Objective structured brainstorming questions (OSBQs) in PBL tutorial sessions: Evidence based pilot study

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ABSTRACT

The fact that faculty tutors do have different backgrounds and specialty has been a concern as a factor that contributes to disparity in the delivery of brainstorming session outcomes. This paper aims to introduce **a road map** in the form of a set of focused objective structured questions **(OSBQs)** for tutors to follow in brainstorming.

Methods

Objectively structured questions were generated by the block planning committees.
A pilot study was conducted from February 2008 – March 2009 and included groups (44 students) of second and third year undergraduate students of the Faculty of Medicine, King Fahad Medical City. Four indicators were considered to check the validity of the proposed OSBQs; (i) feed back on the perception of medical students experiencing different types of tutorial sessions, (ii) learning objectives achieved under both systems, (iii) student's performance under the OSBQs and the unguided tutorials and (iv) proper utilization of the time allocated to brainstorming sessions.

Results

The student's perception of their satisfaction of implementation of OSBQs was unanimous. Student's performances were much better in blocks implementing OSBQs. The time allocated for brainstorming sessions was efficiently utilized with the introduction of OSBQs.

Conclusion

Implementation of OSBQs leads to standardization of tutorial sessions and allows more interaction between students to achieve their learning objectives and score better in their exams. Concern over the role of tutors will diminish.

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Introduction

Problem-based learning (PBL) is a student centered process in which students assume responsibility for their own learning. Both content and process of learning are emphasized in PBL. Different approaches to implement PBL in many medical schools have evolved during the past 30 years and yet the essential elements of the process remained relatively unchanged (1).

Medical schools all over the world follow different undergraduate curriculum intake policy. The two major types of medical schools are those which enroll only graduates with a B.Sc. degree or equivalent and the other enroll high school graduates with a diploma. Tremendous variation exists across medical schools in the type of medical curricula and amount of health education students receive (2,3). Curriculum design in PBL schools takes into consideration important issues such as the level and background of students admitted and the duration of the school years (4,5).

PBL is a method of learning in which students encounter problems or cases that are designed to encourage students to explore ideas, find resources, share knowledge and think logically during tutorial sessions. PBL is not about problem solving per se, but rather it uses appropriate problems to increase knowledge and understanding (1,4).

Curriculum planning, design and implementation is usually concerned primarily with identifying learning objectives in advance through scenarios and clinical cases that lead students towards achieving those learning objectives (4,6).

The learning process in PBL is clearly defined and despite several variations that exist all follow the same path. PBL typically involves certain predictable steps. The seven jumps introduced by the McMaster (2004) is one of the processes followed by many PBL schools (2,6).

The first session referred to as brainstorming session at which a group of students sit together and work through a problem (case) usually follows the following steps: identifying problem; exploring pre-existing knowledge; generating hypothesis and explaining mechanisms and unfolding the case by identifying learning objectives. The process is facilitated by a faculty tutor whose role has been defined to guide the process without contributing directly to the solution of the problem or being the primary source of information (7,8).

Among the important roles of the tutor is helping students to explore pre-existing knowledge related to the problem under discussion and also helping them to integrate multiple perspectives and basic scientific principles.

The fact that faculty tutors do have different background and specialty has been a concern as one of the factors that contribute to disparity in the delivery of brainstorming session outcome.

The tutor role is to facilitate the process by encouraging all students to contribute equally (7,8) and asking specific stimulating open ended questions. A subject specialist becomes a good tutor with proper tutor-training and is more likely to direct the process efficiently in his area of expertise as valued by students (9,10,11). On the other hand, a tutor whose specialty is outside the scope of the presented case becomes passive and usually leaves the students unguided thorough brainstorming. Many tutors are not certain what relevant specific stimulating, probing and clarifying questions to be asked in areas out of their specialty. This is very much noticed when comparing the learning issues identified by different groups of students of the same class.

During the progressive disclosure and discussion of a case, students in the absence of an effective guidance of a tutor skip or jump over exploring pre-existing knowledge and start identifying learning issues failing to bridge for linking pre existing knowledge to new knowledge (12).

Curriculum activities and teaching methods in PBL schools promote interactivity. The roles of the teacher as tutor and the student as learner exist in a complex system in which both are transformed by questioning and by seeking understanding(3).

