Problem-Based Learning in comparison with Lecture-Based Learning in post-graduation Medical short course among Medical Interns in Al Ahsa Saudi Arabia, Randomized Control Trial

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Problem-Based Learning in comparison with Lecture-Based Learning in post-graduation Medical short course among Medical Interns in Al Ahsa Saudi Arabia, Randomized Control Trial

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Abstract

Background: The phenomenal development in medical practice in the last years was coincided with medical education advancement. Study aims to compare between problem-based learning and lecture-based learning in post-graduation medical short course among medical interns.

Methods: A randomized blinded experimental study was conducted among medical interns at King Abdulaziz Hospital in Al Ahsa in July 2019. A medical subject of “Adolescent health” was explained using problem-based learning method for intervention group and lecture-based learning for comparison group. A validated questionnaire for measuring the attitude of the educational method and pre-posttest multiple-choices questions quizzes were used for both groups. Nor study investigator or participants were aware of the process of randomization and groups’ assignment. Study used the Statistical Package for Social Sciences for data analysis.

Results: Total number of medical interns who participated in the study was 14 in every group. Problem-based learning interns noticed that it was stimulating (85.71%), ease (35.71%), useful (71.43%), powering (92.86%) and enlightening (71.43%). However, there was a statistical difference between pre and post scores in lecture-based learning group ($p < 0.001$). Mean posttest score of the problem-based learning group was (Mean $\pm$ SD =13.85 $\pm$ 3.08) compared to (Mean $\pm$ SD =16.64 $\pm$ 1.64) in the lecture-based learning group ($p = 0.01$). Also, mean post-pretest score was (Mean $\pm$ SD =1.35 $\pm$ 2.76) in the problem-based learning and (Mean $\pm$ SD =4.21 $\pm$ 2.42) in the lecture-based learning group ($p = 0.01$).

Conclusions: Lecture-based learning is more effective than problem-based learning in short duration medical courses for post-graduate education medical interns.

Keywords: Problem-based learning, Medical education, Randomized clinical trial, Saudi Arabia

Background

Problem-based learning (PBL) is a method of education where learners acquire knowledge by working through problems, pursuing self-

directed learning and discussing topics in small groups. The learning method challenges learners to evaluate, analyze, think, rethink, infer and synthesize information [1]. It is

37 more student-centered that enable learners
38 to apply the acquired knowledge for solving
39 real-life problems, connect real clinical
40 problems to the theoretical learning concepts
41 and acquire better vocational and clinical
42 reasoning skills with real-world experiences in
43 addition to develop learning autonomy and
44 gain motivation [2-3].

45 Lecture-based learning (LBL) on the other side
46 involves training learners to recite, describe,
47 define and list of factual knowledge through
48 presenting a didactic lecture without practice
49 usually [1-2]. Although, both educational
50 methods differ in terms of application, style,
51 engagement, and mastery of concepts among
52 students. Nevertheless, all learning styles
53 contribute to knowledge sharing and
54 cognitive development despite the efficacy
55 and applicability differences [3-4].

56 However, previous observational [1, 5-7],
57 quasi-experimental [2-3, 8] and experimental
58 studies [4, 9-13] in this subject compared the
59 educational performance of PBL and LBL

60 mainly among university pre-graduate
61 students in different specialties using
62 different measurements and founding
63 different results. As well, outcomes of those
64 studies included mean score, educational
65 performance, attitude and satisfaction toward
66 learning.

67 Compared to literature, this study tried to fill
68 the gap of short courses post-graduate
69 Medical learning. It answered the question of
70 “Is there a difference between PBL and LBL in
71 short courses post-graduation medical
72 education among physicians in the
73 internship?”. Study aims to compare the
74 learning outcomes, performance, attitude and
75 motivation among Medical Interns at King
76 Abdulaziz Hospital, Al Ahsa exposed to PBL
77 and LBL in short course duration.

78 **Methods**

79 A randomized blinded experimental study
80 included physicians in internship year
81 “regardless of medical specialty” who were

82 training in King Abdulaziz Hospital for
83 National Guard (KAHNG) Al Ahsa, Saudi
84 Arabia during July 2019.

85 A minimum calculated sample size was 10 in
86 every group using two independent means
87 difference equation for sample size
88 estimation. It assumed that 2.3 standard
89 deviation score difference between PBL and
90 LBL [6], 2 % accuracy and 95% confidence
91 interval. Out of 45 participants who were
92 training at study time, 28 interns were
93 selected from the internship list “sampling
94 reference” using of systematic random
95 sampling technique of every second name.

