The Effectiveness of Problem-Based Learning on Evidence Based Medicine: A Double-Blind Randomized Trial

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ABSTRACT

Problem-based learning is recognized as promoting integration of knowledge and fostering a deeper approach to life-long learning, but is associated with significant resource implications. This paper utilizes preliminary data from both the facilitator and postgraduate viewpoint to determine whether the use of this novel methodology is feasible with large groups of postgraduates in evidence based medicine. To investigate the effectiveness of problem-based learning (PBL) in comparison with lecture-based learning (LBL) in postgraduate coursework on evidence based medicine by the double-blind randomized control trial. Participating postgraduates were assigned to the LBL group and PBL group. The examination scores, questionnaire, and seminars were used to evaluate the teaching effectiveness. SPSS 11.5 software was used for statistical analysis.103 postgraduates were included in the study, the baseline characteristics were balanced between the two groups. The examination mark was higher in the PBL group than in the LBL group, there were significant differences between the two groups in the attitude of the LBL. The postgraduate of PBL group revealed a high overall satisfaction with the course. The problem-based program appeared to be more effective than the lecture-based program in EBM teaching.

Keywords: Problem-based learning, Evidence-based medicine, Postgraduate.

INTRODUCTION

Problem-based learning (PBL) is a learning method that encourages students to develop self directed learning and critical thinking skills.[1] In contrast to lecture-based learning (LBL) curriculum. Where the material to be taught is arranged according to some subject, PBL is designed around a series of "problems" that students have to resolve. PBL students use the problem scenario to define their objectives. soon after, they do independent, self directed study before returning to the group to discuss and refine their acquired knowledge.[2] it can be seen that PBL is an instructional student-centered approach which uses carefully constructed clinical problems as a context for postgraduate to: define their learning needs, conduct self-directed enquiry, integrate theory and practice, and apply knowledge and skills to develop a solution to a defined problem. PBL is not only problem solving, but rather it uses appropriate problems to increase knowledge and understanding. PBL has now spread widely across the globe and beyond the healthcare disciplines.[3,4]

Though there is some evidence from China's universities that postgraduates in a PBL curriculum become better at problem solving and self-directed learning than those in a LBL curriculum. There are many universities that offer a course of evidence-based medicine in China, such as Peking University Health Science Center, Sichuan University, etc. Evidence based medicine (EBM) is the integration of clinical expertise, patient values, and the best evidence

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into the decision making process for patient care. EBM requires new skills of the clinician, including efficient literature-searching, and the application of formal rules of evidence in evaluating the clinical literature.[5] But the overall evidence of teaching effectiveness for EBM is not strong, there is not enough evidence to support the utility of PBL for EBM learning in universities in China.

The purpose of this study was to assess the effect and learning satisfaction of PBL in a course of evidence based medicine in postgraduates on the ability of constructing clinical question, searching and selecting relative literature, evaluating evidence and applying evidence into clinical practice.

METHODS

Study design

This prospective, randomized, control study was designed to compare the efficacy of PBL and LBL in a course of evidence based medicine in postgraduates. The allocation sequence generation, data analysis was performed by the Shen XP, who did not take part to perform this study and holds the primary data. All the authors reviewed the data, vouch for the completeness of the data and data analyses, and wrote the manuscript.

The study written informed consent was obtained from all participants and teacher. All participants were randomly assigned to receive either PBL or LBL, according to random digits table by Shen XP. A randomization sequence was determined by random numbers generated by a Microsoft Excel Software program. Outcome of all participants were assessed at end of study (after 18 weeks) (Figure 1).

