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Original Article

Introducing Problem- Based Learning as an Effective Learning Tool to Medical Students: An Approach in Bangladesh

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Abstract:

Background: Bangladesh, A country with scintillating beauty of nature burdened with a dense population. Along with infectious diseases, tropical diseases are also prevalent here with a higher trend of non- communicable diseases as a result of industrialization. Practicing and prescribing as a doctor is a quite challenging profession here particularly when to deal with vast rural populations in a low resource facility. Medical education system is well developed in Bangladesh which follows traditional curriculum of teaching learning. Students are not accustomed with problem-based learning as it does not exist in curriculum. In order to confront with diverse disease pattern and overloaded population in this arduous backdrop of Bangladesh, problem- based learning can be a very effective tool for preparing medical students as an efficient, self- directed and insightful prescriber. This study was a primary step to introduce problem- based learning (PBL) to medical students of Bangladesh to evaluate the effectiveness of PBL in context of Bangladesh. **Methods:** Around 117 students of 4th year from 6 different medical colleges were randomly assigned for this study. Among them, half of the students attended PBL session for three days on a topic of Pharmacology and other students participated traditional lecture class. Following classes, odds ratio of performance was determined. MCQ, SAQ and total scores of assessment were compared. Comparison of scores was also done between male and female students of PBL group. **Results:** PBL students performed better than the LBL students. Odds ratio of their assessment performance was 252.08; with 95% confidence interval and lower range 53.89 and upper range 1179.28. The odds ratio showed strong association between PBL and student performance in Bangladesh context. Mean of total score was 30.7 ± 4.3 in PBL group and 17.2 ± 4.8 in LBL group. Total score was significantly higher (p= 0.000) in PBL group. Mean SAQ score in PBL and LBL group was 17.2 ± 2.2 and 5.3 ± 1.9 respectively which was extremely significant (p= 0.000). MCQ score mean was 13.4 ± 3.4 in PBL group versus 11.8 ± 3.7 in LBL group which was significantly higher in PBL group (p= 0.02). Among PBL group, total score and SAQ score was significantly higher in female students over male students. **Conclusion:** Significant findings of this study revealed PBL as an effective tool in Bangladesh context. Thereby, it is recommended from this study to take approaches for further study and initiative to incorporate PBL in curriculum as well.

Key Words : *Problem- Based Learning, Effective Learning Tool, Medical Students*

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Introduction:

Being the 12th most populous country of the world, Bangladesh has a well-developed health and referral infrastructure. Alongside with a large population load; 7,25,000 Rohingya refugees are residing in Bangladesh since 2017 [1]. Majority of the population of Bangladesh inhabits in rural area. Health care facility a bit lags in rural area due to shortage of specialized hospitals, laboratory, manpower and so on. This shortfall being tried to overcome by an organized referral system from root level to super specialized hospital [2].

Disease pattern shows a divergent array across the country with predominant infectious diseases. Non- communicable diseases, occupational diseases are also rising exponentially with increasing urbanization, industrialization and life style change [3].

Doctors in Bangladesh has to encounter new challenges in everyday practice while working in resource poor settings. Moreover, doctor patient ratio in this country is lower than recommendation of WHO. Therefore, doctors has to face a huge patient load in working place[4]. Precisely, to build a future physician capable of managing assorted patient with diversified disease array in a resource poor setting, it is mandatory to develop and at the same time boost up his/her core capacities. In a word, problem based learning can be a ground breaking approach in Bangladesh to enrich and intensify medical students effective learning process.

