

# Integrated Problem Based Learning (PBL) Evaluation by Students in Kerbala Medical College

\*Dr Shahrazad S Al Jobori FIBMS, \*\* Dr Ali M Al Mousawi MSc, \*\*\*Dr Ali A. Abutiheen FIBMS

## ABSTRACT

**Background:** Scientific education aims to be inclusive and to improve students learning achievements, through appropriate teaching and learning. Problem Based Learning (PBL) system, a student centered method, started in the second half of the previous century and is expanding progressively, organizes learning around problems and students learn about a subject through the experience of solving these problems.

**Objectives:** To assess the opinions of undergraduate medical students regarding learning outcomes of PBL in small group teaching and to explore their views about the role of tutors and methods of evaluation.

**Type of the study:** A cross-sectional study.

**Methods:** This study was conducted in Kerbala Medical Colleges among second year students. A self-administered questionnaire was prepared to evaluate the newly applied teaching system. The study analysis included simple descriptive analysis and determining association through t-test, chi square test and regression analysis and using structural equation models to determine simultaneous association between different students' demographic characteristics and potential predictors using SPSS-20 and Amos software at a significance level of < 0.05.

**Results:** A total of 131 undergraduate medical students participated in the study with a response rate of 94%. The majority (93%) have indicated that PBL strategy contributed effectively to their knowledge development with a similar majority (92%) considering PBL successful new teaching method. About 86% reported that would choose PBL rather than conventional method and also 86% would advise PBL for others. Similarly, high majority indicated that various PBL activities are

essential. Regarding the tutors' role in PBL, the majority (92%) indicated that this role was positive and fundamental. According to two thirds (68%) of participants PBL application in Kerbala Medical college was very good application while a higher majority described various PBL sessions as successful and positive and fundamental role of tutors was stressed by most students.

**Conclusions:** This study highlighted the benefits of soliciting student impressions of effective small group teaching. The students' emphasized group atmosphere and facilitation skills of tutor in learning.

**Key words:** Problem Based Learning, Medical Education, Small Group Teaching, Team Based Learning, Kerbala Medical College.

*Al-Kindy College Medical Journal Vol. 12 No. 1. Page: 48-56*

\* Received at 18<sup>th</sup> Dec 2015, accepted in final 4<sup>th</sup> April 2016.

\* shayoha@Yahoo.com; Lecturer at Kerbala Medical College Department of Family and Community Medicine

\*\*aalmousawi1@hotmail.com; Lecturer at Kerbala Medical College Department of Family and Community Medicine

\*\*\* aliabutiheen@yahoo.com; Lecturer at Kerbala Medical College Department of Family and Community Medicine

*Corresponding author to: Dr. Shahrazad S Al Jobori FIBMS*  
E mail: shayoha@Yahoo.com; Lecturer at Kerbala Medical College Department of Family and Community Medicine.

Teaching and learning methods were continuously a matter of great argument and vast spectrum of different theories adapted to describe the process. The scope is more complex in medical discipline and an important issue here is to keep high students motivation to learn<sup>(1)</sup>. The important type of motivation is that which comes from genuine interest or personal value known as autonomous motivation which, in comparison with controlled motivation that arise from the desire to obtain rewards, usually result in better learning, academic success, and less exhaustion<sup>(1)</sup>. Problem-based Learning (PBL) was first started at McMaster University Medical School in Canada in early 1960s due to dissatisfaction with the available medical educational

systems<sup>(2)</sup>. PBL was extensively expanding all over the world<sup>(3-6)</sup>, and has been endorsed by the World Health Organization, the Association of American Medical Colleges and the World Federation of Medical Education<sup>(7)</sup>. In addition, many schools with more traditional curricula have incorporated partial PBL teaching sessions into undergraduate programs<sup>(6)</sup>, or followed a hybrid system of PBL with other teaching approaches. The main goals in PBL are to help the students develop flexible knowledge, critical thinking, effective problem solving skills, self-directed learning, effective collaboration, team work skills and intrinsic motivation and PBL promise an important improvement in outcomes for higher education<sup>(1, 8)</sup>. These benefits

attributed to this educational strategy compared to those of the traditional approaches are behind the great expansion in PBL adaptation in large number of medical colleges and many other non-medical colleges<sup>(9-12)</sup>.

For evaluation, a large number of studies since the 1970s confirmed the significantly higher academic rating<sup>(13-16)</sup>, although some studies claimed no superiority<sup>(12, 17)</sup>.

