

ORIGINAL ARTICLE

COMPARISON OF PROBLEM BASED WITH CASE BASED LEARNING:
A CROSS-SECTIONAL STUDY

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Background: Problem-based learning (PBL) and case-based learning (CBL) are teaching methodologies, which regulate self-directed learning skills. In medical schools of Pakistan either or both are being consistently used in the undergraduate and postgraduate curriculum. The objective of our study was to compare CBL with PBL on the basis of perception of those students who have observed this transition of learning methodologies in the undergraduate medical curriculum.

Methods: It was a cross sectional comparative study, conducted from February to May 2016 whereby all 3rd year medical students who were exposed to PBL in the third year of education after two years experience of CBL were included. Response of students on the usefulness of PBL was acquired on 5-point Likert scale. Results were compared by chi square test. **Result:** The complete response was obtained from 212 students. Eighty four percent students preferred PBL over CBL ($p<0.01$). PBL significantly assisted students to; identify gaps in knowledge, improve their areas of weakness, manage time, make decisions, solve problems, use critical reasoning skills and communicate with each other ($p<0.01$) in comparison to CBL. It enhanced the ability to find information from internet and libraries. Students recommended that PBLs were time consuming and proper training of facilitators was required as compared to CBL. They were convinced with system of education of CBL followed by PBL. **Conclusion:** The PBL was effective in terms of retention of concepts, critical reasoning and problem-solving approaches yet satisfaction with the current system of education elucidated role of CBL in the first two years of undergraduate medical curriculum to prepare students through guided enquiry and presentation of clinical scenarios. Proper training of facilitators will be a key point to improve learning of students through PBLs.

Keywords: Problem based learning, case based learning, medical students

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INTRODUCTION

Doctors have a societal responsibility to uphold their knowledge and skills and engage in lifelong learning.¹ They are required to have cognitive skills that include decision-making, problem-solving and adequate clinical judgment. Medical Councils all around the world have identified importance of learning of these skills as a lifelong activity. They recommend that these learning skills should be improved and evaluated throughout the education of doctors.^{1,2}

Keeping in consideration the role of a doctor in a society, medical institutions have a prime objective to ensure that students should be well equipped with the essential self-directed learning (SDL). It comprises of stages to enhance independent learning which eventually leads to self-regulated learning (SRL).³ The latter is an umbrella term for various processes like goal setting, metacognition and self-assessment which are required to accomplish the continued exponential growth in the field of medicine.^{3,4}

In medical education, problem-based learning (PBL) and case-based learning (CBL) have become ideal teaching methodologies by which students clear most of their confusions and misperceptions as a result of

interaction with peers and teachers in small group discussions. Problem-based learning is a strategy that develops SRL and encourages students to learn through enquiry and investigation by understanding a problem, which acts as a stimulus for development of diagnostic and SRL skills.^{3,5} A PBL comprises of a scenario, designed from the objectives covered during lectures every week.² The scenario may be represented as a textual format description, or sometimes as illustrations, pictures, videos and simulations.⁶ It usually consists of a set of descriptive situation that requires explanation and resolution. These representations lead students to SRL with predetermined objectives⁷ and prepare students to 'engage in learning activities defined by him- or herself, rather than by a teacher'.⁸ Some facilitators however, believe that SDL is not always helpful and sometimes students need a small lecture before starting the discussion.^{9,10}

CBL is an approach to medical education, which aims to prepare students for clinical practice, through the use of real clinical cases.¹¹ These cases link theory to practice through the application of theoretical knowledge to the cases themselves and encourage the use of methods of inquiry-based learning.¹² Case-based learning is considered as a more

general class of discovery learning.¹³ It usually involves common scenarios aligned with defined learning outcomes that have educational value that stimulate interest, create empathy with the characters and usually have general applicability.

Many medical institutes in Pakistan have introduced PBL in their curriculum but very few of them have included both CBL and PBL as instructional strategies in their medical curriculum. Our institute is unique in the sense that in the first two years of medical education, CBL remains an integral part of the curriculum while PBL is introduced from third year till the final (fifth year).

The medical educationists are aware of the fact that PBL and CBL are described as auspicious tools for medical and dental educators.¹⁴ Therefore, we wanted to know the feed back of those students who experienced CBL for two years of undergraduate medical curriculum and were then exposed to PBL. The objective of our study was to compare CBL with PBL on the basis of perception of the students who have observed this transition of learning methodologies in the undergraduate medical curriculum.

