**Abstract**

**Background:** Problems posed in problem-based learning (PBL) cases used during pre-clinical teaching-framework are typically a set of descriptions of events in need of explanations and resolution. The objectives of this study were to analyze the problems in PBL cases aimed to suggest areas for improvement. **Methods:** It was a review of cases used in PBL in undergraduate medical curriculum at UKM Medical Centre. Problems in PBL cases were labeled as „Triggers” and „Patient Information Sheets” which were disclosed as prescribed in structured facilitators” guide. Six of the 10 PBL cases used in semester-1, session 2013-2014 were selected randomly for analysis. **Results:** Problems in 50% cases were overloaded and in 50% cases sequences of problem-disclosure were disorderly-labeled, though the flow of descriptions were alright. Averagely, 82% faculty-intended learning issues prescribed in facilitators” guide were connected with problems. Unconnected learning issues were the result of faculty directed teacher-centered approach of guidance, while important learning issues that could have been derived against problems were un-identified. **Conclusion:** Connectivity of average 82% faculty-intended learning issues with problems reflect as good quality of PBL problems in UKM Medical Centre. However, problem disclosers in disorderly-labeled fashion, unconnected and unidentified issues against some problems in spite of conducting a good numbers of faculty development workshops, raised the issue of needs of further research on standard of training workshops. Educational leaders should give due importance on professionalism and needs of high-quality training for faculty to enhance PBL skills either by utilizing and mobilizing existing properly trained faculty or by hiring appropriate trained faculty.

**Keywords:** analysis; problems (triggers); nature; sequence of disclosure; connectivity of learning issues

---

**Introduction**

Problem-based learning (PBL) has been used in many universities over the past 30 years as a learner-centred active learning approach. In basic science teaching frame work, PBL curricula uses problems in terms of paper-based case write-up to contextualize a real world scenario. Problems are typically a set of descriptions of events used to trigger discussion and probe resolution. Designing a PBL problem, three aspects need to be emphasized: i) degree of

1. Abdus Salam, Associate Professor and Chairperson of Medical Education and Quality Assurance, Asia Metropolitan University, Malaysia.
2. Mohamad Nurman Yaman, Senior Lecturer, Department of Medical Education, Universiti Kebangsaan Malaysia (UKM) Medical Centre.
3. Rahanawati Hashim, Associate Professor, Unit of Medical Education, International Medical School, Management and Science University (MSU), Malaysia.
4. Farihah Hj Suhaimi, Professor, Department of Anatomy, UKM Medical Centre.
5. Zaiton Zakaria, Professor, Department of Physiology, UKM Medical Centre.
6. Nabishah Mohamad, Professor, Vice President for Medical and Health Sciences Cluster, MSU. Authors 1, 3 and 6 were in Medical Education Department at UKM Medical Centre while this study was done

**Correspondence to:** Dr. Abdus Salam, Associate Professor and Chair, Medical Education and Quality Assurance, Asia Metropolitan University, Malaysia, E mail: abdussalam.dr@gmail.com
correctly structured, ii) extent to allow expected learning activities, and iii) extent of time and resources to work on.5,6 Dolmans et al.5 prescribed seven principles indicated that, the problem should i) stimulate real life, ii) lead to elaboration, iii) integrate knowledge, iv) encourage self-directed learning, v) fit in with students” prior knowledge, vi) interest to students, vii) reflect faculty objectives. A well designed problem acts as an impetus for students” learning. Students’ function also closely corresponds to teachers’ efforts to facilitate students” scientific literacy. Within PBL, the teacher referred as „facilitator” who is a guide, assists in trainees” development of skills in reasoning, hypothesis design, testing and self-evaluation.6 The PBL tutors must play a collaborative-facilitative role which is different from the role of a teacher in a traditional teaching format.7-9 Successful PBL requires a good interaction, asks students to be curious and willing to explore information.10 A good interaction depends on structure of problems, a foundational element of PBL besides teachers and students. Design of problems significantly influences students” learning and in fact this influence is higher than the influence by teachers” role and students” prior knowledge.12,14