PBL relies almost entirely on small group teaching (SGT) methods, and many medical colleges with more traditional curricula have incorporated a significant number of SGT sessions into undergraduate programs<sup>(6, 18, 19)</sup>. SGT provide opportunities for students to be more interactive than in large-group lectures as the students get more chance to discuss issues, questions or problems, examine their personal views, clarify their own understanding through comparing and contrasting their own views with their peers and their tutors<sup>(6)</sup>. In addition they get the opportunity to ask questions and verify comprehension, to work as a team and learn from each other, to apply content to clinical situations and to learn to solve problems<sup>(6)</sup>. The emphasis on group atmosphere and tutor characteristics in the PBL system underscored the value of the tutor as a "guide" to student learning<sup>(20)</sup>.

However, in spite the increased use of SGT in medical education, relatively small bulk of research explored student perceptions of SGT goals<sup>(6)</sup>, as most published studies tried comparison of educational output results. Several studies have investigated student perceptions of effective tutors in PBL curricula<sup>(21, 22)</sup>. These studies focused on tutor characteristics in PBL curricula, and little attention was given to other aspects of teaching, including the value of specific materials and resources<sup>(23)</sup>. Furthermore, most of these studies relied on the use of written instruments methods given to students at the end of SGT sessions<sup>(3-6)</sup>.

#### Educational context

The Faculty of Kerbala Medical College (KMC) offers a 6-year undergraduate PBL curriculum. This curriculum was adopted in the academic year 2013/ 2014 to promote integrated system-based approach training. In PBL curriculum, there was a strong commitment to decrease the number of large class lectures and to increase SGT, so that at least 50% of student contact time would occur in a laboratory or small group PBL setting intended to raise skills and attitudes. There was also a clear attempt to integrate the basic and clinical sciences early in the students' training.

The preclinical curriculum, entitled the "Fundamentals of Medicine" and "Human Biology", occupies the first year of the undergraduate curriculum with 9 units system in the next two years. The small groups meet in two PBL sessions weekly in addition to variable practical and skill

laboratories related to the clinical case scenario presented in the first PBL session at the beginning of each week. During these sessions, students spend time in small groups designed to complement and reinforce the related lectures content presented over the week days.

#### Material and Methods

The study used across-sectional sample of 130 second year undergraduate students at KMC in central region of Iraq during the period from 1<sup>st</sup> to 31<sup>st</sup> January 2015. The sample included all students in the second year who were the first group of students undergoing the new changes in the college from conventional to PBL. Self-administered anonymous questionnaire was prepared by the researchers depending on literature review of similar studies<sup>(1, 3, 8, 24)</sup>.

The questionnaire included questions on six main domains: PBL teaching method efficiency (question -Q- 1 and 10); comparison between PBL and conventional teaching methods (Q 8, 9, 14); PBL application in Kerbala Medical College (Q 2, 3, 4), PBL evaluation process (Q 6,7); tutors role (Q 11,12) and team work assessment (Q 13). Answers depended on Likert scale of five grades and answers ranging from 3 (Fairly agree) to 5 (strongly agree) were considered positive while 1 (disagree) and 2 (strongly disagree) were considered negative (figure 1). Some answers were arranged in a reversed sequence to detect possible ignorant 'yes or no to all' answers. Additional analysis used mean answers comparison was conducted to reach more precise comparison.

Analysis plan included determination of internal reliability of the measurement tool, simple descriptive analysis using frequency distribution and chi-square test, t-test, regression analysis and Structural Equation Modeling (SEM) to explore association. Gender differences were determined in addition to differences among those in favour of PBL application and those preferring conventional teaching method. SEM was used to determine simultaneous association between different study domains. Analysis used the Statistical Package for Social Science version- 20 (SPSS-20) and Analysis of Moment Structure version-18 (Amos-18) software at a significance level of < 0.05.

#### Results

A total of 128 questionnaire forms were distributed and 120 questionnaire forms were obtained which make the response rate at 93.8%. Females formed the majority (71.7%) of the sample which was similar to the gender proportion in the second year students.

The internal reliability (Cronbach' alpha) of the 12 questions measurement tool (gender and choosing PBL or conventional method were excluded) was 0.80 which indicates that it was a reliable tool for PBL teaching evaluation.

For PBL concept, a great majority of students (93.3%) considered PBL teaching method efficient teaching method in improving students scientifically (question-Q-1, Figure 1), and almost a similar proportion (91.7%) reported that PBL is successful new teaching method (Q- 10). When comparison between PBL and conventional teaching methods was made, about four fifth of the students (79.8%) reported that they would choose PBL (Q-9). Similarly, 85.6% of the students reported that PBL is a better method for students understanding of scientific material in comparison with conventional (question 8, Figure 1). Additionally, 86.4% of the students reported that they would advise PBL teaching for others (Q- 14).