METHODS

This cross sectional comparative study was conducted from February to May 2016 in a medical university of Pakistan after getting official approval. In this study, third year students of both genders, all ethnic groups and diverse socioeconomic backgrounds were included. Students of other years were excluded from the study. A total of 10–12 CBLs were carried out in each of the 1st and 2nd years and 10–12 PBLs in the 3rd year.

Three hundred and fifty students of 3rd year MBBS were included through convenience sampling after written informed consent. The class of 350 students was divided in 5 small groups for ease of discussion with each group having 70 students. The cases to be discussed were uploaded on our university webpage at the start of the week. The time 1.5 hours was allotted to each session.

PBL sessions had the same number of students. In PBL sessions students were instructed to study the case and set the learning objectives beforehand. They were then given the opportunity to reflect their understanding during discussion of the case with the facilitator.

The questionnaire was pretested and verified (validated) on a group of 50 students. In the pilot survey, reliability of the study questionnaire was computed by Cronbach's alpha and a value of more than 0.7 was acquired.

The study instrument (Section A) was a 24-point questionnaire that contained statements regarding the benefits of PBL over CBL; its importance in development of clinical skills (confidence, time management, approach to patient) and 6 statements (Section B) for the inclusion of PBL in the continuous assessment.

With the expected 70% response rate from 350 students, two hundred and fifty questionnaires were distributed among the university students. The research group of students explained the project and discussed the queries. Each student took approximately 10–15 minutes to fill it out. The responses were assessed according to the 5-point Likert scale with a score of 1= strongly disagree (SDA), 2=diasagree (DA), 3=neutral (N), 4= agree (A) and 5= strongly agree (SA).

Data was analyzed using Microsoft excel and SPSS (Statistical Package for Social Sciences). Frequency of all questions was calculated to determine the perception of students. For calculating the responses, the SA and A were added and considered as positive perceptions whereas SD and D were counted as negative perception of students about PBL. Chi square test was used to compare results; considered significant with p -value<0.05.

RESULTS

The complete response was obtained from 212 students, out of which 184 (87%) were females and 28 (13%) males.

The results (Table-1) indicates that students found PBL interesting as compared to CBL ($p<0.01$) however it was more time consuming. PBL significantly assisted students to identify gaps in knowledge and improved their areas of weakness more than CBL ($p<0.01$). They were able to make decisions, solve problems and critically think over the difficulty and to speak on them ($p<0.01$). PBL enhanced their ability to find information from internet and libraries, encouraged them to do more research and developed their ability for SDL (Table-1). Students found that in PBL they took responsibility to learn on their own, they were able to actively process information and use their prior understanding to elaborate their knowledge far more than in CBL. The facilitator's role was found to be more helpful in PBL by the students ($p<0.001$) but they recommended the need of proper training of facilitators before its implementation (Table-1). According to the students, in PBL sessions the group should self-evaluate themselves and marks of this assessment should be added at the end of the semester ($p<0.01$). The students were convinced that PBL would assist them to do better in university exams ($p<0.01$).

