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LBL + PBL + EBM Teaching Method Can Improve Critical Thinking Ability

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Abstract: *Objective: Critical thinking is an essential competency for medical students .The survey's aims was to explore the influencing factors of critical thinking ability and evaluate the critical thinking ability of medical students under LBL + PBL + EBM method, LBL + PBL method and LBL method, so as to provide theoretical basis for improving the critical thinking ability of medical students and provide data support for the effective implementation of LBL + PBL + EBM teaching method in medical colleges. Methods: Using stratified random cluster sampling method, 1 ~ 2 classes were randomly selected from grade 1 to grade 4 in Guangzhou Medical University. A total of 557 students were surveyed by the critical thinking disposition questionnaire in California. Using SPSS 20.0 statistical software for statistical analysis, statistical methods include : descriptive statistical analysis, t test, analysis of variance. Results: the critical thinking ability scores of medical students from different grades and genders were statistically significant ($p<0.05$). With grades ascend, the critical thinking ability gradually decreased ($rs = -0.119, p=0.005$). The critical thinking ability scores of female was higher than that of male ($t = -2.030, p=0.043$). Excluding the impact of grades and genders, the critical thinking ability scores of students underwent LBL+PBL+EBM teaching method were higher than that of students underwent LBL ($F=10.344, p<0.001$).Conclusions: LBL+PBL+EBM teaching method can improve critical thinking ability.*

Keywords: *Problem-Based Learning; Lecture-Based Learning; Evidence-Based Medicine; Critical thinking*

1. Introduction

Traditional teaching (lecture-base-learning, LBL) is a teaching-oriented teaching mode. It is a traditional and most commonly used educational method in China, and is widely used in many disciplines, including medical education. The LBL teaching method has the advantages of complete teaching materials, complete theory and complete knowledge. In the teaching process, teachers systematically impart theoretical knowledge to students according to the chapters of the book. For teachers, they can better grasp the teaching process, have a better grasp of the completion of teachers ' predetermined goals, and for students, they can fully understand the learning structure and logical relationship of a subject. This teaching mode is not particularly high for teachers ' comprehensive and students ' learning ability. Therefore, LBL still plays an important role in the teaching of many subjects, especially in some basic theories and basic education.

Nowadays, medical education widely advocates the combination of theory and application, which high requirements for the innovation ability of talents. Therefore, the drawbacks of LBL in current medical education are gradually emerging. LBL teaching method weakens students ' interest and curiosity, ignores students ' active learning ability, and is not conducive to cultivating students ' innovative spirit and self-learning ability. It is difficult for students to truly apply and understand the received information, which is not conducive to the ability to solve practical problems and the of students ' innovative thinking, nor to the overall development of students. At present, foreign colleges and universities actively carry out LBL teaching reform, some scholars use Problem-based learning.

Problem-based learning is mainly based on disease problems and closely integrated with clinical practice，it is a popular teaching method at medical schools across the country[1]. Advocate ' student - centered, teacher - guided ' group discussion teaching. The specific teaching method is a discussion

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group composed of 6~8 students and a tutor, which specifically discusses the diagnosis and treatment of a case of disease, and emphasizes that under the condition of clear learning purpose and real situation, learners can understand and master the problems hidden behind medical knowledge and the specific ideas and methods to solve problems in the learning process.

The advanced teaching methods and concepts of PBL are consistent with the goals of quality education in China. Its advantage is to change the passive learning of traditional teaching methods into active learning. With the group as the unit, the group members cooperate with each other, find the information to solve the problem by themselves through various ways, and learn the necessary knowledge in the process of solving the problem. It is conducive to cultivating students ' ability of autonomous learning and lifelong learning, communication ability, teamwork ability, humanistic care spirit and practical application ability to solve difficult problems. However, PBL teaching also has some shortcomings. First of all, compared with traditional teaching, PBL is still a new teaching method, with insufficient teaching experience and lack of special PBL teaching materials. Secondly, the comprehensive implementation of PBL requires sufficient funding, high-quality teachers, adequate teaching venues and hardware equipment, advanced libraries, rich network resource information support and other conditions. Finally, PBL teaching lacks the best solution for how students can access problems judiciously, and evidence-based teaching provides the best evidence for solving problems.