For PBL application process in KMC, more than two thirds of the students (67.5%) considered the application of PBL method very good application (Q- 2), and this was also clear in the high proportions of students who agreed that different PBL activities application were successful. For example, 92.5% reported that PBL 2 sessions (where the end results of students activities are presented) application was successful (Q- 5), and 91.7% reported that resource lectures were beneficial and covered intended objectives (Q- 3), and a high proportion (86.7%) reported that Team Based Learning (TBL) evaluation session was successful (Q- 6). However 71.4% reported that complementary cases presentation was very important (Q- 4).

For evaluation processes, more than three quarters (76.1%) of the students reported that evaluation of PBL teaching method was good and convincing (Q- 7), and a higher proportion (86.4%) were convinced by PBL approach and they would advise others to apply this system (Q- 14). For determining tutors role in PBL a high majority (95%) reported that the tutors paid high respect to their students and responded to students' enquiries and needs (Q- 12), and almost similar proportion (91.6%) reported that tutor role was positive and fundamental in facilitating the learning process (Q- 11). For team work assessment, a great majority (94.1%) reported that team work was useful and improved their relation with group members (Q- 13). All these results are shown in table 1.

Table 1: The distribution of students' answers to the survey questions (frequency and percentage-in brackets- in Kerbala Medical College in 2015 (n=120). When the analysis through comparison of mean values of the ordinal scale answers was tried, the results showed almost similar findings to those determined through algorithm scale. The means of students' answers were clearly inclined to the higher scale values (Table 1). Some discrepancy was noted for two questions and the reason might be related to the high number of "Fairly agree" answers.

When gender differences were determined, no significant association was discovered for all study questions in both chi-square and t-test mean

comparison methods and this was an expected result as there was no logical base for such difference.

Next comparison was made between the students' group who chooses PBL with those choosing conventional method regarding their answers for other questions using chi-square test for differences where significant differences were found for most answers (Table 2).

For improving the results precision, t- test was used to compare means where almost similar findings were observed. The only different results noticed were for the importance of complementary cases where t-test showed no significant difference ( $p=.128$ ). It was noticed that the mean for the question about resource lectures was significantly higher for those choosing conventional method compared to those choosing PBL method (Table 3). Next Structural Equation Modeling (SEM) was used to assess PBL evaluation. SEM showed excellent correlation between the three pedicles as conceptual PBL process with PBL methods ( $r=.97$ ) and PBL application ( $r=.82$ ). Application and methods showed similar high correlation with each other and with PBL concept output variables, and within the predictors of each pedicle (Figure 2).

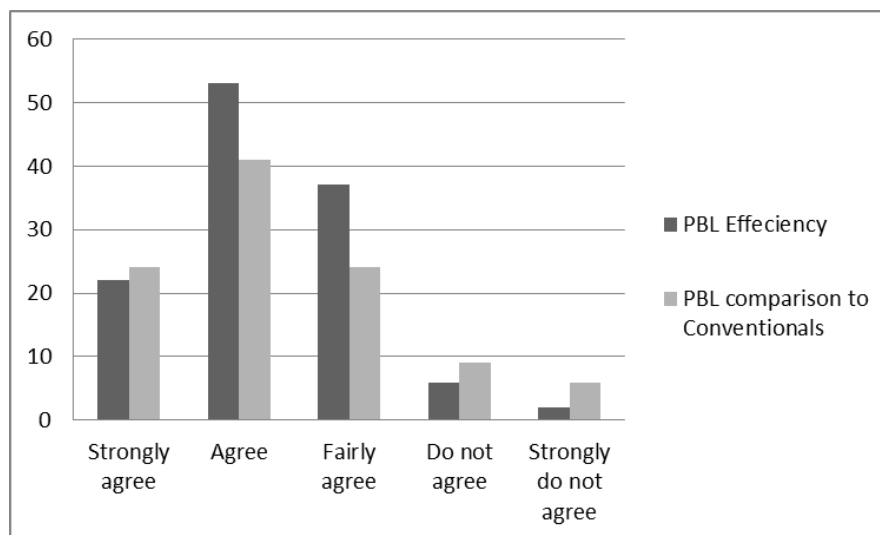
Table 2: The distribution of students' answers to the survey questions (frequency and percentage-in brackets- in Kerbala Medical College in 2015 (n=120)

