

Proposed model of case based learning for training undergraduate medical student in surgery

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Abstract

Background Systematic surveys of undergraduate medical education have cautiously supported the outcomes of Problem Based Learning (PBL) compared with traditional learning. This article provides a critical overview of PBL, its limitations in the developing country scenario and our proposed model of PBL triggered by Real cases, to address these limitations.

Aim Our hypothesis was to see whether the proposed CBL model would work in Indian set up in comparison with traditional teaching.

Methods We followed a modified Barrow's Model.. A tutor selected a real case and created a problem scenario which was progressively disclosed to students, and learning issues were raised.

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In session 2 students presented self studied learning issues. The process was evaluated throughout with feedback from students and faculty.

Results We were successful in establishing CBL. Study group (n=57) students scored better in SAQ((short Answer question) and EMQ((extended matching question)) assessment, (Mean study 21.15+/- 4.0565, control 18.5357+/- 3.8632 , n=56, p value 0.01.) Students appreciated it as good learning activity

Statistical design SAQ and EMQ, are compared in study vs. control groups by unpaired 't' test & also by equivalent non-parametric Mann-Whitney test

Conclusion The training of doctors is too important an activity for bold experiments to be conducted without discovery what really happens. We had success in establishing Case based learning with faculty of almost all departments participating in the project as Resources. Although size of sample is small, CBL is found to be an effective modality of imparting medical education with effective integration of all departments.

Keywords Problem based learning · Case based learning · Self directed learning

Introduction

Problem based Learning (PBL) can be defined as learning resulting from intellectual processes involved in understanding and resolving problems. PBL is a method of education that is based on active learning in small groups, with clinical problems serving as a stimulus for learning. It uses like the adult learning theory which is shown to have a greater effectiveness for acquisition of basic knowledge and clinical skills [1].

Concern with rigidity and over-emphasis on memorizing of large volumes of information in medical education is a known phenomenon. In PBL, problems are primarily used as vehicles to stimulate learning, and students approach the problems without specific prior preparations, forcing them to use their existing knowledge base.

PBL is being used in medical training for over 30 years. It originated at McMaster University in Hamilton Ontario, Canada during the 1960s and was adopted as the learning approach at the medical faculty of the University of Limburg in Maastricht, Netherlands [2]. PBL methodology is currently used in more than 80% of medical schools across the United States and Canada [3]. It is even implemented in African Medical schools and Singapore [4] and Latin America [5]. Currently, Barrow's Model [6] is followed the world over.

This article provides a critical overview of PBL, its effectiveness, claimed advantages, results, limitations and our proposed model to address these limitations.

Claimed Advantages of PBL

The strengths of PBL lie in its emphasis on team work, the fostering of long-term memory and provision of a framework that sustains lifelong learning. The concept of PBL implies increased attention to qualitative aspects of the learning process [7].

Students' learning is characterized by either a 'deep' or a 'surface' approach. For instance when reading a text, those with a surface approach focus on the text itself, trying to remember it, whereas those with a deep approach focus on the message conveyed by the text, trying to understand the meaning of it. PBL might be regarded as a way of getting a larger proportion of the students to use a 'deep' learning approach [8].

Evidence Surrounding PBL

Systematic surveys of UG medical education cautiously supported the short term and long term outcomes of PBL compared with traditional learning [9, 10, 11].

Six reviews of PBL have been published in the past decade.

- Norman and Schmidts' [12] found that students taught with PBL curricula were superior in knowledge retention but inferior in overall knowledge and competence when compared with students taught by traditional curricula.
- Vernon and Blake [3] concluded that PBL students' attitudes, class attendance and mood were better than those of students from traditional teaching institutions.
- Albanese and Mitchell [13] reported similar findings.
- Colliver concluded that, although some studies show marginal outcome advantages for students educated

with PBL, there is no evidence of educational superiority to the extent one might expect given the resource-intensive nature of the PBL curriculum [1].

- The review by Nandi et al [14] in the same year, concluded that PBL students consistently find their course more enjoyable and demonstrated better interpersonal skills compared with traditionally trained students.
- In the most recent review, conducted by Newman in 2003 [15] indicated that PBL students report greater satisfaction and employ more productive approaches to study. However, in terms of knowledge accumulation and practice-based outcomes, results from the articles analyzed were mixed, with some showing benefits for PBL students and others indicating benefits for traditionally taught students.