Problem Based Learning (PBL) is "A learning method based on the principle of using problems as a starting point for the acquisition and integration of new knowledge. Problem Based Learning (PBL) is a method of learning in which students first encounter a problem, followed by a student-centered inquiry process"[5]. PBL actually is a brainstorming teaching learning session where students are the key participants. It is delivered in small groups. It can be in a whole class which is divided in many small groups. Each group usually consists of 3 to 5 students. A real world problem is presented to all groups of students. Students conceive the problem and ponder over it, search and use appropriate resources to solve it. Students themselves rises questions regarding the problem, they evaluate the validity, accuracy and appropriateness of the information they obtained after repeated review. After that, they impose the new knowledge to the problem and integrates their newly gained knowledge. And thus find out answers after thorough speculation [6,7]. A teacher performs as a guide and facilitator of the session. Teachers role is to direct the session in proper way, checks the understanding of students and provide expert input in learning issues and resources. As a whole, in PBL teacher act as a guide by the side of students, not as a sage on stage like in traditional teaching. On the other hand, students are active learner in PBL by actively participating in solving the problem rather as inactive listener in traditional learning [7,8]. Eventually, this active learning system makes a students an active self- directed learners. It provokes the student's critical thinking and problem solving capability and students learn to appraise a situation critically. Students become motivated and confident learner physician. All of this can lead to the development of positive attitudes to learning that serve as a foundation for lifelong learning and continuing professional development [9,10,11].

In the backdrop of population burden, disease patterns, lower doctor patient ratio and health sector facility shortage of Bangladesh; from the very beginning, medical students needs to be nurtured in a way that will enable them to cope with every possible challenges they will face in professional life. And problem based learning is the golden educational instrument in this regard. This study was contemplated with the objective to introduce problem based learning in medical students of Bangladesh and to assess the student's performance and to evaluate the difference in assessment scores from the view point of total score, SAQ and MCQ scores between groups of students receiving problem based learning and lecture based teaching. Performance of female and male students of PBL also compared.

Methodology:

Study settings and student selection: This study was conducted in department of Pharmacology of 6 different medical colleges of Bangladesh. Students from 3 medical colleges was invited in PBL group and another 3 medical college students participated in LBL. Among the study groups, 1 government and 2 non-government medical colleges was contemplated in PBL group and in LBL group there was 1 government and 2 non-government medical college students. Students who had almost similar performance in previous years speculating professional examinations and willing to participate voluntarily were randomly selected for the study. Students who failed in preceding professional examinations were excluded from the study to minimize the difference of knowledge among them.

Study procedure: This study was a randomized control study. Considering the inclusion criteria 58 students was included in PBL group and 59 students in LBL group. Students were informed about the study objectives and research methodology and written consent was obtained. Students were also informed that their participation was entirely voluntary and that the results of the present study would not be a part of their academic examinations, there were no potential benefits or harms of the study, and their test results would be kept confidential. Students in PBL group attended PBL teaching learning for 3 days on a topic of Pharmacology. Students were divided into small groups, 5 students in each group and introduced with different problems on that topic targeting the learning objective of the curriculum. Students discussed and debated on different aspects of the problem and arises questions and tried to answer. They were referred to various sources of information with no limitations on their use.

Faculty involvement: Distinguished faculties conducted the PBL session. Similarly, honorable faculties of Pharmacology delivered traditional lectures in LBL sessions. For ensuring proper validity of the PBL materials, respectable faculties from medical education unit and internal medicine cross checked all the PBL teaching and assessment contents.

Assessment of knowledge: One week after the PBL and LBL session, an assessment was taken in both groups. A question comprising MCQ, SBA and SAQ was prepared for assessment. A total 8 questions covering different aspects was formed to assess the knowledge of the students on the single topic. The content validity of each question was verified by conferring with

experts of respected field. Scoring procedure was implemented over 40 points where each correct answer was scored as five points and each wrong answer was scored zero point.

Answer script confidentiality: In order to avert the chance of biasness, a code number was allocated on each answer script instead of students name by third person unrelated to this research. After scrutinizing all answer scripts, decoding was done and data was implied for statistical analysis. Thus, answer script confidentiality was maintained. An answer key was provided to maintain equality during scoring.

Measures: Baseline measures for this study referred as student's age, gender and previous professional exam result.
Outcome measure 1 comprised contemplating the performance of students between groups by measuring odds ratio of result. Outcome measure 2 concerned evaluation of knowledge by comparing total scores in assessment amidst PBL and LBL group. Outcome measure 3 was comparing SAQ scores and outcome measure 4 was to compare MCQ scores between groups. Outcome measure 5 referred to comparison of the scores between male and female students in PBL group.