The Universiti Kebangsaan Malaysia (UKM) Medical Centre introduced PBL in 1983 which has been a main integrated teaching-learning approach in undergraduate program since 2005.15 The UKM Medical Centre regularly conducts faculty development workshops to raise the standard of education. The Centre employs problems labeled/titled as „Triggers” and „Patient Information Sheets” (PIS), through which sequences of events for patients are disclosed progressively. Triggers are usually a small paragraph that highlights the clinical events and the four PISs in each case sequentially describes the detail history, clinical-examination findings, laboratory and other investigation results and management including progresses. Sometimes contents of two PISs are combined and sometimes fewer number of PISs are used where learning objectives are less. The problems are provided in packages of specific PBL cases along with a structured facilitator” guide to assists facilitators. There are not many studies conducted on design of PBL problems12 and limited studies on this attributes in Malaysia necessitates to investigate further on this aspect. The objectives of this study were to analyze the problems posed in PBL cases aimed to identify any lacunae and suggest areas for further improvement.

Materials and methods

It was a review of problems (Triggers and PISs) posed in PBL cases in preclinical setting of undergraduate medical program at UKM Medical Centre, Malaysia, session 2013-2014. The PBL facilitators were provided with packages of specific PBL cases a couple of days before the PBL session started. The package contained list of groups of students, problems labeled / titled as triggers and PISs, case specific relevant resources and a facilitators” guide with instructions. The facilitators” guide included a “three columns structured” guides headed by “Facilitator Activities”, “Reasoning/Discussion” and “Learning Issues” under each column to assist facilitators. The PBL packages were developed by a number of faculty members from various discipline based on specificity of problems and the learning objectives to be achieved. After consultations among the members, case writer design the problems, which were evaluated by the medical education expertise. All PBL facilitators were briefed on specific cases before they conduct the PBL session and were trained through a two-day PBL workshop earlier.16 Students” feedbacks were also sought at the end of each PBL case sessions. It is critically important to analyze the quality of any teaching method after its adoption,18 and as such the authors analyzed the problems posed in PBL cases in UKM Medical School in order to raise the standard of education.

The preclinical teaching frame work in the UKM Medical School comprised of four semesters. In each semester, approximately four modules were covered and 2-4 PBL cases were laid down under each module.19 Six of 10 PBL cases used in four modules during 1st semester were examined. Two cases were derived from „Cellular Biomolecules,” one from „Body Tissue,” two from „Membrane and Receptor” and one from „Metabolism” modules, selected randomly. The PBL cases were then coded as case-1 to case-6. The nature of problems in terms of content and labeling, sequences of problem discloser and whether faculty intended learning issues were connected with problems prescribed in the structured facilitator’s guide were analyzed. Learning issues those did not relate to contents of the problems were considered as faculty directed self-leaning (SDL) issues by traditional teacher-centered approach rather than self-directed learning (SDL) approach by students.

Results

Table-1 showed the distribution of semester-1 modules with PBL cases, number of faculty-intended
learning issues (LI) and problems (Triggers and PISs), sequence of problem disclosure, connectivity of LI with problems and author’s reflection. The number of faculty-intended learning issues against each PBL cases in the structured facilitators guide varied from 12-20. The sequences of progressive disclosure of problems in some case were consistent i.e. labeled and disclosed in an orderly manner while in others were not consistent. On an average, 82% faculty-intended learning issues prescribed in structured facilitators guide were connected with the contents of problems with a variation of 57%-100%. Table-2 showed an illustrative example of analysis of problems and learning issues prescribed in facilitators’ guide. This table illustrated that, important LI against some problems can be derived from the discussion of contents of those problems, but not prescribed in facilitators’ guide. On the other hand, LI prescribed in the guide against some problems, seems the results of traditional teacher-centered, subject-driven approach, being directed by teachers.

Table 1 revealed the distribution of semester-1 modules with PBL cases, number of faculty intended learning issues (LI), number of problems (Triggers and PISs), sequence of problem disclosure, connectivity of LI with problems and expert authors’ reflections.