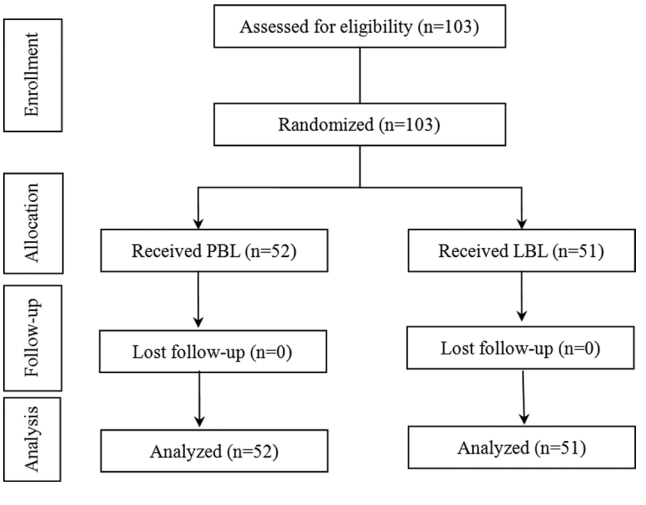

Figure 1: Intervention assignment, follow-up, and analysis.

Participating postgraduates

The course of EBM at the Lanzhou University has traditionally been located in the second semester of the medical curriculum and is given on a once weekly basis. First-year medical postgraduates attending the Lanzhou University were included in the study. The participants were not told which method was used.

Intervention procedure

PBL group

The postgraduates of the PBL group were divided into nine small groups; each subgroup was given a clinical conduction. the postgraduate had the following objectives: to provide a clinical question according to a clinical case; to search and evaluate the relative evidence of the clinical question; to apply the best evidence to the patient. Finally, they had to communicate their conclusions to the other members of the study group, and take an examination in order to pass the subject.

The problem consisted of a clinical case that described a usual situation in clinical practice. The step as following: (1) detect and clarify unfamiliar clinical conduction; (2) define the questions to be discussed; (3) discuss the problems, suggesting possible answers on basis of the current self-knowledge; (4) repeat steps 2 and 3 and sort answers into tentative solutions; (5) formulate learning objectives and consensus on the learning objectives in group, teacher checks learning objectives; (6) all postgraduates search and gather relative information for each learning objective; (7) share the results of private study; teacher checks learning and evaluate the group.

LBL group

The LBL group received lectures in which the teacher made a presentation and then described the solution to similar clinical cases to those addressed by the LBL group. They had to study the material presented in class.

Outcome and evaluation methods

Three different approaches were used to evaluate the outcome, knowledge tests was used to evaluate the basic knowledge of evidence based medicine, questionnaire was used to collect related data on the attitude of postgraduates of both groups for the LBL, seminar was to collect related data on satisfaction with the PBL course and dissatisfaction with the PBL course.

1. Knowledge tests: the examination of EBM at the end of the semester, the postgraduates of both groups used the same examination after completion of the course; the examination was designed

as a combined glossary/short-essay test. Standard answers for all questions were defined and handed out to the staff before students' answers in the examination were scored. The staff that scored the examinations was blinded as to the identity and group of the students.

2. A questionnaire was completed to investigate the attitude of postgraduates of both groups for the LBL after the course.
3. A seminar was held to address postgraduates' satisfaction with the PBL course and dissatisfaction with the PBL course.

Ethical review

Permission was obtained in advance from the Ethical Review Boards of the School of Basic Medical Sciences of Lanzhou University where the research was conducted. The aim of the study was explained to the students and participation was entirely voluntary.

Statistical analysis

The statistical analysis was performed using SPSS 11.5; an analysis of differences of continuous variables was performed using independent t-tests, but categorical outcomes for the proportions of students with events with Pearson's Chi-Square statistic. The level of significance was 0.05.

RESULTS

Participation

103 postgraduates were included in the study; all postgraduates took the final examination of EBM, Fifty-two of these postgraduates were from the PBL group and fifty-one from the LBL group. The distribution of baseline characteristics was balanced between the two arms. (Table 1)

Postgraduate examination marks

The distribution of examination marks between the groups is shown in Table 2. The mean mark was higher ($p < 0.05$) in the PBL group than in the LBL group.