Statistical analysis: Statistical analysis was be done by SPSS version 24. Chi-square test was applied to analyze qualitative and categorical data like gender of students. Independent 't' test was carried out to analyze all the continuous data like assessment scores of the students. Calculated 'p' value $p \leq 0.05$ was considered as significant.

Results:

Demographic characteristics:

Table 1 demonstrating that in PBL group 58 students participated and in LBL group student number were 59. Among the students of PBL group 19 was male and 39 female. In LBL group, male students were 19 and female students were 40. No significant difference observed in gender. All students in both groups were of similar age and passed in previous exam in first attempt.

Table I: Demographic characteristics of students

Variables	PBL[a]	LBL[b]	P value
Number of students	58	59	
Male	19	19	0.95[x]
Female	39	40	

[a]PBL group received problem based teaching learning
[b]LBL group attended traditional lecture class
[x]Chi- square (x^2) test was done. $P \leq 0.05$= statistically significant

Odds Ratio for the performance of students:

Table II is showing student's performance in assessment. In PBL group 94.4% students passed where in LBL group passing rate was 6.8%. Odds ratio for performance of students measured at 95% confidence interval was 252.08 which indicates a very strong association of better performance with PBL over LBL.

Table II: Odds ratio for students performance

			Result		Odds ratio for group LBL/ PBL
			Passed	**Failed**	
Group	**PBL**	Count	55	3	
		% within Group	94.8%	5.2%	252.08 95% CI (lower 53.89, upper 1179.28)
	LBL	Count	4	55	
		% within Group	6.8%	93.2%	

Comparison of total score:
Table II is showing in PBL group the mean total score of assessment was 30.6 ± 4.3 compared to 17.2 ± 4.8 in LBL group. This difference in total score was highly significant (p= 0.00).

Table III: Comparison in total score of assessment among PBL and LBL group

	Group	**N**	**Mean**	**Standard Deviation**	**P value**
Total scores obtained	PBL[a]	58	30.6	4.3	0.00[x]
	LBL[b]	59	17.2	4.8	

[a]PBL group received problem based teaching learning
[b]LBL group attended traditional lecture class
[x]Independent 't' test was done. P ≤0.05= statistically significant

Comparison of SAQ scores:

Mean SAQ score in PBL group was 17.2 ± 2.2, whereas it mean SAQ score in LBL group was 5.3 ± 2.0. Table III revealed the difference is extremely significant (p= 0.00).

Table IV: Comparison of SAQ scores between PBL and LBL group

	Group	**N**	**Mean**	**Standard Deviation**	**P value**
SAQ score	PBL[a]	58	17.2	2.2	0.00[x]
	LBL[b]	59	5.3	2.0	

[a]PBL group received problem based teaching learning
[b]LBL group attended traditional lecture class
[x]Independent 't' test was done. P ≤0.05= statistically significant

Comparison of MCQ scores:

Table IV is demonstrating the MCQ score difference between groups. MCQ score in PBL group was 13.4 ± 3.4 and in LBL group was 11.9 ± 3.7. MCQ score was significantly higher (p= 0.02) in PBL group over LBL group.

Table V: Comparison of MCQ scores between PBL and LBL group

	Groups	N	Mean	Standard Deviation	P value
MCQ score	PBL[a]	58	13.4	3.4	0.02[x]
	LBL[b]	59	11.9	3.7	

[a]PBL group received problem based teaching learning
[b]LBL group attended traditional lecture class
[x]Independent 't' test was done. P ≤0.05= statistically significant

Gender comparison of scores in PBL group:
Table V is demonstrating, among 39 female and 19 male students of PBL group, total score (p= 0.05) and SAQ score (p= 0.02) of assessment was significantly higher in female students. Mean total score of female and male students was 31.3 ± 4.4 and 29.1 ± 3.6 respectively. Mean SAQ score of female students was 17.5 ± 2.3. On the other hand, in male students mean SAQ score was 16.3 ± 1.7.