| Modules & PBL cases | Nature of problems | Number of faculty-intended LI | Number of problems (Triggers & PISs) | Sequence of problem disclosure | Connectivity of LI with problems | Medical education expertise authors’ reflections |
|---------------------|--------------------|-------------------------------|--------------------------------------|--------------------------------|-----------------------------------|-------------------------------------------------|
| Cellular Biomolecules | Case-1             | 15                            | 1 Trigger with 4 PISs.               | -Trigger-1, PIS-1, 2,3,4         | 14 (93) 1 (7)                     | -No LI were identified, though a few more LI from PIS-1&2 could be. -1 LI from PIS-4 is DSL -Problems are overloaded as 15 LI already known and more could be from PIS-1& 2. |
|                     | Case-2             | 14                            | 2 Triggers with 3 PISs.              | -Trigger-1,PIS-1,2,3,4&Trigger-2 | 8 (57) 6 (43)                     | -No LI seen, although there could be few more LI derived from PIS-1 -6LLDSL throughout |
| Body Tissues        | Case-3             | 14                            | 1 Trigger with 4 PISs.               | -Trigger-1, PIS-1,2,3,4          | 11 (79) 3 (21)                   | -3 LI reflected as DSL throughout |
| Membrane & Receptors| Case-4             | 15                            | 3 Triggers                           | -Trigger-1,2,3                   | 15 (100) 0 (0)                   | -More (15) LI reflected content overloaded within the problems |
|                     | Case-5             | 12                            | 2 Triggers with 1 PL                 | -Trigger-1,2, PIS-1              | 12 (100) 0 (0)                   | -Less (12) LI with100% matching with problems reflected well design of PBL problems |
| Metabolism          | Case-6             | 20                            | 2 Triggers with 2 PISs.              | -Trigger-1,2, PIS-1,2            | 13 (65) 7 (35)                   | -Too many (20) LI reflected overload problems -7LI, DSL throughout |
|                     | Total              | 90                            | (11Triggers + 14 PISs)               | Consistent disclosure in some and not consistent in others | 73 (82) 17 (18) | -17 (18%) LI were from DSL by faculty rather than SDL by students |

DSL: Directed self-learning; SDL: Self-directed learning
Table 2 showed an example of illustrative analysis regarding connectivity of problems and learning issues prescribed in structured PBL facilitators’ guide

| Problems | Learning issues | Example of illustrative analysis |
|----------|----------------|----------------------------------|
| Trigger: (Case-1) | 1. What are the causes of non-healing sores? | The learning issues (LI) prescribed in the facilitator’s guide are connected with the prescribed problem (Trigger). |
| Mr Raja gopal, a 25-year old Clerk | 2. Describe the structure and function of hemoglobin (Hb). | |
| came to see you as a Medical officer at the hematology clinic, | 3. Relate Hb. to structure and function of red cells. | |
| complaining of sores in the leg | 4. Describe the causes of abnormal Hb structure | |
| which has not healed for the last 7 Years. He previously diagnosed | 5. Relate abnormal Hb. structure to anemia and non-healing sores. | |
| at a private clinic to have anemia due to abnormal haemoglobin when he was 9 years old | | |
| PIS-1: Past medical history (Case-1) | Important LI on recurrent pain, ulcer, siblings and marriage can be derived from the discussion of this problem (PIS-1), but not prescribed in guide. | |
| Since the age of 5 the patient has had recurrent joint pains. About 7 years ago, the patient developed an ulcer on his left leg. This lesion has never healed | Probable derived LI through discovery learning should be like: | |
| One of his sisters is severely affected while other two siblings appear well. Both parents are alive and well. | - How does recurrent joint pain relate in a patient with abnormal Hb? | |
| Social history | - What is ulcer, what are the causes of ulcer in left leg, how does ulcer relate with abnormal Hb? | |
| Marital status: bachelor but is getting married soon. | - How can severely affected sister and well siblings be explained? | |
| Trigger-1: (Case-6) | The LI prescribed in the guide against this problem (Trigger-1), seems traditional teacher-centered, subject-driven approach, being directed by teachers. | |
| Madam M, a 45 year-old female, CEO of a company, was advised by her colleagues to go for an executive health screening. She went to your clinic and upon examination you found that her weight was 85 kg and her height was 165 cm. | LI relate to this problem (Trigger-1) in true PBL approach to nurture reasons should be like: | |
| | 1. What is obesity and how do you classify it? [Explain BMI ] | - What is normal weight and height for a 45 year old female? | |
| | 2. What is Basal Metabolic Rate (BMR)? | - Was 85kg weight and 165 cm height normal for the 45 years old female? | |
| | 3. What are the causes of obesity? | - If not, what are the causes of over and underweight? | |
| | 4. What is the significance of waist measurement? | - What are terminologies used for over and underweight? | |
| | | - What are the mechanisms of over and underweight and how they measure? | |