	Question	Agree	Do not agree	Total	Mean	Standard Deviation
1.	<b>PBL is efficient teaching method in improving students scientifically</b>	112 (93.3%)	8 (6.7%)	120	3.73	0.88
2.	<b>Good PBL application</b>	81 (67.5%)	39 (32.5%)	120	2.81*	0.92
3.	<b>Resource Lectures were essential</b>	10 (8.3%)	110 (91.7%)	120	2.74**	0.99
4.	<b>Importance of complementary cases</b>	85 (71.4%)	34 (28.6%)	119	3.15	1.13
5.	<b>PBL2 sessions application was successful</b>	111 (92.5%)	9 (7.5%)	120	3.89	0.99
6.	<b>TBL sessions were successful</b>	104 (86.7%)	16 (13.3%)	120	3.51	0.96
7.	<b>Evaluation of PBL method was good and convincing</b>	89 (76.1%)	28 (23.9%)	117	3.20	1.04
8.	<b>PBL is better for students understanding of scientific material</b>	89 (85.6%)	15 (14.4%)	104	3.65	1.62
9.	<b>Choosing PBL rather than conventional method for teaching</b>	79 (79.8%)	20 (20.2%)	99	1.78***	0.77
10.	<b>PBL successful new teaching method</b>	100 (91.7%)	9 (8.3%)	109	3.63	1.32
11.	<b>Tutor role was positive in teaching and making learning easier</b>	109 (91.6%)	10 (8.4%)	119	3.79	1.00
12.	<b>Tutors pay respect to the students</b>	113 (95.0%)	6 (5.0%)	119	4.06	0.93
13.	<b>Team work was useful and improved my relations with group members</b>	112 (94.1%)	7 (5.9%)	119	3.90	0.95
14.	<b>Advice PBL for others</b>	102 (86.4%)	16 (13.6%)	118	3.37	1.00

\*,\*\* The proportion of 'Fairly agree' answers was high

\*\*\*The scale was 1-2

Figure 1: Bar chart for students answers about PBL efficiency and comparison with conventional method in Kerbala Medical College in 2015 (n=120)



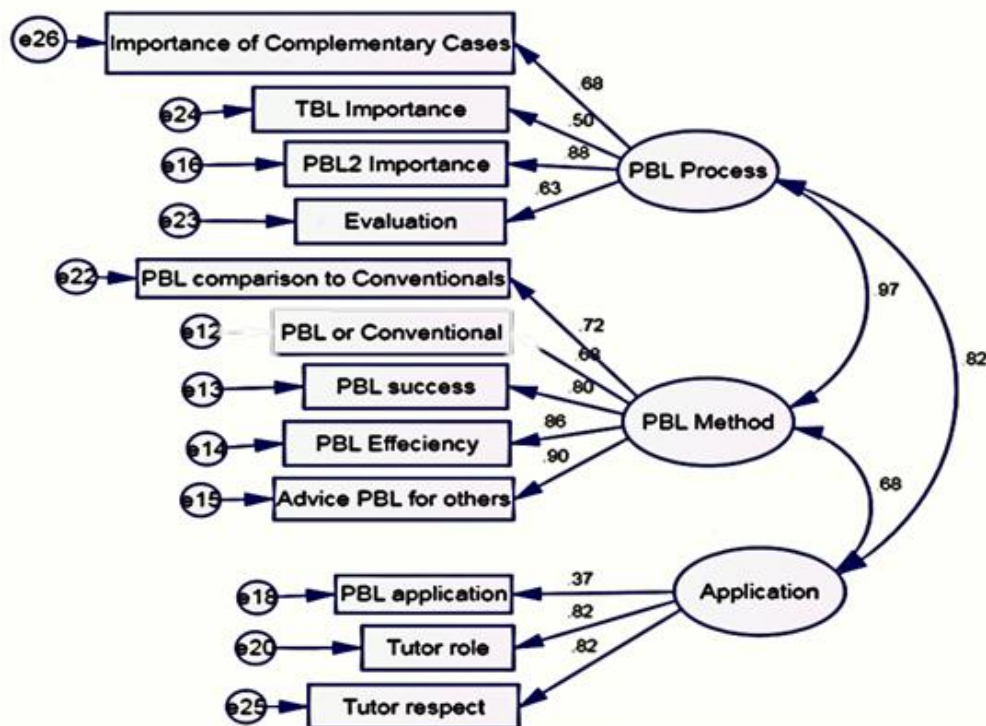
**Table 3: Comparison of the answers of student group who chooses PBL with those choosing conventional method in Kerbala Medical College in 2015 (n=120)**