No PBL medical schools follow standardized road map to guide all tutors to ensure that all small group classes have been through similar process of sharing, applying, and synthesizing prior and new knowledge leading them to reach the same learning objectives. Small group classes are usually dismissed from brainstorming session, once they specify the educational learning objectives, regardless of the process involved which arouse concern on how sessions are conducted (10,12).

Many educators recommended that non-expert tutors, in particular, should prepare by getting familiar with the content of the problem scenario (9,13,14,15). However, the role of the tutor, especially in medical schools which enroll high school graduates, should be reconsidered and guidelines to be established that lead to a standardized and guided role by all tutors regardless of their background or experience (9).

The objective of this paper is to introduce (***a road map***) in a format of objective structured brainstorming questions **OSBQs** as a standardized process for tutors to follow in brainstorming sessions to override the inconsistencies introduced by the tutor specialty or expertise. This approach will ensure that all students in different groups have been through the same process exploring their pre-existing knowledge linking it with the basic underlying principles and mechanisms of the problem under investigation.

Methods

The following is a model how to construct and implement the proposed OSBQs. The first problem in a block on ***GROWTH AND DEVELOPMENT*** in the undergraduate curriculum of the Faculty of Medicine at King Fahad Medical City is the following case scenario:

"*Mrs. Nadia and her husband are newly married couple who came to the primary health center (PHC) because Mrs. Nadia has missed her period for 2 weeks. Her pregnancy test was positive. Last week, she visited her family physician complaining of headache."*

The learning objectives set up by the planning committee are:

1. *To know the process of spermatogenesis, oogenesis, ovarian and menstrual cycles.*
2. *To be able to demonstrate knowledge about fertilization, implementation and accompanying hormonal changes.*
3. *To recognize some pregnancy risk factors.*
4. *To know health care services provided to pregnant women in PHC.*

Construction of OSBQs:

Management:

A major goal of the tutorial process is to generate questions that lead to the acquisition of new knowledge that builds upon and connects with existing one. This tutorial process of generating questions should be managed and standardized by the block planning committee to ensure that the tutors with different backgrounds deliver equally the process to students in different groups.

Curriculum design and implementation need to address the existing variations in tutor backgrounds and student's backgrounds and ensure that by the end of the brainstorming sessions all students are exposed to the same process.

Subject matter expert will construct and list a number of open-ended questions on different topics indicated in the learning objectives. Therefore, construction and generation of OSBQs in the problem will furnish enough stimulation for the students in the brainstorming session to

identify their existing knowledge and what they are supposed to know more about the subject. Each learning objective is facilitated by a set of objectively structured questions aimed directly to explore the student existing knowledge and what they need to learn in order to advance their understanding and unraveling of the problem.

Let us take the first learning objective: ***"To know the process of spermatogenesis, oogenesis, ovarian and menstrual cycles"***

The following is a list of OSBQs covering the first objective aimed to stimulate students to embark on discussing the problem at hand:

1- In which organs do spermatogenesis and cogenesis occur?

2- How germ cells (sperm & ova are produced in the human body?

3- How meiosis differ from mitosis?

4- What determines the sex of an individual?

5- Describe the main events of the menstrual cycle in a female.

6- Discuss the anatomy and physiology of the testes.

7- Name the endocrine glands involved in maintaining the sex characteristics and the hormones produced by each in both sexes.

8- Describe the anatomy and physiology of the ovaries.

9- What you know about the ovarian cycle?

10- Describe how the ovarian and uterine cycles are related.

Implementation:

The proposed OSBQs will serve as **a check list**. The role of the tutor is to monitor the progress of discussion in the brainstorming session and crossing off from the check list points raised by the students. The tutor will intervene, when necessary, guided by OSBQs from the checklist.

Pilot study

A pilot study was conducted from February 2008 – March 2009 and targeted second and third year undergraduate students of the Faculty of Medicine, King Fahad Medical City.

Four indicators were considered to check the validity of the proposed OSBQs in an undergraduate medical curriculum; (i) feed back on the perception of medical students experiencing both unguided and the standardized OSBQs tutorial sessions, (ii) learning objectives achieved under different systems, (iii) students performance under the two systems and (vi) proper utilization of the time allocated to brainstorming tutorial session.

