

Original article

Analysis of Problems Posed in Problem Based Learning Cases: Nature, Sequence of Disclosure and Connectivity with Learning Issues

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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

*Bangladesh Journal of Medical Science Vol. 17 No. 03 July'18. Page : 417-423
DOI: <http://dx.doi.org/10.3329/bjms.v17i3.36997>*

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

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correctly structured, ii) extent to allow expected learning activities, and iii) extent of time and resources to work on.³⁻⁵ 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 problem¹¹-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,¹⁶ 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.¹⁶ 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 disclosure 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-learning (DSL) 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		Sequence of problem disclosure	Connectivity of LI with problems		Medical education expertise authors' reflections
	Number of faculty-intended LI	Number of problems (Triggers & PISs)		Yes n (%)	No n (%)	
Cellular Biomolecules Case-1	15	1 Trigger with 4 PISs.	-Trigger-1, PIS-1, 2,3,4 -Problem disclosed with consistent labeling as trigger followed by PISs	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.
	14	2 Triggers with 3 PISs.	-Trigger-1,PIS-1,2,3&Trigger-2 -Problem disclosed inconsistently, first trigger then PISs and trigger again	8 (57)	6 (43)	-No LI seen, although there could be few more LI derived from PIS-1 -6LI,DSL throughout
Body Tissues Case-3	14	1 Trigger with 4 PISs.	-Trigger-1, PIS-1,2,3,4 -Problem disclosed consistently, first trigger then PISs	11 (79)	3 (21)	-3 LI reflected as DSL throughout
Membrane & Receptors Case-4	15	3 Triggers	-Trigger-1,2,3 -Problem disclosed labeling an order as trigger 1, 2, 3 without any PISs	15 (100)	0 (0)	-More (15) LI reflected content overloaded within the problems
	12	2 Triggers with 1 PI.	-Trigger-1,2, PIS-1 -Problem disclosed inconsistently, first trigger-1, than 2 and then PIS-1	12 (100)	0 (0)	-Less (12) LI with 100% matching with problems reflected well design of PBL problems
Metabolism Case-6	20	2 Triggers with 2 PISs.	-Trigger-1,2,PIS-1,2 -Problem disclosed inconsistently	13 (65)	7 (35)	-Too many (20) LI reflected overload problems -7LI, DSL throughout
Total	90	25 (11 Triggers + 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
<p>Trigger: (Case-1) Mr Raja gopal, a 25-year old Clerk came to see you as a Medical officer at the hematology clinic, complaining of sores in the leg which has not healed for the last 7 Years. He previously diagnosed at a private clinic to have anemia due to abnormal haemoglobin when he was 9 years old</p>	<ol style="list-style-type: none"> 1. What are the causes of non-healing sores? 2. Describe the structure and function of hemoglobin (Hb). 3. Relate Hb. to structure and function of red cells. 4. Describe the causes of abnormal Hb structure 5. Relate abnormal Hb. structure to anemia and non-healing sores. 	<p>The learning issues (LI) prescribed in the facilitator's guide are connected with the prescribed problem (Trigger).</p>
<p>PIS-1:Past medical history (Case-1) 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</p> <p>One of his sisters is severely affected while other two siblings appear well. Both parents are alive and well.</p> <p>Social history Marital status: bachelor but is getting married soon.</p>	<p>No learning issues prescribed in structured facilitators' guide</p>	<p>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.</p> <p>Probable derived LI through discovery learning should be like: -How does recurrent joint pain relate in a patient with abnormal Hb? -What is ulcer, what are the causes of ulcer in left leg, how does ulcer relate with abnormal Hb, -How can severely affected sister and well siblings be explained?</p>
<p>Trigger-1: (Case-6) 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.</p>	<ol style="list-style-type: none"> 1. What is obesity and how do you classify it? [Explain BMI] 2. What is Basal Metabolic Rate (BMR)? 3. What are the causes of obesity? 4. What is the significance of waist measurement? 	<p>The LI prescribed in the guide against this problem (Trigger-1), seems traditional teacher-centered, subject-driven approach, being directed by teachers.</p> <p>LI relate to this problem (Trigger-1) in true PBL approach to nurture reasons should be like: -What is normal weight and height for a 45 year old female? -Was 85kg weight and 165 cm height normal for the 45 years old female? -If not, what are the causes of over and underweight?= -What are terminologies used for over and underweight? -What are the mechanisms of over and underweight and how they measure?</p>

Discussion

Too much content is a big problem in higher education.¹⁷ Schmidt & Moust¹⁸ 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.¹⁸ 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.¹⁸ 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.^{7,18}

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.¹⁹ Disorderly and unorganized environment makes teaching-learning difficult. For effective learning, educators should follow a system approach.²⁰ 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. Jones²¹ 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 curriculum²².

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.⁷ 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 mode¹⁸ while PBL demands a move towards student-centered instruction.^{6,23} 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.²⁴ Facilitators should probe students' discussion within the context of problems. Designing a PBL unit is not as simple as planning a traditional instructional unit.²⁵ Selecting and designing cases are the two key challenges faced in implementing PBL.²⁶ 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.²⁷ In UKM Medical Centre, the facilitators were supplied with facilitator guides to help them in conducting PBL session.²⁴ A total of 200 faculty development workshops were conducted in UKM between year 2005 and 2008 to train faculty.⁶ In spite of conducting such a good number of workshops, progressive disclosure 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,⁷ facilitators must have quality training based on critical evaluation of educational theory.¹⁶ Problems should arouse situational interest that drives learning.²⁸ Training of faculty is not too easy²⁹ and the quality of training depends on the system in place.³⁰ Any faculty developmental training programme requires adequate resources in terms of man, money and materials³¹ with their proper utilization. Professionalism and leadership 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 disclosure 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.

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