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Application Effect of PBL Teaching Method Based on Situational Simulation Videos in Undergraduate Teaching of Internal Medicine

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Abstract: *Objective*: To explore the application effect of Problem-Based Learning (PBL) teaching method based on situational simulation videos in undergraduate teaching of internal medicine, and to provide practical basis for optimizing the undergraduate teaching mode of internal medicine and improving teaching quality. *Methods*: A total of 32 undergraduate students majoring in clinical medicine (Grade 2021) from Shanghai University of Medicine & Health Sciences were selected as the research subjects. They were divided into an experimental group and a control group by random number table method, with 16 students in each group. The control group adopted the traditional PBL teaching method, while the experimental group used the PBL teaching method based on situational simulation videos. After the teaching, the mastery of theoretical knowledge of students in the two groups was evaluated by examinations; a questionnaire survey was conducted to assess students' self-perceived improvement in clinical thinking, learning interest, self-directed learning ability and teamwork ability; statistical methods were used to analyze the data. *Results*: The scores of theoretical knowledge examination of students in the experimental group were significantly higher than those in the control group, and the difference was statistically significant ($p < 0.05$). In terms of self-evaluation, the experimental group showed better performance than the control group in the cultivation of clinical thinking, learning interest and self-directed learning ability, with statistically significant differences ($p < 0.05$); however, there was no statistically significant difference in the self-evaluation of teamwork ability between the two groups ($p > 0.05$). *Conclusion*: The PBL teaching method based on situational simulation videos can effectively improve students' level of theoretical knowledge, enhance their clinical thinking, learning interest and self-directed learning ability in undergraduate teaching of internal medicine, and is worthy of further promotion and application in undergraduate teaching of internal medicine.

Keywords: PBL; Situational simulation video; Teaching effect; Undergraduate teaching of internal medicine; Clinical medicine major

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1. Introduction

For undergraduate students majoring in clinical medicine, learning internal medicine not only requires mastering solid theoretical knowledge, but also developing the ability to flexibly apply theoretical knowledge to clinical practice, as well as sound clinical thinking and teamwork skills. As a new teaching model, Problem-Based Learning (PBL) is student-centered. Through teachers putting forward questions, guiding students to take the initiative to search for materials, conduct group discussions and solve problems, it plays an important role in cultivating students' various abilities [1]. Scenario simulation videos can transform abstract medical knowledge into intuitive and vivid clinical scenarios. By simulating real doctor-patient communication, disease diagnosis and treatment processes, these videos make students feel as if they are in an actual clinical environment, which helps students better understand and master medical knowledge and develop clinical thinking skills. Therefore, this study, which combines scenario simulation videos with the PBL teaching method and applies them to the undergraduate teaching of internal medicine, is of great value.

2. Materials and methods

2.1. General information

Thirty-two undergraduate students majoring in Clinical Medicine from the 2021 cohort of Shanghai University of Medicine & Health Sciences were selected as the research subjects. All students had completed the study of basic medical courses, possessed a certain level of basic medical knowledge, and voluntarily participated in this research. The 32 students were divided into an experimental group and a control group using the random number table method, with 16 students in each group. In the experimental group, there were 7 male students and 9 female students; the age range was 22–24 years old, with an average age of (23.88 ± 1.03) years old. In the control group, there were 6 male students and 10 female students; the age range was 22–24 years old, with an average age of (23.75 ± 1.28) years old. Statistical analysis was conducted on the general information such as gender and age of the students in the two groups. The results showed that there was no statistically significant difference ($p > 0.05$), indicating comparability between the two groups.

To ensure the homogeneity of the research subjects and the reliability of the research results, the following inclusion criteria were formulated for this study.

(1) Full-time undergraduate students majoring in Clinical Medicine from the 2021 cohort of Shanghai University of Medicine & Health Sciences, who have completed the study of basic medical courses which includes Anatomy, Physiology, Pathology, Pharmacology, achieved qualified scores in the basic course assessments, possess the knowledge foundation for conducting internal medicine learning.

(2) Voluntarily participate in this research, sign the informed consent form, and be able to complete the learning, examinations, and questionnaires throughout the entire teaching cycle in accordance with the research plan.

(3) No serious physical diseases, mental illnesses, or learning disabilities, and be able to normally participate in teaching activities such as classroom discussions and literature review.

(4) No long-term leave, with continuous leave of more than 3 class hours or absence from class during the teaching cycle to ensure the integrity of participation in teaching activities.

(5) Have not participated in other concurrent research related to internal medicine teaching reform, so as to avoid the interference of other teaching intervention measures on the results of this research.

2.2. Methods

Both groups of students studied the integrated course, Hematology, which is organized by organ systems. The teaching was delivered by the same internal medicine lecturer with extensive teaching and clinical experience. The total teaching duration was 4 weeks, with 2 class hours per week and each class hour lasting 45 minutes.