Table VI: Gender comparison of scores in PBL group

	Student's Gender	Mean	Standard Deviation	P value
Total scores	Female	31.3	4.4	0.05[x]
	Male	29.1	3.6	
MCQ score	Female	13.7	3.3	0.36[x]
	Male	12.8	3.6	
SAQ score	Female	17.5	2.3	0.02[x]
	Male	16.3	1.7	

[x]Independent 't' test was done. P ≤0.05= statistically significant

Discussion:

In order to create an educational environment for medical students that prioritize translational knowledge and skill development from early years of medical life, it necessitates PBL as a learning tool. Therefore, in Bangladesh background, this study was conducted to introduce this learning tool in medical students to explore effectiveness of PBL over LBL.

In this regard, the first outcome measure of this study was to evaluate the students

performance in assessment and measuring the odds ratio for PBL versus LBL group. Odds ratio was found 252.08 which signifies a concrete alliance between PBL and student performance. Ding et al., 2014 also affirmed a significantly higher odds ratio of student performance in PBL group [12]. Current study finding also goes along with the finding of Assadi, 2016 which enumerated better learning and performance in PBL group with a significant odds ratio [13]. A systematic review and meta- analysis by Galvao et al., 2014 also reported better examination performance in PBL group and identified a higher odds ratio over LBL group [14].

Another outcome measure was to compare the total score in between PBL and LBL group. Mean total score in PBL and LBL group was 30.6 ± 4.3 and 17.2 ± 4.8 respectively which was significantly higher in PBL group. This significant finding is consistent with Thomas, 2015; which also demonstrates a significantly higher mean test score in between PBL over LBL group [15]. Similar positive result regarding total score also published by Tsou et al., 2009 [16]. Imanieh et al., 2014 and Dong and Zeng, 2017 also revealed a significant difference in mean test score between groups and this finding agrees with this current study [17,18]. On the other hand, Dyke et al., 2001 found a non- significant difference in mean total score between groups[19].

With regard to total SAQ score, an extremely significant difference was observed between PBL group and LBL group. Mean SAQ score in PBL group was 17.2 ± 2.2 and in LBL group was 5.3 ± 2.0. Similar significant finding in SAQ score was observed in Joseph et al., 2016 [20]. A study conducted in USA by Sivam et al., also found a better written score in PBL students[21]. Contrastingly, Carrio et al., 2011 found a non- significant improvement in SAQ score in PBL group [22].

One of the outcome measures of the study was MCQ score comparison between groups. Mean MCQ score in PBL groups was 13.4 ± 3.4 and in LBL group was 11.9 ± 3.7. PBL group got a significantly higher (p=0.02) MCQ score over LBL score. Meo, 2013 found a significantly higher MCQ score in PBL group and this finding is in concordance with the current study finding[23]. Besides, McParland et al., 2004 also revealed a significant MCQ score difference between PBL and LBL groups which is actually in agreement with this study [24]. On the contrast, Carrio et al., did not showed a significant MCQ score in PBL group and this finding in not in line with the current study finding [22].

Within PBL group, female students achieved significantly higher score when total score (p= 0.05) and SAQ score (p= 0.02) was compared with the male students. Joseph et al., 2016 also demonstrated a significant difference in comparing scores of gender. It showed female students got a score in SAQ higher than their male counterparts which is statistically significant [20]. Another study conducted in London also revealed a significantly higher score of female students in written and viva over male students [24].

Limitation:

This study was conducted only in 6 medical colleges of a district of Bangladesh. There would be a better and deep speculation of result regarding effectiveness of problem- based learning

in Bangladesh context if the study could be carried out in a large scale.

Conclusion:

Culture and environment are two determining factors for effectiveness of PBL for any country background. Though PBL not yet a part of medical curriculum in Bangladesh, the positive result of this study regarding effectiveness of PBL in educational ambiance of Bangladesh can be a very first step to yield enthusiasm for further thinking into this issue.

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