	Question	Conventional group			PBL group			P
		Agree	Do not agree	Total	Agree	Do not agree	Total	
1.	PBL Efficiency	13 (65.0%)	7 (35.0%)	20 (100.0)	62 (78.5%)	17 (21.5%)	79(100.0)	.209
2.	PBL application	7 (35.0%)	13 (65.0%)	20 (100.0)	61 (77.2%)	18 (22.8%)	79 (100.0)	<.001
3.	Resources Lecture Importance	12 (60.0%)	8 (40.0%)	20 (100.0)	74 (93.7%)	5 (6.3%)	79 (100.0)	<.001
4.	Importance of Complementary Cases	10 (50.0%)	10 (50.0%)	20 (100.0)	63 (79.7%)	15 (19.2%)	78 (100.0)	.005
5.	PBL2 Importance	15 (75.0%)	5 (25.0%)	20 (100.0)	78 (98.7%)	1 (1.3%)	79 (100.0)	<.001
6.	TBL Importance	18 (90.0%)	2 (10.0%)	20 (100.0)	70 (88.6%)	9 (11.4%)	79 (100.0)	.860
7.	Evaluation	12 (60.0%)	8 (40.0%)	20 (100.0)	62 (81.6%)	14 (18.4%)	76 (100.0)	.041
8.	PBL comparison to conventional method	8 (50.0%)	8 (50.0%)	16 (100.0)	1 (1.4%)	70 (98.6%)	71 (100.0)	<.001
9.	PBL success	9 (52.9%)	8 (47.1%)	17 (100.0)	73 (100.0%)	0 (0%)	73 (100.0)	<.001
10.	Tutor role	16 (80.0%)	4 (20.0%)	20 (100.0)	75 (94.9%)	4 (5.1%)	79 (100.0)	.029
11.	Tutor respect	17 (85.0%)	3 (15.0%)	20 (100.0)	76 (96.2%)	3 (3.8%)	79 (100.0)	.061
12.	Team work Importance	17 (85.0%)	3 (15.0%)	20 (100.0)	76 (96.2%)	3 (3.8%)	79 (100.0)	.062
13.	Convinced in PBL	11 (55.0%)	9 (45.0%)	20 (100.0)	51 (65.4%)	27 (34.6%)	78 (100.0)	.390

**Table 4: Comparison of the mean answers between student group who chooses PBL and those choosing conventional method in Kerbala Medical College in 2015 (n=120)**

	Question	Conventional group		PBL group		P value
		Mean	Standard Deviation	Mean	Standard Deviation	
1.	PBL Efficiency	2.85	1.040	4.04	0.69	< .001
2.	PBL application	2.10	.788	3.06	0.91	< .001
3.	Resources Lecture Importance	2.65	1.040	2.15	0.98	.047
4.	Importance of Complementary Cases	2.90	1.210	3.32	1.06	.128
5.	PBL2 Importance	3.10	1.119	4.22	0.83	< .001
6.	TBL Importance	3.25	.910	3.62	0.95	.120
7.	Evaluation	2.70	.865	3.38	1.06	.009
8.	PBL comparison to conventional method	1.85	1.268	3.71	1.46	< .001
9.	PBL success	2.15	1.309	3.90	1.15	< .001
10.	Tutor role	3.30	1.081	3.97	0.92	.006
11.	Tutor respect	3.70	1.031	4.13	0.94	.078
12.	Team work Importance	3.55	1.099	4.13	0.88	< .001
13.	Convinced in PBL	2.40	.995	3.83	0.78	< .001

Figure 2: Structural Equation Model of students answers about Problem Based Application in Kerbala Medical College in 2015(n=120).



**Discussion:** This study was planned first to have a feedback on the newly adopted and implemented guided PBL (hybrid method) in Kerbala Medical College through reflection of students' perception. Secondly, to provide practical advice to assist in making informed decisions as to when which strategy is most appropriate to use to support learning. These decisions will be based on a sound understanding of each strategy and a consideration of when each is most appropriate to use in enhancing the learning of the students.

The response rate was high and this is a common finding in most self-administered questionnaire surveys performed in Iraq.

It was found that most of the students realize the importance of the integrated PBL method as a new strategy that would improve their scientific basis and critical thinking. This is consistent with a study done by the Medical School in McGill University in Canada<sup>(6)</sup>, and many review studies<sup>(7, 25-28)</sup>. PBL engages the basic sciences and link them to the clinical knowledge and skills unlike the conventional method of learning in which the basic sciences are studied in the first 3 years and

then afterwards the clinical implication is studied separately which would make recalling the basic sciences a difficult task for the students<sup>(20, 29)</sup>.