Table-1: Comparison of perception of students on Problem and Case-Based Learning

Statement	Positive reflection of PBL N (%)	Negative reflection of PBL N (%)	p
1. The PBL strategy is interesting as compared to case based learning (CBL)	157 (92.35)	13 (7.65)	<0.01
2. The knowledge gained by PBL is more than it would be by CBL	165 (97.63)	4 (2.36)	<0.01
3. PBL identifies gaps in knowledge more than CBL	155 (93.37)	11 (6.62)	<0.01
4. Real medical problems are explained better by PBL as compared to CBL	152 (89.94)	17 (10.05)	<0.01
5. Objectives of the course are understood better by PBL	156 (95.12)	8 (4.87)	<0.01
6. Time taken by PBL is more than CBL	160 (94.11)	10 (5.88)	<0.01
7. Knowledge is organized around problem rather than discipline more by PBL	163 (93.60)	4 (2.39)	<0.01
8. Learner assumes responsibility for their own learning in PBL	141 (85.97)	23 (14.02)	<0.01
9. Learners become active processors of information in PBL as compared to CBL	149 (90.30)	16 (9.69)	<0.01
10. Learners activate prior knowledge and learn to elaborate their knowledge more by PBL	151 (89.34)	18 (10.65)	<0.01
11. PBL stimulates in doing research more than CBL	151 (94.96)	8 (5.03)	<0.01
12. PBL enhances the ability to find the information using the internet/library more than CBL	143 (91.66)	13 (8.33)	<0.01
13. PBL helps in identifying the areas of weakness for Improvement more than CBL	138 (90.19)	15 (9.80)	<0.01
14. PBL enables the learner to establish a concrete action plan to achieve their learning goals more than CBL	140 (85.89)	23 (7.36)	<0.01
15. PBL enhances the ability to speak in front of people more than CBL	132 (84.07)	25 (15.92)	<0.01
16. PBL increases ability to manage the time effectively as compared to CBL	135 (87.09)	20 (12.90)	<0.01
17. PBL helps to convert from passive to active life long learner	154 (95.65)	7 (4.34)	<0.01
18. The role of facilitator in the process is helpful in PBL more than CBL	162 (92.57)	13 (7.42)	<0.01
19. PBL improves the decision-making skills more than CBL	153 (95.03)	8 (4.96)	<0.01
20. PBL improves the problem-solving skills more than CBL	164 (93.71)	11 (6.28)	<0.01
21. PBL develops the competence in self-directed learning more than CBL	154 (96.85)	5 (3.14)	<0.01
22. PBL improves communication skills more than CBL	144 (87.80)	20 (12.19)	<0.01
23. PBL helps in managing patients more than CBL	154 (93.90)	10 (6.09)	<0.01
24. PBL enables skill of critical reasoning more than CBL	160 (96.96)	5 (3.03)	<0.01
Section B			
25. The proper training of PBL should be given before its implementation	152 (91.09%)	15 (8.98)	<0.01
26. The group assessment mark should be used towards the semester examination marks (semester use)	128 (81.01%)	30 (18.98)	<0.01
27. Awarding an individual mark to each student would be a fairer reflection of an individual's performance in the group.	136 (85.53%)	23 (14.46)	<0.01
28. The group should evaluate themselves against the objectives they set early rather than by the tutor	153 (92.72%)	12 (7.27)	<0.01
29. The assessment marks should be used for guiding the group and not towards the summative semester examination marks.	143 (90.50%)	15 (9.49)	<0.01
30. The teaching tool will help you to perform better in University exams	161 (98.17%)	3 (1.82)	<0.01
Statement	Yes	No	P value
31. Are you satisfied with the current system of education?	152 (71.69%)	60 (28.30%)	<0.01

DISCUSSION

Students in third year of undergraduate medical curriculum found PBL strategy to be more interesting as compared to CBL employed in first two years of medical education. Furthermore, problems in PBL provoked situational interest that intensified interest in learning and is comparable to other reports.¹⁰ Studies have revealed that second year students responded to PBL more effectively as compared to first year.^{10,15} A step ahead, third year students in our research learnt about real medical problems and managing the patients with the help of PBLs.

PBLs encourage students to use internet sites and reference books since the pre-reading material is not provided beforehand.¹⁰ In a research, response of online PBL sessions was given and students said that they gained a lot of knowledge with this learning strategy.¹⁶ An analysis revealed involvement of librarians in building and implementing the PBL curricula and guided policy makers and PBL practitioners to involve librarians in curriculum development.¹⁷

Facilitators are responsible to create the environment that is conducive for learners to construct their own knowledge, skills and values through interaction.¹⁸ The PBL although recommended to be an “open enquiry” by researchers, the role of the facilitator to elaborate on theoretical knowledge of clinical cases, the diagnostic characteristics, and their management was emphasized by our students. The need for training of facilitators to make certain rules for themselves in order to become good facilitators has been documented in the literature.¹⁹ On the contrary training of facilitators for CBL was not recommended by the students.