Questionnaire on attitude of postgraduates for the LBL

Table 3 shows significant differences in the attitude of postgraduates of both groups for the LBL. 94.2% (49/52) postgraduates thought that the PBL method was currently the best teaching methods in the PBL group. 74.5% (38/51) postgraduates thought that the

Table 1: Baseline Characteristics of Two Groups

	PBL group (n = 52)	LBL group (n = 51)	Statistic	*P*
Sex (Man/Female)	22/30	20/31	$\chi^2 = 0.102$	0.750
Age ($\bar{X} \pm$ SD) (years)	26.06 ± 3.06	26.04 ± 3.00	t = 0.031	0.975
To participate in the retrieval training	96.2% (50/52)	96.1% (49/51)	$\chi^2 = 0.000$	0.984
To use the following database				
Chinese Biomedical Literature Database	30.8% (31/52)	40.4% (21/51)	$\chi^2 = 0.007$	0.945
PubMed/Medline	94.2% (49/52)	5.8% (3/51)	$\chi^2 = 0.001$	0.980
EMBASE	86.5% (45/52)	13.5% (7/51)	$\chi^2 = 0.102$	0.749
Science Direct	60.0% (26/52)	45.1% (23/51)	$\chi^2 = 0.248$	0.618
To participate in the clinical epidemiology	9.6% (5/52)	7.8% (4/51)	$\chi^2 = 0.101$	0.750
To participate in the medical statistics	5.8% (3/52)	2.0% (1/51)	$\chi^2 = 1.000$	0.317
To participate in the clinical research	9.6% (5/52)	5.9% (3/51)	$\chi^2 = 0.501$	0.479
To know the evidence-based medicine	98.1% (51/52)	98.0% (50/51)	$\chi^2 = 0.000$	0.989
To know the of PBL	23.1% (12/52)	25.5% (13/51)	$\chi^2 = 0.082$	0.775

Table 2: Comparison of Test Scores ($\bar{X} \pm$ SD)

	Basic knowledge of EBM	Clinical question	Literature search	Evaluating evidence	Applied evidence	Total score
Maximum score	20	20	20	15	25	100
PBL Group	16.00 ± 1.76	14.35 ± 1.82	14.54 ± 2.16	13.62 ± 2.28	21.94 ± 2.72	80.48 ± 6.84
LBL Group	13.27 ± 4.43	12.10 ± 2.71	12.57 ± 2.08	9.78 ± 4.02	19.88 ± 4.03	67.63 ± 9.38
Statistic	6.516	4.923	4.717	5.929	3.034	7.935
P	0.000	0.000	0.002	0.000	0.003	0.000

Table 3: Outcome of Questionnaire (agree%)

Statement in questionnaire	PBL group	LBL group	Statistic	*P*
To activate learning enthusiasm	73.1% (38/52)	52.9% (27/51)	$\chi^2 = 4.943$	0.084
To activate learning interest	76.9% (40/52)	58.0% (30/51)	$\chi^2 = 7.042$	0.030
To enhance the consciousness of participation	88.5% (44/52)	70.6% (36/51)	$\chi^2 = 14.211$	0.001
To enhance the ability comprehensive analysis	76.9% (40/52)	39.2% (20/51)	$\chi^2 = 27.300$	0.000
To improve language skills	78.8% (41/52)	58.8% (30/51)	$\chi^2 = 13.728$	0.001
To enhance the ability of self-learning	75.0% (39/52)	43.1% (22/51)	$\chi^2 = 11.249$	0.004
To improve the learning efficiency	65.4% (34/52)	58.8% (30/51)	$\chi^2 = 0.474$	0.789
To improve the ability to obtain information	76.9% (40/52)	56.9% (29/51)	$\chi^2 = 10.485$	0.005
To improve the ability to analyze and use information	75.0% (39/52)	56.9% (29/51)	$\chi^2 = 12.929$	0.002
To improve the ability to resolve problem	80.8% (42/52)	58.8% (30/51)	$\chi^2 = 6.258$	0.044
To make a better combination of theory and clinical	75.0% (39/52)	52.9% (27/51)	$\chi^2 = 6.601$	0.037
To enhance the practical ability	92.3% (48/52)	76.5% (39/51)	$\chi^2 = 6.740$	0.034
To enhance the ability of scientific writing	80.8% (42/52)	58.8% (30/51)	$\chi^2 = 8.444$	0.015
To enhance the communication	96.2% (50/52)	70.6% (36/51)	$\chi^2 = 13.048$	0.001
To strengthen the sense of teamwork	92.3% (48/52)	66.7% (34/51)	$\chi^2 = 11.054$	0.004

teacher/university should reform teaching methods in the LBL group.

