.3. Evaluation indicators

The quantitative indicator is the final exam grade. Qualitative indicators are questionnaires, including overall satisfaction, improved interest in learning, improved diagnostic imaging skills, improved communication skills, and improved independent learning skills.

2.4. Statistical methods

SPSS 22.0 software is used, and the measurement information is expressed as x ± s. The t-test is used for comparison between groups. Differences between the two groups will be considered statistically significant when $P < 0.05$.

3. Results

3.1. Comparison of examination results

In the experimental group, 10.00% of the students' grades were excellent (90–100 points) while there were none in the control group. In the experimental group, 40.00% of the students had good grades (80–89 points), which was significantly higher than the 26.25% in the control group. In addition, there were no students with failing grades in the experimental group compared to 7.50% in the control group (**Table 1**).

Table 1. Comparison of test scores

Distribution of results	Experimental group	Control subjects
Excellent (90–100 points)	8 (10.00%)	0
Good (80–89 points)	32 (40.00%)	21 (26.25%)
Medium (70–79 points)	25 (31.25%)	37 (46.25%)
Pass (60–69 points)	15 (18.75%)	16 (20.00%)
Failing (< 60 points)	0	6 (7.50%)

Further comparing the test scores, the experimental group's test scores averaged 78.98 ± 9.22 compared to 73.90 ± 8.32 in the control group, and the difference between the two groups was statistically significant ($P < 0.05$) (**Table 2**).

Table 2. Comparison of test scores

Theoretical results	Experimental group (*n*=80)	Control group (*n*=80)	*P*-value
	78.98 ± 9.22	73.90 ± 8.32	< 0.05

3.2. Results of the questionnaire survey

The overall satisfaction of teaching in the experimental group was 95.00%, and the students thought that the teaching mode of CBL combined with PBL improved learning interest, diagnostic imaging ability, and communication ability, and the students were more willing to actively participate in the study of medical imaging. In the control group, the overall satisfaction of the teaching was 73.75%, and the students thought that the traditional teaching mode could partially improve the diagnostic imaging ability, and was limited in improving the learning interest, communication ability, and independent learning ability.

4. Discussion

Medical imaging involves anatomy, pathology, physiology, and other disciplines. The traditional teaching mode is mainly based on theoretical teaching, teacher-student interaction is insufficient, the teaching effect is poor, it is difficult to stimulate interest in learning, and the feedback from the students is poor [4, 5]. CBL focuses on the accuracy of case analysis, while PBL evaluates the problem-solving process, which can comprehensively assess knowledge mastery, logical reasoning, and expression ability. Meanwhile, group discussion can simulate Multi-Disciplinary Treatment (MDT), integrate knowledge from various disciplines to solve complex problems, promote multi-perspective communication, improve teamwork ability, and strengthen the combination of theory and practice [6–10].

The CBL and PBL teaching mode adopted in this study, through the combination of real case analysis and clinical problems, students need to comprehensively analyze the imaging manifestations, medical history and laboratory examination, to cultivate and strengthen the integrated thinking of "imaging-clinical", emphasize the practicality and promote the combination of theory and practice, which is conducive to the construction of clinical diagnostic thinking of the students. Comparison results show that the final theoretical scores of students using CBL and PBL teaching mode are significantly higher than those of the control group, and they show higher motivation for learning, and this mode also cultivates students' clinical diagnostic thinking and differential diagnosis ability, which improves the overall quality of teaching. CBL provides a large amount of typical and atypical image data, and students can improve their sensitivity to key signs and enhance their ability of image interpretation through repeated training. PBL teaching method is student-centered and teacher-guided, focusing on cultivating students' innovative thinking ability and independent learning ability. Students' overall satisfaction with CBL combined with PBL medical imaging teaching is high, and the open-ended questions of PBL allow students to consider a variety of possibilities, which can be applied to the differential diagnosis of homozygous and heterozygous images to reduce the risk of clinical misdiagnosis.

To further improve the quality of CBL combined with PBL teaching mode applied to medical imaging, it is

necessary to train teachers to master the dual-mode guidance skills to avoid PBL discussion deviating from the topic or CBL flowing on the surface. It is also necessary to build a high-quality case bank covering common, difficult and misdiagnosed cases, and to design progressive problem chains. There are also some limitations to this study, and the long-term instructional effects need to be further tracked.

5. Conclusion

The teaching mode of CBL combined with PBL has advantages in the teaching of medical imaging for undergraduate students majoring in clinical medicine, realizing the complementary advantages of case anchoring and problem driving, which can help students to improve their diagnostic imaging ability and motivation to learn, and is a suitable and effective teaching mode to help cultivate compound medical talents in line with the needs of modern healthcare, which is worthy of popularizing and applying to the teaching of medical imaging.

Funding

Disclosure statement

The authors declare no conflict of interest.

References

[1] Liang Y, Chen Q, Chen Q, et al., 2024, Application of CBL Combined With PBL Teaching Mode in Medical Imaging Practical Training Teaching. China Health Industry, 21(16): 30–33.

[2] Liu J, 2021, Research on the Joint Application of Case Discussion and PBL Teaching Method in Medical Imaging Teaching. Continuing Medical Education, 35(1): 7–9.

[3] Wang J, Fang J, Liu Y, et al., 2024, Research on the Application of Diversified Teaching Mode in Medical Imaging Undergraduate Internship Teaching. Journal of Clinical Radiology, 43(7): 1230–1233.

[4] Liu C, Guo L, Hao J, 2024, Status and Practice of Medical Imaging Teaching Mode. China Continuing Medical Education, 16(3): 76–79.

[5] Xia Z, Dai Y, Lu B, et al., 2023, Application of PBL and CBL Joint Visualization Technology in Teaching Medical Imaging Internship to International Students. China Higher Medical Education, 2023(4): 89–90.

[6] Huang Q, Su H, Zhong L, 2020, The Application Value of Case-Based Teaching Method in Medical Imaging Teaching. Imaging Research and Medical Application, 4(20): 234–236.

[7] Yang M, Gao Z, 2023, Joint Application and Thinking of Multiple New Teaching Methods in Clinical Teaching of Medical Imaging. Primary Medical Forum, 27(10): 110–113.

[8] Liu X, Liu W, Zhao Y, et al., 2023, Application of Online and Offline Hybrid Teaching Mode in Medical Imaging Teaching Based on Case-Introduced Problem-Driven Teaching Method. Clinical Medicine Research and Practice, 8(25): 190–194.

[9]   Bian Y, Fang X, Li J, et al., 2023, Application of Cloud Imaging and Multiple Teaching Methods in Teaching Undergraduate Medical Imaging. China Continuing Medical Education, 15(4): 28–32.

[10] Zhang H, Li J, Jiang X, et al., 2021, Application of CBL+PBL Joint Teaching Method Based on WeChat Platform in Undergraduate Teaching of Respiratory Imaging. China Higher Medical Education, 2021(3): 122–123.