Evidence-based teaching is the improvement and supplement of PBL teaching method. It is based on solving teaching problems and puts forward a set of theories and methods to find problems, find the best evidence, evaluate and comprehensively analyze evidence and correctly use evidence .The concept of evidence-based teaching comes from evidence-based medicine. It is a teaching that follows evidence, that is, carefully, accurately and wisely applies the best research basis available at present. At the same time, it combines teachers ' personal professional skills and years of teaching experience and considers students ' values and aspirations.Learning evidence-based medicine (EBM) skills is now integral to university medical education[2]. Evidence-based medicine (EBM) is a clear and wise application of the best available evidence, combined with the doctor 's personal professional skills and clinical experience, fully considering the patient 's wishes, and ultimately making medical decisions for patients. Evidence-based medicine teaching can promote the improvement of students ' evidence-based consciousness. When analyzing and solving problems, students can make prudent, correct and wise decisions, constantly strengthen evidence-based awareness, find the core root of the problem, and correctly query and evaluate relevant evidence.

Critical thinking is based on rational reflection on certain issues and their related evidence to make judgments, that is, ' a reflective and reasonable thinking mode for deciding what to believe or do ', which includes skills such as clarifying meaning, analyzing arguments, evaluating evidence, and judging the rationality and appropriateness of arguments[3]. Critical thinking is the ability of personal analysis, reasoning, evaluation, interpretation and judgment of the authenticity, accuracy, nature and value of the knowledge learned and the thinking mode of making reasonable decisions on this basis. In essence, critical thinking is a kind of thinking ability that can control knowledge. These abilities are also various medical college graduates should have the ability. PBL is overall effective for promoting the acquisition of critical thinking ability[4]. It also needs to explore the effectiveness and influence factors of various learning or teaching strategies, environments and frameworks, as well as tasks based on situational problems。

2. Methods

Using stratified random cluster sampling method, 1 ~ 2 classes were randomly selected from grade 1 to grade 4 in Guangzhou Medical University. A total of 608 students were surveyed by the critical thinking disposition questionnaire in California, and 557 valid questionnaires were obtained after the incomplete or unqualified ones were eliminated, with an effective recovery rate of 91.6%.

The total score of the questionnaire was 420 points. The critical thinking ability of students in different grades, genders and teaching methods was compared by ANOVA or t-test; Univariate multivariate analysis of variance was used to eliminate the interference of confounding factors. Inspection level α=0.05

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3. Results

3.1 The score of critical thinking ability

In this study, the Cronbach coefficient of the critical thinking score is 0.910. Higher scores indicated stronger critical thinking dispositions. In this survey, the score of critical thinking ability of medical students is 285.26 ± 30.99.

3.2 Influencing factors of critical thinking ability

The scores of critical thinking ability of medical students in different grades were statistically significant. Through Q-test and pairwise comparison, it is found that the score of critical thinking ability of first grade is higher than second grade、third grade and fourth grade, and the difference is statistically significant. Female scored higher than male in critical thinking (Table 1). The correlation analysis found that: with the increase of grade, the critical thinking ability gradually decreased（rs = -0.125 , P=0.003）.