A high majority of the students in the present study (>90%) believed that it is a successful teaching method and encouraged the application of PBL by others; this can be attributed to the motivation of team work adapted in PBL. A recent study in Zanjan University of Medical Science in Iran in 2014 found that students preferred PBL because of higher motivation boost, a higher quality of education, knowledge retention, class attractiveness, and practical use<sup>(30)</sup>, and motivation was shown to increase across study years in a longitudinal three year study in China<sup>(31)</sup>. The discussion around a specific problem during the week within small groups is more effective for facilitating knowledge acquisition and retention, and improved students ability to search for information and look for available reliable scientific resources<sup>(20, 29)</sup>. The survey also denoted that 86% of the students believe that PBL was a better learning method in acquiring and retention of scientific material as it facilitates the understanding of the assigned curriculum and makes the learning process more

interesting when compared with conventional teaching method. Similar high rates were reported in many published studies<sup>(7, 12, 32)</sup>.

Team work assessment revealed that 94% of the participants thought that team cooperation was beneficial and improved inter-relation within groups<sup>(19, 32, 33)</sup>. Group learning facilitates not only the acquisition of knowledge but also several other desirable attributes, such as communication skills, teamwork, problem solving, independent responsibility for learning, sharing information, and respect for others. PBL can therefore be thought of as a small group teaching method that combines the acquisition of knowledge with the development of generic skills and attitudes<sup>(6, 32, 34)</sup>.

Comparing PBL with conventional method revealed a clear preference of the first by the majority in this study and many published studies<sup>(12, 30)</sup>. When comparison was extended to examine graduates in both systems, PBL was also better professionals in the future<sup>(17, 35-39)</sup>. This teaching method also pay attention to building students' self-esteem, self-trust, self-reliance in exploration, information gathering as well as analyzing, hypothesis formulation, building their personality as doctors in the future and foundation of doctor patient approaches.

Two thirds of the students thought that PBL was implemented satisfactorily in KMC, and this proportion could be considered as a good success results for a new program in its early implementation phase. It could be argued that this method was recently implemented for the first time in KMC and it needs more training and logistic support to facilitate success. Several published studies reported similar problems in the early implementation of PBL in Saudi Arabia<sup>(34, 40)</sup> and many others<sup>(32, 41, 42)</sup>. Review studies summarized the difficulties in the transition from the conventional to PBL method including several major administrative problems (for example cost) affecting tutors and students such as the difficulties in formulating the problems scenario and the narrow scope of science around these problems (cognitive-processing weaknesses), the longer time needed in implementation<sup>(17, 35)</sup>. However, high majority of students were satisfied by the different PBL implementation activities (93% for PBL 2, 87% for TBL and 71% for complementary cases). Different proportions were reported for these activities in the reviewed studies<sup>(19, 32-38, 40)</sup>, and this is an expected finding, as application differs in different educational premises. Evaluation process in PBL was convincing for three quarters (76.1%) of the students and this was similar to other reviewed studies<sup>(7, 16, 17)</sup>.

For tutor role, the study showed agreement between students on the fundamental role played by tutors in PBL. Significantly more Brazilian medical students viewed expert facilitators more effective than non-expert counterparts<sup>(41)</sup>, and tutor role was impressive in a large

bulk of references<sup>(7, 43-47)</sup>. Structural Equation Modeling also confirmed the results of data analysis and provides additional confirmation for the significant associations in the model.

Both chi-square test and t-test confirmed that students preferring PBL also preferred all PBL activities significantly more than those preferring conventional teaching (better results were discovered when mean comparison was used, Table 3) and these findings was similar to literature findings<sup>(7, 16)</sup>.

**Conclusions and recommendations:** A high majority (>90%) of medical students encouraged the application of integrated problem based learning method and regarded it as a successful method when compared to the conventional method. Tutor fundamental role in regulating SGT sessions was obviously clear and indicated by most students (>90%). Application of PBL in Kerbala Medical College is considered very well by two thirds of the students. However, there is a need for logistic and training support.

To improve the application, logistic needs such as classrooms and skill laboratories, internet connections and lecture halls are needed. Training of the tutors and responsible authorities on standard PBL program implementation with clear regulations and instructions should be set as soon as possible.