Critical thinking is the ability to think clearly and rationally about what to do or what to believe. PBL is an effective strategy, which improves critical thinking, clinical reasoning and problem solving skills among medical students.¹⁰ The development of critical thinking in our students is comparable to studies for example; an intensive problem-based course facilitated the development of students' clinical reasoning skills in undergraduate occupational therapy students.²⁰

Moreover, the critical thinking skills are augmented to such an extent that students attending PBL sessions scored higher marks than the students who attended just the routine lectures.^{12,21}

After attending PBL, students were able to identify the purpose of brainstorming the possible choices, making decisions and evaluating each choice. In CBL sessions, students were not able to make instant decisions since they were not asked to think about the management and treatment of the diseases rather, the pathology of the disease is explained. Students use their decision-making skills to solve problems by selecting one course of action from several possible alternatives during PBL which could be useful in the course of professional life. In a supporting research on nursing professionals, competencies and decision to learn were acquired by those who graduated with a PBL based curriculum.²² The decision-making skills of respiration therapy students were also improved by carrying out PBLs.²³ Development of this skill can help in time management and eventually help the future doctors in saving lives.

Educational constructivism hypothesizes that students actively build their knowledge networks, generate meaning and build personal interpretations of the world based on individual experiences and interactions.²⁴ As an instructional methodology, PBL incorporates many elements from adult learning theory and helps students gain knowledge and develop the skills, attitudes, and habits to perform competently in a chosen field. PBL simultaneously, stresses the ability of individuals to design and accomplish their own learning methods.²⁵ The SRL is thus the essence of PBL and that is why when asked if PBL develops the competence in SRL more than CBL, the students replied in affirmative. Majority of the students believed that their areas of weakness were better identified in the PBL sessions. The teaching strategy motivated the students with the desire to know that further helped them in generating hypothesis for future research.

When the survey was performed, students were asked if they should be allotted marks on their performance in the PBL session and they strongly agreed to it. They think it would be wonderful if during each session they are given marks for correct answers and then that could be added to their semester results. Since assessment derives learning, it would be a great incentive for the students to come well prepared for the PBL and would ultimately result in a fruitful and outcome based discussion. This would then help students to perform better in university exams and this in the long run would also help students improve their respective GPAs (grade point averages) and percentages.

The two teaching methodologies when compared, CBL sessions provided opportunities to

practice higher order thinking while the extent of learning in PBL is acquired through individual knowledge acquisition and group collaboration.²⁶ Students in our university however preferred CBL with reference to time taken in the sessions which is in agreement with Srinivasan M. et al, who observed that students preferred CBL over PBL for better utilization of time.^{11,27}

Results of the study are limited which could be fortified by inclusion of qualitative along with quantitative analysis. The opinion of faculty in terms of usefulness of both learning methodologies is also required to give the final disclosure statement. Outcomes of the survey could have ideally compared when students are exposed to both methodologies at the same time. However, this is the pioneer study in Pakistan which proved the need of CBL in first two years to be followed by PBL. While the policy makers consider about curricular reforms, careful consideration needs to be given and more research needs to be undertaken before implementation of all instructional strategies.

CONCLUSION

The study has elucidated the effectiveness of PBL in terms of retention of concepts, critical reasoning and problem-solving approaches. The satisfaction with the current system of education further explicates role of CBL (in the first two years of undergraduate medical curriculum) to prepare students through guided enquiry and presentation of clinical scenarios. Medically trained educators are a scarce entity both in Pakistan and worldwide thus excellent, superior, provocative mentorship is needed to ensure the successful implementation to conduct PBL curriculum. We further emphasize that workshops should be conducted on orientation, methodology and facilitation of PBL as has been done by some other universities in Pakistan.

CONFLICT OF INTEREST

The authors do not declare any conflict of interest.

REFERENCES

1. Sockalingam N, Rotgans J, Schmidt H. Assessing the Quality of Problems in Problem-Based Learning. *Int J Teach Learn High Educ* 2012;24(1):43–51.
2. Gijsselaers WH, Schmidt HG. Development and evaluation of a causal model of problem-based learning. In: Nooman ZH, Schmidt HG, Ezzat ES (Eds.), *Innovation in medical education: An evaluation of its present status*. New York: Springer; 1990. p.95–102.
3. Loyens SM, Magda J, Rikers RM. Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educ Psychol Rev* 2008;20(4):411–27.
4. Demirören M, Turan S, Öztuna D. Medical students' self-efficacy in problem-based learning and its relationship with self-regulated learning. *Med Educ online*. 2016;21:30049.
5. Salam A, Besar MNA, Kamaruddin MA, Mohamad N. Classroom audit: student self-performance, group performance,