Seminars

The postgraduates of the PBL group revealed a high overall satisfaction with the course. Postgraduates said that the PBL teaching model can effectively train postgraduate clinical thinking, cultivate the abilities of deconstructing problems, comprehensive analysis, literature retrieval, language expression, exploration innovation; and overall improve the teaching quality of EBM. Some student said that: "I learned where to search various sources of information and how to participate in a group", "self-confidence, shared information, different opinions" and "My developing on this module will help me study my other modules next semester". at the same time, Postgraduates of LBL group said that LBL places students in a passive rather than an active role, which hinders learning and requires the instructor to have or to learn effective writing and speaking skills.

DISCUSSION

The summary findings

When we perform the PBL method in EBM, we should know the characteristic of EBM and PBL. The advantages of PBL include: PBL method offers a flexible learning process, enhancing postgraduates to decide and prioritize their own learning agenda. It confers postgraduates a chance to use their own experiential knowledge, and allows them to reflect on the very process of their own thinking. It could make them more goal-oriented, seeing their work in a larger perspective, and is an excellent introduction to the research process. In PBL one is allowed to make mistakes and learn from them. Finally, group interaction enables individuals to see the many perspectives on a problem. All of these are valuable professional and team-working skills for life beyond university. But, postgraduates are no longer given the "answers", and this can require a change in attitude and mind-set.[6]

Our study confirmed that PBL is a useful method for postgraduates learning EBM. The PBL postgraduates obtained a good examination mark, which was higher than the mean mark achieved by students receiving LBL. Compared with LBL methods, the teaching method of PBL could activate learning enthusiasm and interest; improve problem analysis; enhance independent study abilities, comprehensive analysis and learning efficiency; digesting the contents of study and strengthening the teacher-student communication. Most studies show the same result.[7] Therefore, compared with LBL, PBL could promote self-motivation and self-responsibility to learn, facilitate more enjoyable and more effective learning, encourage learning from experience, allowing students to use and organize what has been learnt to understand problems, integrate knowledge with practice, nurture the ability to analyze problems and to identify and acquire knowledge and skills needed to deal with real-life situations, develop teamwork and communication skills, train postgraduates to be reflective and assess their own and others' work and cultivate independence, curiosity, and skills for self-directed, life-long learning.

The barriers to PBL implementation in China

First, PBL is more expensive than LBL. Indeed, the PBL curriculum necessitates a large number of well-equipped

rooms for small groups. In addition, it requires other important resources to support subgroup investigations, including instructional materials (both textbooks and multimedia), space, and library, equipment, and support personnel.[8]

Second, the adoption of the PBL curriculum involves a radical change for teachers used to traditional teaching methods. Teachers are not always ready for this radical change. Similarly, the implementation of the PBL curriculum implies a radical change for students used to traditional teaching methods. Given the fact that PBL is student-centered, and that students are expected to be independent learners, the transition from conventional curricula to PBL is sometimes difficult.

Third, faculties lack rewards for PBL teaching: Indeed professors get more compensation for research and publication than for teaching. Furthermore, given the fact that PBL is experimental, the compensation system may de facto produce disincentives.[8]

Limitations

The PBL group could have been affected by the teacher. It is also possible that the postgraduates in the PBL group received more attention from the teacher than those in the LBL group. Thus, postgraduates' individual behaviors such as motivation may have been influenced by their perception that they received more attention from the teacher in the PBL group compared with their experience in previous lecture classes. In addition, the sample size was small, and the study period was only 18 weeks.

CONCLUSION

Postgraduates who participated in the PBL obtained significantly higher grades than those attending lectures during the course. PBL can enhance postgraduates' achievement of both professional skills and process skills. Postgraduates of the PBL group spent more time on group work and reference analysis than those attending conventional lectures. The time devoted by teachers was much higher in the PBL group. But the effect of PBL needs to be studied in clinical practice after the postgraduates' graduation.

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