96 Study investigator contacted all selected
97 interns for explaining study aim and
98 confirming their attendance in the
99 experiment by taking preliminary verbal
100 consent. After that, 14 interns were allocated
101 to two comparable groups using block
102 randomization technique (through coding
103 system AABB). Nor study investigator or the
104 participants were aware of the process of

105 randomization selection, allocation and group
106 assignment.

107 During the experiment, both PBL and LBL
108 groups did a pretest quiz and every group
109 distributed in separated classes based on the
110 prior randomization process. Then, every
111 group learned about “Adolescence Health” by
112 external Academic Medical education experts’
113 tutors with the same agenda and contents
114 and followed by the posttest quiz. Both tutors
115 were aware of study objectives and they
116 confirmed to implement the PBL and LBL
117 educational methods properly as planned.
118 Pretest quiz was carried out to find the
119 variation between interns and give a
120 background about their learning outcomes,
121 performance, attitude and motivation while
122 posttest quiz to find out the effect of the
123 learning models on the participants.

124 Interns in the PBL group were divided into
125 subgroups and each intern took on a role
126 within the subgroup based on PBL principles.
127 Each subgroup had different resources and

128 materials to search on the internet, retrieving
129 information, discuss and present the findings.
130 The External tutor “rather than study
131 investigators” was facilitated PBL through
132 supporting, guiding and monitoring PBL
133 educational process.

134 The participants worked independently,
135 searching and looking for the learning goals
136 and objectives during the tutorials, and then
137 the participants in each subgroup met again
138 and presented their findings. After that, each
139 subgroup submitted a paper summarizing the
140 subject and each intern filled the
141 questionnaire and tested posttest PBL quiz.

142 In the LBL group, the external tutor presented
143 a lecture about “Adolescent Health” in about
144 30 minutes followed by filling the
145 questionnaire and posttest LBL quiz. Interns in
146 the PBL group consumed 3 hours compared
147 to one hour in the LBL group. Intern’s name
148 and study’s group were concealed in all
149 questionnaires and pre-posttests as well as an

150 encrypted code were used during the
151 correction of pre-posttests and data entry.

152 The investigator collected data through a self-
153 created questionnaire and MCQs pre-posttest
154 quiz in “Adolescent health” after a review of
155 some relevant literatures [4, 6, 14]. They were
156 validated by a revision of two Family
157 Medicine Consultants with Biostatistician and
158 modified accordingly. As well, pilot study was
159 performed on 5 participants in the same
160 hospital.

161 The questionnaire included two sections;
162 section one collected the academic
163 performance, satisfaction with the PBL,
164 preferable method of learning in post-
165 graduation medical education and the
166 participants' knowledge about the topic of
167 “Adolescence Health”. Section two included
168 the attitude toward the educational method
169 that exposed to. The pre-posttest quiz
170 included 20 multiple-choice questions (MCQs)
171 in the topic of “Adolescent health”.

172 Collected data were entered into a personal
173 computer and analyzed using (SPSS) software
174 with ensuring data privacy and safety. All
175 variables were coded before entry and
176 checked before analysis. Cross tables with
177 percentages and P-value through Chi-square
178 test was used to compare between PBL and
179 LBL (Table 1-2). As well, score mean
180 difference between pre-posttests and both
181 groups was calculated through Paired T test
182 and Student T test (Table 3-4). Inferential
183 statistics assessed through P value of equal or
184 less than 0.05 and 95% confidence interval
185 level which consider the statistically
186 significant result.

187 Study proposal was approved by Saudi
188 commission for health specialties. Study
189 investigator coordinated with Academic
190 Affairs at KAHNG Al Ahsa and King Saud Bin
191 Abdulaziz University for Health Sciences
192 (KSAUHS) Al Ahsa to contact with medical
193 interns and utilize the educational classes to
194 conduct the experiment. All the information

195 kept confidential. All included interns signed
196 the consent form before involving in the
197 study.

198 **Results**

199 Table 1 elaborates post-graduation medical
200 education information for medical interns in
201 PBL and LBL groups. The total number of
202 medical interns who participated in the study
203 was 14 in the PBL group and 14 in the LBL
204 group. The academic performance revealed
205 that 6 Interns (60.00%) in the PBL group and 4
206 Interns (36.36%) in the LBL group had GPA
207 between 3 to 3.9 out of 5 while 40.00% in the
208 PBL group and 63.64% in the LBL group had
209 GPA between 4 to 4.9 ($p = 0.39$).