2.2.1. Control group

The control group adopted the traditional Problem-Based Learning (PBL) method. Sixteen students were divided into 2 groups, with 8 students in each group. The role of each student in the group was clearly defined, and the group leader was responsible for organizing group discussions and coordinating the division of labor among group members. The teacher designed relevant medical scenarios and corresponding questions based on the course content and learning objectives, and presented each clinical scenario in the form of paper media. Students searched for relevant books, teaching materials and literature to answer the questions and acquire the necessary key knowledge points [2]. Each group conducted discussions under the organization of the group leader, and every member was required to present their findings and opinions, followed by in-depth analysis and communication on the questions. Subsequently, each group reported their discussion results to the teacher. The teacher evaluated and summarized each group's answers, sorted out key concepts, corrected inappropriate viewpoints, and emphasized the key points.

2.2.2. Experimental group

The experimental group adopted the PBL method based on situational simulation videos. The basic processes, including group division, role assignment, question raising, literature review, group discussion and result presentation, were consistent with those of the control group. The main difference lay in the way of scenario presentation, which was as follows.

(1) Production of situational simulation videos

Before the course, the teacher collaborated with medical doctors and filmmakers to produce situational simulation videos based on real clinical backgrounds. These videos covered scenarios such as outpatients with common internal medicine diseases, the process of doctors' physical examination, the diagnostic steps after reading test reports, and the formulation of diagnosis and treatment plans as well as corresponding measures. The roles in the videos were played by medical undergraduates or licensed physicians to ensure the authenticity and professionalism of the videos. The duration of the videos varied according to the content, generally ranging from 5 to 10 minutes [3].

(2) Presentation of situational simulation videos

During the course, the teacher played the situational simulation videos using multimedia equipment. After watching the videos, students needed to analyze the questions raised by the teacher and determine the direction and focus of their research to solve the problems. Taking "anemia" as an example, a video was played, which showed a patient visiting the doctor due to fatigue and discomfort. The doctor conducted an inquiry, performed a physical examination, arranged blood-related tests (which indicated "severe anemia"), further recommended and completed gastrointestinal endoscopy examinations, and finally diagnosed the patient with colon cancer and provided treatment suggestions based on the test results. After watching the video, the teacher would ask questions such as: "What are the etiologies of anemia? What are the important steps in the diagnosis and treatment of gastrointestinal tumors? How to formulate

a reasonable medication plan for iron-deficiency anemia?" Through the video content played and the questions raised by the teacher, students independently searched for relevant literature and summarized the key knowledge points [4].

(3) Literature review and discussion

In the group discussion session, students analyzed and discussed the questions based on the specific content of the videos. For example, in the doctor-patient communication session, they considered how to inquire about the patient to collect health information; in the session where doctors formulated treatment plans, they discussed whether the plan was feasible and the reasons for its feasibility. During this session, the tutor would remind students to pay attention to the details in the videos during the inspection tour, including the details of the patient's symptoms, dynamic changes in the patient's physical condition, and the interpretation of test data. This not only enabled students to acquire more theoretical knowledge but also helped them better connect theory with practice [5].

2.3. Observation indicators

After the completion of the teaching, both groups of students took a unified theoretical knowledge exam. The exam content covered all the knowledge points of this internal medicine teaching, with question types including multiple-choice questions, short-answer questions, and case analysis questions, and the full score was 100. A self-designed questionnaire survey was conducted on the two groups of students. The questionnaire content mainly focused on evaluating the improvement of students' own clinical thinking, learning interest, self-directed learning ability, and teamwork ability. Each evaluation item was divided into 3 levels, "Significantly Improved", "Slightly Improved", and "No Significant Change". After the teaching, the questionnaires were distributed to the two groups of students by the teachers. A total of 32 questionnaires were distributed and 32 were recovered, with a questionnaire recovery rate of 100%.

2.4. Statistical analysis

The data in this study were analyzed and processed using SPSS 26.0 statistical software. Measurement data such as exam scores and age were expressed as mean ± standard deviation ($\bar{x} \pm s$) and *t*-test was used for inter-group comparison; count data such as the number and percentage of students at each level in the questionnaire survey results were expressed as [n (%)], and chi-square test (χ^2 test) was used for inter-group comparison. A *p*-value of less than 0.05 ($p < 0.05$) was considered statistically significant.

3. Results

3.1. Comparison of assessment scores between the two groups of students

After the completion of teaching, statistical analysis was conducted on the theoretical knowledge test scores of the two groups of students, and the specific data are shown in **Table 1**.

Table 1. Comparison of theoretical knowledge test scores between the two groups of students ($\bar{x} \pm s$, points)

Group	Number of Participants	Test Score	*t*-value	*p*-value
Experimental Group	16	86.56 ± 3.97	2.586	0.014
Control Group	16	83.13 ± 3.10		

3.2. Comparison of self-evaluation between the two groups of students

The questionnaire survey results of the two groups of students were statistically analyzed, and the specific data are shown in **Table 2** and **3**.