Discussion

Too much content is a big problem in higher education. Schmidt & Moust specified that, problem-content should introduce a limited number of learning issues as students cannot handle too many topics at the same time; two or three major issues are sufficient within one problem to keep the students busy. Problem should triggers the discussion and its content leads to the development of learning issues. Higher number of learning issues (15-20) identified against case-1,4 and 6 in this study echoed the excess contents in these problems. Forcing students to handle a vast content will make their cognitive system overloaded and will make the learning burden; this will end up with feeling of frustration as they fail to master the topic to a reasonable extent even though they engaged in all kinds of learning activities for long hours of study. The PBL designers need to understand the PBL concept clearly and should look at the problem size with specificity, so that it will not end up with feeling of frustration. A well designed problem attributes of PBL help the students to develop their analytical skills and self-directed learning skills.
In 50% PBL cases i.e. case-2, case-5 and case-6, the progressive disclosure and labeling of problems were inconsistent, although the flow of contents was alright. Case-2 disclosed the problems following an order of Trigger-1, PIS-1, PIS-2, PIS-3 and Trigger-2. Case-5 disclosed as Trigger-1, Trigger-2 and PIS-1. Case-6 disclosed as Trigger-1, Trigger-2, PIS-1 and PIS-2. While in rest of the 50% cases, a consistent sequence of labeling and disclosure of information were maintained. In case-1 and case-3, the problems were disclosed as labeled Trigger-1 followed by PIS1 to 4 to contextualize with real world scenario. In case-4, the problems were disclosed labeled as Trigger-1 followed by Trigger-2 and Trigger-3 without any PISs. In both the situations i.e. cases-1 and 3 and case-4, the problems were disclosed consistently or systematically. Doing things in organized or systematically is a prerequisite to accomplish the task efficiently. Classroom environments were most effective when contents were purposeful and delivered in an organized way. Disorderly and unorganized environment makes teaching-learning difficult. For effective learning, educators should follow a system approach. The number of problems may vary depending on the level of student and amount of learning outcomes to be achieved. But the problems should be labeled and disclosed logically. Problem should be disclosed either labeled first as trigger then PISs as in case 1 and 3 or labeled as triggers only as in case 4. Jones indicated that much misunderstanding and confusion exists on PBL. Fifty percent of the problems posed in PBL cases in this study disclosed with disorderly labeling assumed that problem designers were confused with PBL concept which support to Jones. Asian medical educators need to have a clear understanding of PBL process, philosophy and practice in order to be able to improve the educational outcomes that can be derived from a PBL curriculum.

Averagely 82% connectivity of faculty-intended learning issues against the problems prescribed in structured facilitator’s guide reflected a good quality of problem design. Structured facilitators’ guides were also good guides; to our knowledge many universities do not use this guide which they can actually introduce for guiding the facilitators. Unconnected 18% learning issues were reflected as contents expert faculty directed self-learning (DSL) issues rather than self-directed learning (SDL) issues by students. The DSL issues were consistent with Dolmans et al. report, where it was mentioned that content expert tutors tend to provide more information as they were already aware of the topic. Mindset of many facilitators still in teacher-centered mode while PBL demands a move towards student-centered instruction. There was no learning issues projected in the structured facilitators guide against PIS-1 and 2 of case-1 and PIS-1 of case-2, although a few important learning issues could have been derived from these problems. An exemplary illustrative analysis of learning issues with problems has shown in Table-2. This finding leads to assume that facilitators need to be skilled in problem facilitation too. The most dominant factors that affected PBL were the quality of problems and teachers’ skills in problem processing. Facilitators should probe students’ discussion within the context of problems. Designing a PBL unit is not as simple as planning a traditional instructional unit. Selecting and designing cases are the two key challenges faced in implementing PBL. Poor design and lack of information in the „Trigger”, „the Tutors Guide” or „Patient Information Sheet” and discrepancy between faculty and students objectives were the problems associated with PBL cases; inadequacy in solving these problems can cause frustration among facilitators and students. The present study also showed some inadequacy in problem design with scope of further improvement.