## References

1. Kusurkar RA, Croiset G. Autonomy support for autonomous motivation in medical education. *Medical education online*. 2015;20.
2. Barrows HS. Problem-based learning in medicine and beyond: A brief overview. *New directions for teaching and learning*. 1996;1996(68):3-12.
3. Kazi H, Haddawy P, Suebnukarn S. Employing UMLS for generating hints in a tutoring system for medical problem-based learning. *Journal of biomedical informatics*. 2012;45(3):557-65.
4. Schmidt H. Foundations of problem based learning: some explanatory note. *Medical Education*. 1993;27(4):422-432.
5. Schmidt H, Van Der Arend A, Kokx I, Boon L. Peer versus staff tutoring in problem-based learning. *Instructional science*. 1994;22(4):279-85.
6. Steinert Y. Student perceptions of effective small group teaching. *Medical education*. 2004;38(3):286-93.
7. Dolmans DH, Gijsselaers WH, Moust JH, Grave WSd, Wolffhagen IH, Vleuten CPvd. Trends in research on the tutor in problem-based learning: conclusions and implications for educational practice and research. *Medical teacher*. 2002;24(2):173-80.
8. Gijbels D, Dochy F, Van den Bossche P, Segers M. Effects of problem-based learning: A meta-analysis from the angle of assessment. *Review of educational research*. 2005;75(1):27-61.
9. A Y. Problem-based learning as an instructional method. *J Coll Physicians Surg Pak*. 2013;23:83-5.
10. Yew EH SH. Evidence for constructive, self regulatory and collaborative process in problem-based