Table 2. Comparison of self-evaluation between the two groups of students [n (%)]

Group	Clinical Thinking			Learning Interest		
	Significantly Improved	Slightly Improved	No Significant Change	Significantly Improved	Slightly Improved	No Significant Change
Experimental group	11 (68.75)	3 (18.75)	2 (12.5)	13 (81.25)	2 (12.5)	1 (6.25)
Control group	4 (25)	4 (25)	8 (50)	6 (37.5)	5 (31.25)	5 (31.25)
χ^2		6.873			6.219	
p-Value		0.037			0.046	

Table 3. Comparison of self-evaluation between the two groups of students [n (%)]

Group	Self-directed Learning Ability			Teamwork		
	Significantly Improved	Slightly Improved	No Significant Change	Significantly Improved	Slightly Improved	No Significant Change
Experimental Group	14 (87.5)	1 (6.25)	1 (6.25)	11 (68.75)	4 (25)	1 (6.25)
Control Group	7 (43.75)	4 (25)	5 (31.25)	7 (43.75)	5 (31.25)	4 (25)
χ^2		6.415			2.667	
p-Value		0.043			0.238	

4. Discussion

4.1. PBL teaching method based on situational simulation videos can improve students' theoretical knowledge level

Firstly, situational simulation videos can present the medical environment directly and vividly, integrating abstract theoretical knowledge into specific cases, which is conducive to students' understanding and memory of key points. For example, when learning the chapter on "coronary heart disease", the video demonstrates cases of patients with coronary heart disease experiencing cardiac pain, changes in electrocardiogram (ECG), and how doctors diagnose and treat the disease. This enables students to connect theoretical contents such as the clinical characteristics and diagnostic criteria of cardiac pain with practical situations by watching the video, thereby deepening their understanding and memory of key points [6]. Secondly, situational simulation videos contain a wealth of detailed medical information, such as methods for collecting patients' medical history data, physical examination techniques, and skills for interpreting physical examination results. Therefore, while watching the videos, students can observe these details carefully, identify problems, and think about solutions. They can then learn relevant theoretical knowledge in a targeted manner through literature review or discussions, ultimately achieving the goal of improving students' learning effectiveness [7].

4.2. PBL teaching method based on situational simulation videos can enhance students' clinical thinking ability

This immersive learning experience encourages students to develop a habit of taking clinical practice as the starting point and using theoretical knowledge for analysis and reasoning, thereby enhancing their clinical thinking ability [8]. During group discussions, students need to analyze problems based on the content of the videos, such as the patient's past medical history, medication status, changes in physical signs, and more. This not only requires mastery of basic medical knowledge but also reflects their ability to identify key data from complex information, and conduct summarization and analysis [9].

4.3. PBL teaching method based on situational simulation videos can boost students' learning interest and self-directed learning ability

From the perspective of learning interest, the traditional PBL teaching method presents scenarios through paper-based media. The content is relatively dull and abstract, making it difficult to stimulate students' enthusiasm for learning. In contrast, situational simulation videos are characterized by intuitiveness, vividness and interest. They can transform abstract medical knowledge into specific and vivid clinical scenarios, thereby capturing students' attention [10]. By watching the videos, students can more intuitively perceive the clinical manifestations of diseases and the diagnosis and treatment process, which in turn stimulates their learning interest and encourages them to actively participate in teaching activities [11].

From the perspective of self-directed learning ability, the PBL teaching method based on situational simulation videos requires students to independently search for materials and organize key knowledge points in combination with the questions raised by teachers after watching the videos [12]. Situational simulation videos can provide students with richer clinical information and problem orientation, helping students clarify the knowledge content they need to learn and master, and thus conduct self-directed learning in a more targeted manner. In the group discussion session, students need to share the materials they have found with group members and jointly explore solutions to problems, which further promotes the improvement of students' self-directed learning ability [13].

4.4. Analysis of reasons for the insignificant impact of PBL teaching method based on situational simulation videos on students' teamwork ability

The results of this study indicate that there is no statistically significant difference in the self-evaluation of teamwork ability between the two groups of students ($p > 0.05$), which may be related to the following factors.

First, both the traditional PBL teaching format and the PBL teaching format based on situational simulation videos adopt the teaching model of group discussion. Students must complete role division and work collaboration within the group, and discuss with each other to achieve learning goals. The two teaching strategies have similar types and requirements for the development of teamwork ability; therefore, there is no obvious difference in their training effects on students' teamwork ability [14].

Second, the teaching duration of this study was only 4 weeks, which may not have allowed the two teaching methods to produce significant differences in cultivating teamwork ability. However, the cultivation of teamwork ability is a long-term process that requires students to develop teamwork skills from the experience of learning tasks and practical activities. For this reason, in the future, the teaching duration can be appropriately extended according to the course content, and the complexity of task collaboration challenges can be increased to better cultivate students' teamwork ability [15].

5. Conclusion

Based on the findings of this study, it can be concluded that the Problem-Based Learning (PBL) teaching method, when integrated with situational simulation videos, serves as an effective approach in undergraduate internal medicine education. This pedagogical strategy not only strengthens students' theoretical knowledge but also fosters the development of clinical thinking, stimulates learning interest, and enhances self-directed learning capabilities. Therefore, it is recommended that this innovative teaching model be widely promoted and applied in undergraduate internal medicine curricula to further enrich educational outcomes and better prepare students for clinical practice.

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Disclosure statement

The authors declare no conflict of interest.

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