210 The satisfaction with PBL as an effective post-
211 graduation medical education method was
212 57.14% in the PBL group compared to 78.57%
213 in the LBL group ($p = 0.42$). Furthermore,
214 64.29% of both groups considered PBL as a
215 better method for post-graduation medical
216 education. In general, there was no significant
217 difference between PBL and LBL groups.

218 Table 2 measures the attitude of medical
219 interns in PBL and LBL groups toward short
220 course post-graduation educational methods
221 that were exposed in this study. According to
222 interns in the PBL group, it was stimulating
223 (85.71%), ease (35.71%), useful (71.43%),
224 powering (92.86%), and enlightening (71.43%)
225 compared to the LBL group which was
226 (64.29%), (64.29%), (92.86%), (71.43%), and
227 (85.71%) respectively.

228 Table 3 summarizes the comparison between
229 pre and posttest score in PBL and LBL groups.
230 There was no statistical difference between
231 posttest (Mean $\pm$ SD = 13.85 $\pm$ 3.08) and
232 pretest (Mean $\pm$ SD = 12.50 $\pm$ 1.95) in PBL
233 group (p = 0.09). While in the LBL group,
234 mean difference between post and pretests
235 was (Mean difference $\pm$ SD = 4.21 $\pm$ 2.42)
236 which was statistically significant (p < 0.001).

237 Table 4 compares pre and posttest scores
238 between PBL and LBL group. There was no
239 statistically significant difference between
240 PBL and LBL in pretest score (p = 0.93).

241 Although mean posttest score of the PBL
242 group was (Mean $\pm$ SD = 13.85 $\pm$ 3.08)
243 compared to LBL group (Mean $\pm$ SD = 16.64 $\pm$
244 1.64) which was statistically significant (p =
245 0.01). As well, mean Post-pre score was
246 (Mean $\pm$ SD = 1.35 $\pm$ 2.76) in PBL group and
247 (Mean $\pm$ SD = 4.21 $\pm$ 2.42) in LBL group (p =
248 0.01).

249 Discussion

250 In the current study, post-pretests mean
251 score of the LBL group was about triple more
252 than the PBL score among medical interns in
253 post-graduation medical educational method.
254 It was also analyzed from the responses that
255 satisfaction for PBL as an effective post-
256 graduation medical education method and
257 the attitude toward the educational method
258 did not demonstrate any statistically
259 significant results between both groups.
260 Medical Intern's academic performance,
261 attending a course about PBL in medical
262 education and having good updated
263 knowledge in the topic of "Adolescence

264 Health” did not show any statistical variation
265 between both groups.

266 From the review of the literature, it was
267 observed that some studies reported that PBL
268 is more effective in learning outcomes than
269 LBL. A study was done at the University of
270 Michigan College of Pharmacy in 2016
271 reported that team-based learning is an
272 effective learning method compare to lecture
273 format on the learning Outcomes [4], while
274 Faisal et al found the medical students of PBL
275 outperformed LBL medical students in
276 academic performance [1].

277 In addition, a study from Kuwait in 2016
278 reported that the PBL students performed
279 better than the old curriculum students in
280 overall grades, theoretical knowledge base
281 and OSCE [5]. It is noticed that PBL teaching
282 model is more effective when applied to
283 laboratory courses than to theory-based
284 courses in undergraduate medical courses in
285 Chinese medical education system based on a
286 systematic review and meta-analysis [15].

287 Further review of the literature did not reveal
288 significant differences between PBL and LBL.
289 A study was done in Malaysia found the
290 outcome after teaching between PBL and
291 traditional methods did not show a significant
292 difference [9]. Khoshnevisasl et al found that
293 the difference between PBL and LBL in the
294 exam scores was not statistically significant.
295 The participants preferred PLB over LBL
296 because of motivation boost, a higher quality
297 of education, knowledge retention, class
298 attractiveness, and practical use [10].

299 A study from Hamadan University of Medical
300 Sciences reported that there was more
301 satisfied with the PBL method, increased
302 motivation and enhanced educational activity
303 but there was no relationship between the
304 students' satisfaction and learning progress.
305 The quality of education can be improved
306 through the PBL method [8].

307 In addition, no statistically significant
308 difference was found between the PBL and
309 LBL in the level of attitude toward learning

method but learning motivation was significantly higher in the PBL group [3]. Nandi et al found a combination of both learning methods that may provide the most effective training for undergraduate medical students. There was no convincing evidence of improved learning using the PBL [14]. Limitations of the study include (i) sample size was small although it was calculated scientifically. (ii) Study has a narrow question and restricted criteria. (iii) Because study's intervention has a short duration, both intervention and outcome were implemented and detected in the same sitting for both groups.