Faculty members are the scholarly talent of medical schools and faculty development activity should be an integral part of an institution to ensure the standard of education. In UKM Medical Centre, the facilitators were supplied with facilitator guides to help them in conducting PBL session. A total of 200 faculty development workshops were conducted in UKM between year 2005 and 2008 to train faculty. In spite of conducting such a good number of workshops, progressive discloser of problems in disorderly labeled fashion in 50% cases and un-projected important learning issues against some problems in structured facilitators’ guide suggested the needs of future research on standard of trainings workshop done. High quality facilitator training is a fundamental aspect of high quality care. Facilitators must have quality training based on critical evaluation of educational theory. Problems should arouse situational interest that drives learning. Training of faculty is not too easy and the quality of training depends on the system in place. Any faculty developmental training programme requires adequate resources in terms of man, money and materials with their proper utilization. Professionalism and leader ship of educational leaders in ongoing faculty.
development workshops must be ensured by proper utilization and mobilization of appropriate existing trained faculty or by hiring appropriate trained faculty to enhance the skills the trainees needed. It is of utmost important to ensure the standard of training workshop and thereby ensure a sustainable organizational development towards the development of competent and confident future leaders.

**Conclusion**

The connectivity of average 82% faculty-intended learning issues against problems prescribed in structured facilitators’ guide represents a good quality PBL problem at UKM Medical Centre. Structured facilitators’ guide used, also a good guide that not many universities used. However, progressive discloser of problems in disorderly labeled manners, content-overload, un-projected important learning issues and faculty directed self-learning issues against some problems were identified as areas for improvement. Despite conduction of a good numbers of PBL faculty training workshops, such areas of gaps raised the needs of future research on standard of training workshop. Much emphasis needs to be given to keep higher number of connectivity of learning issues aligned with problems against each individual case. The problems should progressively disclose, labeled in an orderly manner in all cases. Leaders in educational organization should give due importance on professionalism and standard of faculty development workshop either by utilization and mobilization of appropriate existing trained faculty or by hiring appropriate trained faculty. This is of utmost important to ensure a standard training process and thereby ensure a sustainable organizational development towards the production of competent and confident future leaders. This study investigated the problems posed in PBL cases confined in one school. Further large scale studies including other schools is suggested.

**Acknowledgement**

We acknowledged UKM Research and Ethics Committee to approve this research grant with code: PTS 2012-083.

**References**

1. Savery JR. Overview of Problem-based Learning: Definitions and Distinctions. *Interdisciplinary Journal of Problem-Based Learning*. 2006;1(1).
2. Colliver JA. Effectiveness of Problem based learning Curricula: Research and Theory. *Academic Medicine*. 2000;75:259-266.
3. Sockalingam N, Rotgans J, Schmidt H. Assessing the Quality of Problems in Problem-Based Learning. *International Journal of Teaching and Learning in Higher Education*. 2012; 24(1):43-51.
4. Marin-Campos Y, Mendoza-Morals L, Navarro-Hernandez JA. Students’ assessment of problems in a problem-based pharmacology course. *Advances in Health Sciences Education*. 2004;9:299-307.
5. Dolmans DHJM, Snellen-Balendon H, Wolfhagen IHAP, van der Vleuten CPM. Seven principles of effective case design for a problem-based curriculum. *Medical Teacher*. 1997;19(3):185-189.
6. Mohamad N, Chen R, Isahak I, Salam A, Siraj HH,
Das S. Developing skills in problem-based learning facilitation: An insight. *International Medical Journal*. 2010;17(2):103-106.

7. Salam A, MohdNasri AB, Mohammad Arif K, Nabishah M. Classroom audit: student self-performance, group performance, and tutor performance in a problem-based learning tutorial. *ASEAN Journal of Teaching and Learning in Higher Education*. 2011;3(1):28-35.

8. Das M, Mpofu DJ, Hasan MY, Stewart TS. Student perceptions of tutor skills in problembased learning tutorials. *Medical Education*. 2002;36:272-278.

9. Charlin B, Mann K, Hansen P. The many faces of problem-based learning: a framework for understanding and comparison. *Medical Teacher*. 1998;20:323-330.

10. Salam A. Problem-based learning: an educational strategy for interactive learning: experience from UniversitiSains Malaysia. *Medical Teacher*. 2004;26(3):279.