- learning. *Adv Health Sci Educ Theory Pract.* 2009;14:251-73.
11. Bassir SH, Sadr-Eshkevari P, Amirikhorheh S, Karimbux NY. Problem-Based Learning in Dental Education: A Systematic Review of the Literature. *Journal of Dental Education.* 2014;78(1):98-109.
  12. Belland BR FB, Ertmer PA. Validity and Problem-Based Learning Research: A Review of Instruments Used to Assess Intended Learning Outcomes. *Interdisciplinary Journal of Problem-Based Learning.* 2009;3(1):59-89.
  13. Centra JA, Gaubatz NB. Student perceptions of learning and instructional effectiveness in college courses. *Research Rep.* 2000(9).
  14. Khoshnevisasl P SM, Mazloomzadeh S, Feshareki RH, Ahmadiashar A. Comparison of Problem-based Learning With Lecture-based Learning. *Iranian Red Crescent Journal.* 2014;16(5):e5186.
  15. Allchin D. Problem- and Case-Based Learning in Science: An Introduction to Distinctions, Values, and Outcomes. *CBE-Life Sciences Education.* 2013;12(3):364-72.
  16. Hoffman K, Hosokawa M, Blake Jr R, Headrick L, Johnson G. Problem-based learning outcomes: ten years of experience at the University of Missouri–Columbia School of Medicine. *Academic Medicine.* 2006;81(7):617-25.
  17. Albanese MA, Mitchell S. Problem-based learning: a review of literature on its outcomes and implementation issues. *Acad Med.* 1993;68(1):52-81.
  18. Centra JA. Student ratings of instruction and their relationship to student learning. *ETS Research Bulletin Series.* 1976;1976(1):i-16.
  19. Centra JA. Student ratings of instruction and their relationship to student learning. *American educational research journal.* 1977;14(1):17-24.
  20. English MC, Kitsantas A. Supporting student self-regulated learning in problem-and project-based learning. *Interdisciplinary journal of problem-based learning.* 2013;7(2):6.
  21. Dolmans DHJM, Gijsselaers WH, Moust JHC, Grave WSD, Wolfhagen IHAP, Vleuten CPMvd. Trends in research on the tutor in problem-based learning: conclusions and implications for educational practice and research. *Medical Teacher.* 2002;24(2):173-80.
  22. Kaufman DM, Holmes DB. Tutoring in problem-based learning: perceptions of teachers and students. *Medical education.* 1996;30(5):371-7.
  23. van de Wiel MW, Schaper NC, Scherpbier AJ, van der Vleuten CP, Boshuizen HP. Students' experiences with real-patient tutorials in a problem-based curriculum. *Teaching and learning in medicine.* 1999;11(1):12-20.
  24. Major CH, Palmer B. Assessing the effectiveness of problem-based learning in higher education: Lessons from the literature. *Academic exchange quarterly.* 2001;5(1):4-9.
  25. Stern P. Student perceptions of a problem-based learning course. *The American journal of occupational therapy : official publication of the American Occupational Therapy Association.* 1997;51(7):589-96.
  26. Tan CH, Amin Z, Khoo HE, Gwee M, Davis M, Koh DR. Student perceptions of the benefits of problem-based learning. *Medical teacher.* 2007;29(2-3):284.
  27. Vasconcelos C. Teaching environmental education through PBL: Evaluation of a teaching intervention program. *Research in Science Education.* 2012;42(2):219-32.
  28. Walker A, Leary H. A problem based learning meta analysis: Differences across problem types, implementation types, disciplines, and assessment levels. *Interdisciplinary Journal of Problem-based Learning.* 2009;3(1):6.
  29. Wood DF. ABC of learning and teaching in medicine Problem based learning. 2003.
  30. Khoshnevisasl P, Sadeghzadeh M, Mazloomzadeh S, Hashemi Feshareki R, Ahmadiashar A. Comparison of Problem-based Learning With Lecture-based Learning. *Iran Red Crescent Med J.* 2014;16(5):e5186.
  31. Pan Y, Gauvain M. The continuity of college students' autonomous learning motivation and its predictors: A three-year longitudinal study. *Learning and Individual Differences.* 2012;22(1):92-9.
  32. Cantillon P, Wood D. ABC of Learning and Teaching in Medicine: John Wiley & Sons; 2011.
  33. Jaques D. Teaching small groups. *BMJ : British Medical Journal.* 2003;326(7387):492-4.
  34. Nahar L, Salem RO, Nuzhat A, Alakrash L, Dipro SA. Medical Students' Perceptions and Satisfaction with Under-Graduate Medical Hybrid Problem-Based Learning Curriculum in a Saudi Medical School. *International Journal of Education.* 2014;6(3):70.
  35. Marta CV, editor Using Problem Based Learning to Achieve Lifelong Learning 2011: International Conference on Lifelong Learning 2011, Open University Malaysia.
  36. Wu Y. Applying a hybrid problem-based learning method to the teaching of computer programming. *The China Papers.* 2006(6):63-6.
  37. Nahar L, Salem RO, Nuzhat A, Alakrash L, Dipro SA. Medical Students' Perceptions and Satisfaction with Under-Graduate Medical Hybrid Problem-Based Learning Curriculum in a Saudi Medical School. *International Journal of Education.* 2014;6(3):70-80.
  38. Kamin C, O'Sullivan P, Deterding R, Younger M. A Comparison of Critical Thinking in Groups of Third-year Medical Students in Text, Video, and Virtual PBL Case Modalities. *Academic Medicine.* 2003;78(2):204-11.
  39. Wu L-T, Hsu L-C, Sun S-S, Wu H-C, Tu M-G, Kwan C-Y. The change of student perception toward PBL in a medical school with a hybrid-PBL preclinical curriculum in Taiwan. *J Med Educ.* 2012;16(3):97-113.
  40. Al-Drees AA, Khalil MS, Irshad M, Abdulghani HM. Students' perception towards the problem based learning tutorial session in a system-based hybrid curriculum. *Saudi Medical Journal.* 2015;36(3):341-8.
  41. Couto LB, Bestetti RB, Restini CBA, Faria-Jr M, Romão GS. Brazilian medical students' perceptions of expert versus non-expert facilitators in a (non) problem-based learning environment. 2015. 2015;20.
  42. Das Carlo M, Swadi H, Mpofu D. Medical student perceptions of factors affecting productivity of problem-based learning tutorial groups: does culture influence the outcome? *Teaching and learning in medicine.* 2003;15(1):59-64.
  43. Turan S, Elcin M, Odabası O, Ward K, Sayek I. Evaluating the role of tutors in problem-based learning sessions. *Procedia - Social and Behavioral Sciences.* 2009;1(1):5-8.
  44. Wood DF. Problem based learning. *British medical journal.* 2003;326(7384):328.



45. Donnelly R, Fitzmaurice M. Collaborative project-based learning and problem-based learning in higher education: a consideration of tutor and student role in learner-focused strategies. 2005.
46. Gerhardt-Szep S, Kunkel F, Moeltner A, Hansen M, Bockers A, Ruttermann S, et al. Evaluating differently tutored groups in problem-based learning in a German dental curriculum: a mixed methods study. *BMC medical education*. 2016;16(1):14.
47. Gerhardt-Szep S, Kunkel F, Moeltner A, Hansen M, Böckers A, Rüttermann S, et al. Evaluating differently tutored groups in problem-based learning in a German dental curriculum: a mixed methods study. *BMC medical education*. 2016;16:14.