Conclusion and recommendations

LBL is more effective in the learning outcomes and performance among medical interns in short course duration post-graduation education compared to PBL. The satisfaction, attitude and motivation toward both methods of learning are equal. Further studies are recommended in this regard to compare PBL

and LBL in long course duration post-graduation education on a large number of participants.

Abbreviations

PBL: Problem-based learning; LBL: Lecture-based learning; KAHNG: King Abdulaziz Hospital for National Guard; MCQ: Multiple choice questions; SPSS: Statistical package for social sciences; KSAUHS: King Saud bin Abdulaziz University for health sciences

Declarations:

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Availability of data and materials

Datasets are available from the corresponding author on reasonable request.

Author's contributions

Al Joher is study's Principal investigator and first responsible, wrote study proposal and

356 manuscript, supervised of study's
357 intervention implementation and follow up
358 other tasks. Al Jasem participated in
359 literature review, revised study proposal and
360 manuscript, data entry and assisted the
361 Principal investigator. Al Huwail conducted
362 the literature search for the background of
363 the study. Al Jamaan was the scientific
364 supervisor, analyzed and interpreted
365 statistical data in addition to general review
366 and editing.

367
368 **Author's information**

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398 Primary Health Care and Officer in-charge in
399 Research office of King Abdullah International
400 Medical Research Center.

401 **Ethics approval and consent to participate**

402 Study proposal was approved by the research
403 committee in Saudi commission for health

404 specialties. All the information kept
405 confidential. All included interns signed the
406 consent form before involving in the study.

407 **Consent for publication**

408 Not applicable

409 **Competing interests**

410 This is a clear notification that there is no
411 conflict of interest.

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Table 1: Distribution of post-graduation medical education information for medical interns in PBL and LBL groups

No.	Item		PBL n = 14		LBL n = 14		P
			Number	Percent (%)	Number	Percent (%)	
1	GPA out of 5 (Missed 7)	3-3.9	6	60	4	36.36	0.39
		4-4.9	4	40	7	63.64	
2	Did you attend a course about PBL in medical education?	Yes	12	85.71	12	85.71	1
		No	2	14.29	2	14.29	
3	Are you satisfied for PBL as an effective method in post-graduation medical education?	Yes	8	57.14	11	78.57	0.42
		No	6	42.86	3	21.43	
4	In your opinion, Which method is better in post-graduation medical educational PBL or LBL?	PBL	9	64.29	9	64.29	1
		LBL	5	35.71	5	35.71	
5	Do you have a good updated knowledge in the topic of "Adolescence health"?	Yes	5	35.71	6	42.86	1
		No	9	64.29	8	57.14	

*Chi-square test

Table 2. Attitude of medical interns in PBL and LBL groups toward the received educational method in this study

	Items	PBL n = 14		LBL n = 14		P
		Number	Percent (%)	Number	Percent (%)	
1	Stimulating	12	85.71	9	64.29	0.38
	Boring	2	14.29	5	35.71	
2	Ease	5	35.71	9	64.29	0.13
	Difficult	9	64.29	5	35.71	
3	Useful	10	71.43	13	92.86	0.32
	Waste of time	4	28.57	1	7.14	
4	Empowering	13	92.86	10	71.43	0.32
	Disempowering	1	7.14	4	28.57	
5	Enlightening	10	71.43	12	85.71	0.64
	Confusing	4	28.57	2	14.29	

*Chi-square test

Table 3: Comparison between pre and post test score of medical short courses post-graduation education among medical interns in PBL group and LBL group

	Post-test		Pretest		Mean Dif.	SD	t	P	95%CI	
	Mean	SD	Mean	SD						
PBL	13.58	3.08	12.50	1.95	1.35	2.76	1.83	0.09	-0.23	2.95
LBL	16.64	1.64	12.42	2.47	4.21	2.42	6.50	<0.001	2.81	5.61

*Paired T test

Table 4: Comparison between medical interns in PBL group and LBL group in pre and post test score of medical short courses post-graduation education

	PBL		LBL		Mean Dif.	SE Dif.	t	P	95%CI	
	Mean	SD	Mean	SD						
Pretest score	12.50	1.95	12.42	2.47	0.07	0.84	0.08	0.93	-1.65	1.80
Post-test score	13.85	3.08	16.64	1.64	-2.78	0.93	-2.98	0.01	-4.70	-0.86
Post-Pretests score (Diff.)	1.35	2.76	4.21	2.42	-2.85	0.98	-2.90	0.01	-4.87	-0.83

*Student T test