Second year (59) and third year (38) students from the Faculty of Medicine, King Fahad Medical City were briefed in the last week of the first semester (January 2009) about the objectives of the study and were encouraged to participate. However, only 22 students from year 2 and another 22 students from year 3 agreed voluntarily to be interviewed, using a constructed questionnaire, for their perception of the unguided and OSBQs brainstorming sessions.

The percentage concordance between learning objectives achieved by students and the set of objectives determined by the block planning committee was estimated for six small group tutorial classes using OSBQs in one block and five small group unguided tutorial sessions in another block.

The performance of students in blocks studied under the two systems were compared and analyzed between groups and within group. The results were statistically analyzed using the X^2 test.

The duration of the brainstorming session in small group classes running under different systems were monitored over a period of eight weeks.

Results

Third year students (2007/2008 class) and second year students (2008/2009 class) were called separately for a meeting where they were briefed about the study and were invited to participate by answering a related questionnaire. Twenty two students from the 2007/2008 class (57.9% response) and twenty two students from the 2008/2009 class (37.3% response) agreed to take part in the study.

Table 1 shows dissatisfaction of students in unguided tutorial sessions, and they relate this to the role played by tutors in brainstorming sessions. The students unanimously (question 9) welcome any process that standardizes implementation of the tutorial process between small groups.

Table 1. Student's response to the management of brainstorming sessions (BSS) in PBL classes.

	QUESTION	YES	
		(%)	No.
1	Is BSS time tutor dependant? (*Is the time spent by each tutor in any tutorial session fixed?)*	40.9	18
2	Do you think the tutor management of BSS depends on his specialty?	84.1	37
3	Do you think the tutor management of BSS is consistent from a problem to a problem?	15.9	7
4	Do you think the tutor is asking stimulating open ended questions?	29.5	13
5	Do you wish to join another group because they benefit more from their tutor?	84.1	37
6	Do you wish to join another group because the group is more interactive?	90.9	40
7	Do you believe that all small group classes are going through the same process of brain storming or following a standardized session?	29.5	13
8	Do you prefer that all small groups in your class are exposed to a standardized process in the form of objectively structured BS questions?	100	44

Number of students interviewed = 44

The percentage of student derived learning objectives relative to the learning objectives set up by the block planners was determined in two blocks studied by the same group of students; one managed by unguided brainstorming tutorial and compared with the outcome of a block implementing OSBQs. Students are usually divided into small groups of 8–10 students working together through specific problems to reach the learning objectives. The results show that 56–85 % of the learning objectives are matching in case of unguided sessions, whereas 80–100 % concordance was achieved after implementing the OSBQs, Table 2.

Table 2. Percentage of concordance between students derived learning objectives and block planners set up objectives in different brainstorming tutorial settings.

Tutorial session	# of small group classes*	Range of concordance	Percentage
Unguided	5	65-85	72
OSBQs	6	80-100	90

** Refers to the number of problems per block*

The performance of 2007/2008 and 2008/2009 classes who studied the same block on growth and development but under different tutorial systems was very much different. Table (3) shows statistically significant increase in the percentage of all over success rate from 65 to 87. The increase was more than four fold in grade D and about two fold in grade B. The shift in grades suggests that the newly implemented OSBQs process has helped below average students and also average students.

Table 3. Comparison between performances of 2007 and 2008 classes with reference to the end of the GROWTH block scores.

Tutorial session	Number* and percentages of students/grade									
	F**		D**		C		B**		A	
2007/2008 Class (unguided)	13	(34.2%)	4	(10.5%)	10	(26.3%)	8	(11.0%)	3	(7.9%)
2008/2009 Class (OSBQs)	8	(13.6%)	18	(30.5%)	13	(22.1%)	17	(28.8%)	3	(5.1%)