Table 1: Score of critical thinking ability

Influencing factor	Classification	N	$\bar{x}$ ±s	F	p
Grade	First grade	113	294.77±26	4.642	0.003
	Second grade	146	283.4±33.35		
	Third grade	181	283.27±30.67		
	Fourth grade	117	281.48±31.42		
Gender	Male	267	282.49±30.86	-2.03	0.043
	Female	290	287.81±30.94		
Teaching method	LBL+PBL+EBM	213	284.60±31.72	1.137	0.321
	LBL+PBL	180	288.00±32.95		
	LBL	164	283.42±28.6		

3.3 Univariate and multivariate analysis of variance of critical thinking ability.

Table 2: Univariate Multivariate ANOVA of Influencing Factors of Critical Thinking Ability

influencing factor	Type III sum of squares	freedom	mean square	F	p
teaching method	18169.113	2	9084.557	9.999	<0.001
gender	2252.613	1	2252.613	2.479	0.116
grade	28194.962	3	9398.321	10.344	<0.001

Table 3: Scores of Scale under Different Teaching Methods in Third grade (n=181)

influencing factor	Teaching Methods	N	$\bar{x}$ ±s	F	p
critical thinking	LBL+PBL+EBM	55	289.00±29.44a	11.437	<0.001
	LBL+PBL	80	289.49±30.58 b		
	LBL	46	265.59±25.55		

Note: a: p<0.05 for LBL+PBL+EBM and LBL,b: p<0.05 for LBL+PBL and LBL

After excluding the influence of confounding factors such as grade and gender, it was found that teaching method was the influencing factor of the score of critical thinking ability（Table 2）.

The critical thinking ability of medical students underwent LBL+PBL+EBM, teaching method is higher than that of LBL teaching method（Table 3）.

4. Discussion

Critical thinking ability is a philosophical concept, which involves involves truth-seeking、

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open-mindedness、analyticity、systematicity、self-Confidence、inquisitiveness and maturity[5]. LBL is a traditional lecture-based teaching method. It is led by the teachers and explained step by step according to the teaching ideas, and students can digest and absorb the teaching ideas according to the teachers[6]. PBL is Problem-Based Learning, which is a problem-oriented teaching method[7],it advocates "students as the center and teachers as the guidance", students explore the possible consequences of the problem based on the learning principles[8, 9]. LBL combining with PBL teaching to put forward the problems encountered in clinical practice and seek the answers to the problems. Evidence-based medicine (EBM) is defined as the judicious use of the current evidence in making decisions about the healthcare of individual patients[10], Evidence-based medicine is a core competence[11]. On the basis of comparing multiple answers and evidences, medical students have improved their critical thinking ability, clinical thinking ability and clinical analysis problem-solving ability. LBL + PBL + EBM teaching method provides a new way of thinking for the reform of teaching courses, and has practical application value for the reform of teaching methods in medical colleges and universities.

Critical thinking ability is essential in helping medical students manage complex health situations and solve clinical problems effectively by sound decision-making. [11]. The survey shows that the average score of critical thinking tendency of medical students in Universities in Guangzhou is 285.26 ± 30.99, which is lower than the average score of critical thinking of professional students in Ohio State University College [12] (310.7) and Norway [13] (300.3). The critical thinking ability of senior students is lower than junior students, which suggests that medical education may have some shortcomings in cultivating the critical thinking ability of medical students, and medical educators should pay attention to it. This is related to the influence of LBL examination oriented education on senior medical students during their growth. They are used to memorizing standard answers by rote and only care about authoritative correct answers. In the long run, students' ability to analyze and solve problems as a whole, systematically and independently, and their ability to reflect, question and criticize decisions will be limited.

The critical thinking ability of female medical students is higher than male students, which is consistent with the research results of Walsh C. m[14]. Therefore, when implementing medical teaching, teachers should pay attention to the differences in personality, learning attitude and thinking between male and female students. After excluding the influence of grade confounding factors, it is found that the total score of critical thinking ability of LBL + PBL + EBM teaching mode is higher than that of LBL teaching mode, which is similar to the results of Kong leen[15]. The research shows that LBL has always been the main teaching method in China. Students have long received examination oriented education and are used to memorizing standard answers. Especially in medical education, more emphasis is placed on respecting authority. In the long run, the ability to analyze and solve problems independently and the ability to think critically will be greatly limited. Therefore, medical teaching reform is imperative. Therefore, LBL + PBL + EBM teaching mode will be the trend of medical education reform in China.

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