- and tutor performance in a problem-based learning tutorial. AJTLHE: Asean J Teach Learn High Educ 2011;3(1):28–35.
6. Fosi-Mbantenku J. How to design problems for problem-based curriculum: Problem-based Learning Consultancy; St. Augustine. 1996.
 7. Thistlethwaite JE, Davies D, Ekeocha S, Kidd JM, MacDougall C, Matthews P, et al. The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME Guide No. 23. Med Teach 2012;34(6):e421–44.
 8. Schmidt H. Assumptions underlying self-directed learning may be false. Med Educ 2000;34(4):243–5.
 9. Barrows HS. A taxonomy of problem-based learning methods. Med Educ 1986;20(6):481–6.
 10. Asad M, Iqbal K, Sabir M. Effectiveness of problem based learning as a strategy to foster problem solving and critical reasoning skills among medical students. J Ayub Med Coll Abbottabad 2015;27(3):604–7.
 11. Rehman R. Clinically oriented teaching of physiology through case based lecturing. Pak J Physiol 2014;10(1-2):15–7.
 12. Banchi H, Bell R. The many levels of inquiry. Sci Child 2008;46(2):26–9.
 13. Ricci FL, Consorti F, Gentile M, Messineo L, La Guardia D, Arrigo M, et al. Case-Based Learning: A Formal Approach to Generate Health Case Studies from Electronic Healthcare Records. In: Hofdijk J, Scroussi B, Lovis C. (Eds). Transforming Healthcare with the Internet of Things: Proceedings of the EFMI Special Topic Conference. Washington DC: IOS Press; 2016. p. 107.
 14. Nadershahi NA, Bender DJ, Beck L, Lyon C, Blaseio A. An overview of case-based and problem-based learning methodologies for dental education. J Dent Educ 2013;77(10):1300–5.
 15. Schmidt HG, Rotgans JI, Yew EH. The process of problem-based learning: what works and why. Med Educ 2011;45(8):792–806.
 16. Khoo HE. Implementation of problem-based learning in Asian medical schools and students' perceptions of their experience. Med Educ 2003;37(5):401–9.
 17. Batman C, Tsuchiya L, Treseder M. Problem-solving Skills for Librarians. LOEX Conf Proc 2011 [Internet]. 2013 Dec 1; Available from: <http://commons.emich.edu/loexconf2011/35>.
 18. Oda Y, Koizumi S. Status of medical education reform at Saga Medical School 5 years after introducing PBL. Kaohsiung J Med Sci 2008;24(3 Suppl):S46–53.
 19. Das M, Mpofu D, Hasan MY, Stewart T. Student perceptions of tutor skills in problem-based learning tutorials. Med Educ 2002;36(3):272–8.
 20. Scaffa ME, Wooster DM. Effects of problem-based learning on clinical reasoning in occupational therapy. Am J Occup Ther 2004;58(3):333–6.
 21. Tiwari A, Lai P, So M, Yuen K. A comparison of the effects of problem-based learning and lecturing on the development of students' critical thinking. Med Educ 2006;40(6):547–54.
 22. Cónsul-Giribet M, Medina-Moya JL. Strengths and weaknesses of problem based learning from the professional perspective of registered nurses. Rev Lat Am Enfermagem 2014;22(5):724–30.
 23. Ceconi A. Influence of Problem-Based Learning Instruction on Decision-Making Skills in Respiratory Therapy Students. Seton Hall Univ Diss Theses ETDs [Internet]. 2006; Available from: <http://scholarship.shu.edu/dissertations/473>
 24. Dolmans DH, De Graaf W, Wolfhagen IH, van der Vleuten CP. Problem-based learning: Future challenges for educational practice and research. Med Educ 2005;39(7):732–41.
 25. Caffarella RS. Self-directed learning. New Dir Adult Contin Educ 1993;(57):25–35.
 26. Gwee MC. Globalization of problem-based learning (PBL): cross-cultural implications. Kaohsiung J Med Sci 2008;24(3 Suppl):S14–22.
 27. Srinivasan M, Wilkes M, Stevenson F, Nguyen T, Slavin S. Comparing problem-based learning with case-based learning: effects of a major curricular shift at two institutions. Acad Med 2007;82(1):74–82.

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