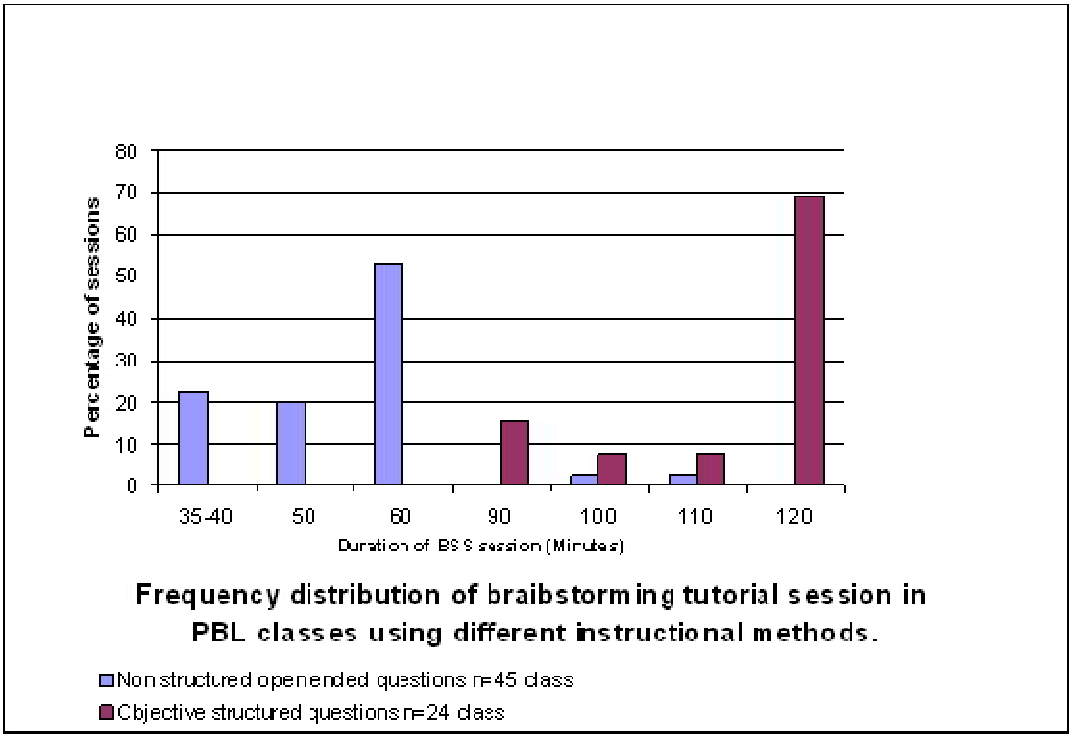
** Total number of students in 2007/2008 class = 38, Total number of students in 2008/2009 class = 59*
***P <0.001*

The performance of the 2007/2008 class in blocks studied in the second semester of year 2 was assessed. Students studied the following blocks in one semester; principals of diseases, haemopoitic system and musculoskeletal system in that order. The first two blocks were managed as unguided tutorial whereas the third block was managed using OSBQs checklists. The majority of students showed a notable improvement in the block implementing the OSBQs compared with unguided blocks. About 60% of the students scored higher grades in the musculoskeletal block administering the OSBQs whereas 40% of the students either maintained the same performance or got lower grades in the other two blocks, Table 4.

Table 4. Comparison of student's performance in a block implementing OSBQs tutorials with the average of TWO other blocks implementing unguided open ended questions.

Number of students in 2007/2008 class = 38
% of students who scored a higher grade in OSBQs block = 59.3
% of students who scored the same grade in all blocks = 22.3
% of students who scored a lower grade in the OSBQs = 18.5

Monitoring the actual time of brainstorming tutorial session shows that about 50% of unguided classes took 60 minutes and about 40% took less time. Tutorial classes following the standardized OSBQs took much longer time where about 70% of the classes took two hours and 30 % took more than 90 minutes, Fig. 1. These results suggest that students spent more time in understanding, discussing and solving the presented problem.



Discussion

PBL is a student self-directed learning approach in contrast to the traditional teacher centered approach. However, both systems have standardized well specified curriculum, management and assessment tools. The curriculum committee in any PBL medical school defines the problems, the learning objectives, the tutorial settings, the resources, activities and methods of evaluation and assessment. All mentioned activities and processes are standardized and all students go through and experience them. However, the role played by tutors as facilitators in small group sessions has introduced a significant factor in the standardization of the learning process. The brainstorming session remains the only loose ring in the chain of the learning process that is left to a significant variable besides the one resulting from distribution of students of the same class into small groups (9,11).