11. Azer SA. Problem-based learning Challenges, barriers and outcome issues. *Saudi Med J*. 2001;22(5):389-397.

12. Sockalingam N, Rotgans J, Schmidt HG. Student and tutor perceptions on attributes of effective problems in problem-based learning. *High Educ*. 2011;62:1-16. DOI 10.1007/s10734-010-9361-3

13. Van BerkelHJM, Schmidt HG. Motivation to commit oneself as a determinant of achievement in problem-based learning. *Higher Education*. 2000;40:231-242.

14. Gijselaers WH, Schmidt HG. Development and evaluation of a causal model of problem-based learning. In *ZH Nooman, H.G., Schmidt, & E.S Ezzat, (Eds.). Innovation in Medical Education: an Evaluation of its Present Status*. 1990. New York: Springer Publishing Co.

15. Chuan TY, Rosly NB, Zolkipli MZB, Wei NW, Ahamed MABB, Mustapha NAB, Salam A, Zakaria Z. Problem-Based Learning: With or Without Facilitator? *Procedia Social and Behavioral Sciences*. 2011;18:394-399.

16. Salam A, Mohamad N, Siraj HH, Latif AA, NirwanaSoelaiman I, Baharuddin HO, Wan Ngah WZ, Norhayati M. Challenges of problem based learning. *South East Asian Journal of Medical Education*. 2009;3:54-60.

17. Salam A. Issues of Objective, Content, Method and Assessment in the Development of a Relevant Curriculum in Medical Schools. *Berita MMA news*. 2010;30(4):22-24.

18. Schmidt H, Moust J. Designing problems. In *van Berkel, H., Scherprier, A., Hillen, H., van der Vleuten, C. (Eds), Lessons from Problem-Based Learning*. 2010. New York: Oxford University Press.

19. Miller Debbie. *Teaching with Intention, Defining Beliefs, Aligning Practice, Taking Action*, Stenhouse, 2008, Portland, Maine.

20. Salam, A. Input, Process and Output: system approach in education to assure the qualityand excellence in performance. *Bangladesh Journal of Medical Science*. 2015;14(01):1-2.

21. Jones RW. Problem-based Learning: Description, Advantages, Disadvantages, Scenarios and Facilitation. *Anaesthesiology and Intensive Care*. 2015;34(4):485-488.

22. Nabishah M, Farihah HS, Das S, Salam A, siti MB, Mohammad AK, Harlina HS, & Wan Zurina WN. Problem-based learning facilitation: new challenges to higher education educators. *International Medical Journal*. 2009;16(4):243-246.

23. Munshi FM, El ZayatElSAA & Dolmans DH. Development and utility of a questionnaire to evaluate the quality of PBL problems. *South East Asian Journal of Medical Education*. 2008;2(2):32-40.

24. Krajcik JS, Blumenfeld PC, Marx RW, Soloway E. A collaborative model for helping middle school science teachers learn project-based instruction. *The Elementary School Journal*. 1994;94:483-497.

25. Gwee MC. Globalization of problem-based learning (PBL): cross-cultural implications. *Kaohsiung J Med Sci*. 2008;24(3 Suppl):S14-22.

26. Angeli C. Teachers’ Practical Theories for the Design and Implementation of Problem Based Learning. *Science Education International*. 2002;13(3):9-15.

27. Salam A, Mohamad N, Siraj HH, ArifKamaruddin M, NurmanYaman M, Mariam Bujang S. Team-based learning in a medical centre in Malaysia: Perspectives of the faculty. *The National Medical Journal of India*. 2014;27(6),350.

28. Schmidt HG, Rotgans JI, Yew EH. The process of problem-based learning: what works and why. *Medical Education*. 2011;45(8):792-806. DOI: 10.1111/j.1365-2923.2011.04035.x

29. Mohamed AL. Future Challenges in Medical Education. *Bangladesh Journal of Medical Science*. 2010;9(1):4-11.

30. Khan MI. Towards the preparation of highest quality medical professionals. *Bangladesh Journal of Medical Science*. 2010;9(3):116-123.

31. Rashid ARA. Continous Professional Development And The Pharmaceutical Industry- Education Or Marketing? *Bangladesh Journal of Medical Science*. 2013;12(1):5-9.