The background of the tutor is a serious concern. Different studies addressed this point and came to different conclusions (7,9). The role of the tutor in brainstorming sessions is influenced by his specialty and this in turn will affect the out come of the learning process. A subject matter expert acting as a tutor is generally considered as a poor PBL facilitator; however he is valued by students more likely to direct the process efficiently in his area of expertise (10,11).

The tutor whose specialty is outside the presented case may play a passive role leaving the students unguided to reach learning objectives. This is very much noticed when comparing the learning objectives identified by different small groups of the same class. In many cases block coordinators resolve the differences in achieved learning objectives by exchanging the outcome between small groups. Implementation of OSBQs would undoubtedly eliminate or significantly reduce this variability as indicated from this study (16).

In many cases, because of the tutor background, his role to help students to discover what they know and to explore their current knowledge or take students to the edge of their learning is disputed (9,11,13,14,15). Many tutors are not certain what specific stimulating, probing and clarifying questions to be asked in areas outside their specialty (9,11.13). Inferences of the disputed role of tutors are expressed directly in the interview of the student's perception of the role of the tutor. The majority of students expressed their concern with regard to disparity in the role of the tutor. All students welcome equalization between small groups of the class in terms of following similar learning settings and processes. Introduction of a road map of OSBQs as guide lines for all tutors will account for their different background and experience and ensures a higher degree of standardization of the learning process.

There is always a risk of letting a student group wander off topic from the point of view of the tutorial content which leads to diminished group performance and is regressive to group function. To recognize that the students are on track, the tutor needs to have sufficient content understanding of the basic principles under discussion to recognize what students should be discussing. To maintain an ideally functioning tutorial group, the tutor needs to be supported by tightly written objectives and appropriate focused questions (OSBQs) for each problem making it easy for the tutor to ask focused questions which relate to the learning objectives and place the students to an appropriate area of inquiry. In this capacity, the tutor is a facilitator of learning, guiding students from one path to another.

Implementation of the proposed OSBQs would also reduce the anxiety between students trying to join the more interactive groups with the more skilled tutor. The goal and objective of introducing a new process is to improve the learning environment as measured by better student's performances. Our results, yet preliminary, demonstrate a significant improvement in the grades of blocks implementing the OSBQs compared with other blocks following the unguided tutorial sessions.

In many scheduled time tables, brainstorming session is allocated 2-3 hours. However, in practice, different groups spend only

a fraction of that time inside the class. The objectives of interaction, exploring existing knowledge and bridging this with what is expected to acquire are not fully achieved. In this study, the majority of the classes used to spend only half the time allocated for this session.

The practice of these OSBQs in the brainstorming sessions has substantiated a proper learning environment aimed at in small group sessions. Assuming about 40 OSBQs are listed in the check list; this will engage the students for 2-3 hours in active participation and discussion which fits with the expectation from conducting and experiencing brainstorming sessions. The abundance of the OSBQs will motivate every student in the group to participate and hence to be assessed properly. Provided these OSBQs are administered by all tutors in different classes, an environment of equal participation in a standardized process should be achieved.

All indicators referred to in this pilot study suggest a profound and significant improvement to the process of PBL through standardization of a very important procedure and reduce disparity related to the background and skills of tutors. However, it must be emphasized that tutors should not refrain active student groups from pursuing their discussions and knowledge exploration beyond the scope of the predetermined OSBQs, but to encourage and facilitate this effort.

Conclusion

Implementation of PBL in different medical schools has to be monitored for pitfalls and outcome of the process. Whenever feasible, correcting measures need to be introduced, and such move should be encouraged to reach the final goal of a valid and accredited process. The proposed OSBQs can undoubtedly help to guide brainstorming sessions in a standardized way and at the same time does not change the tutor role as a facilitator. The outcome of the pilot study leads to these conclusions: (i) standardization of one major step in PBL management and process delivery has been achieved, (ii) implementation of OSBQs encourages students to spend more time discussing and interacting with each other and with their tutor, (III) students are more satisfied with the newly proposed OSBQs, (iv) students are likely to perform and achieve better grades in blocks implementing OSBQs, (v) concern over the diversity of the outcome in brainstorming sessions would diminish.

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