Limitations of PBL (Our situation):

Problem based sessions often deal with videos, at best, and at worst, with case histories and laboratory data as a trigger point.

The following limitations of PBL were recognized by us:

1. The quality of teacher is a critical factor that is understated by proponents of PBL. An excellent teacher can captivate large groups with highly relevant and exciting deliveries, and there is nothing to suggest that such teaching is less effective, stimulating and encouraging than PBL based teaching.
2. Through PBL, students will have only bookish knowledge and this will not help them in their day to day practice as doctors.
3. Typical PBL does not include faculty from other departments
4. PBL does not include clinical skill Training

The limitations specific to a developing country like ours are.

1. A classical PBL would not be able to utilize the large number of patient available in a medical college like ours.
2. At the end of a days learning, a student requires some direction which can easily be given to him by an experienced clinician who has formed his opinion based on valuable practice of many years. In a developing country like ours most work is not published and thus not directly available. This formed opinion is important as western texts cannot adequately address the needs of a student in a developing country which has a different disease scenario. Plus the practical limitations in our country make it difficult to follow standard investigation protocols outlined by the west.

We propose here our modification of the PBL. As our modification will use Real Clinical cases as trigger points, hence forth it will be called as Case Based Learning (CBL).

Materials and Methods

A draft proposal of the present educational research project was presented to the College Council and to the Dean of our medical College Pune. Permission from the Institute's Ethical committee was obtained.

Faculty workshops/discussions were conducted in order to train the 50 faculty as Facilitators and resource personnel.

Three lecturers and three Chief residents of the department were trained to work as Facilitators. For the purpose of training, all post graduate students in the department were taken as a student group and they completed four CBL cases for training. The facilitators were trained in creating case based scenario using standard format available online at various university web sites [16, 17]. In addition they were trained in Formative assessment of CBL process and Evaluation of IPA (Individual process assessment).

A Study group of 57 students, (Batch I: 27 students, Batch II: 30 students) were recruited from III MBBS 8th Term. Additionally 55 students, (Batch III: 28 students, Batch IV: 27 students) of the same class acted as Control.

All students who had completed 6 weeks of clinical clerkship were taken for analysis. All students posted in first author's Unit were taken as the study group and those posted in the other surgical Unit as control. These students were posted as part of the normal curricula. Students were trained in the CBL process for one week before they were handed over to the tutors. Two CBL cases were taken for training them.

One session was taken by first author to train them in the principles of CBL, adult learning and small group dynamics. They were introduced to the concepts of group dynamics, stages like forming, norming, storming and performing.

Six groups were formed of 8–10 students each. Students named their groups:

- Batch 1 (Surgeons incorporated, Surgeons of choice and Dedicated surgeons)
- Batch 2 (Shinning sun, Shushruta, and Einstein).

They elected their chairman, co-chairman, writer and scribe. Initiation was done in a ceremonial manner and loud declaration of the group forming was done. This setting procedure was followed for both the batches. Groups were encouraged to interact outside the classrooms and develop emotional bonds which facilitated sharing, caring and performing. It was found that forming of student groups plays an effective role in implementing CBL.

Modifications were made in protocol depending upon tutor evaluation and CBL process evaluation. The students' feedback was taken into consideration for constant improvement. As per their feedback, clinical skill training was added and during CBL process all students were given demonstration of clinical examination while their clinical findings were confirmed by the tutor.

Evaluation

Student Evaluation

1. Process Evaluation of CBL

- Every participating student was formatively evaluated at the end of first, fifth CBL and at the end. (Queens University Format) [17]
- Evaluation of Tutor in a standard format was done (Queens University Format) [17]. <http://meds.queensu.ca/medicine/pbl/pblhome.htm>

2. Evaluation of IPA (Individual process assessment)

The major foci of this evaluative format are: Application of knowledge content to clinical reasoning process, acquisition and interpretation of data, resources and skill in organization of material. Students were evaluated for this domain with Concept mapping. Students were given topics for creating concept map. The same topic was given to one student from study group and one from control group.

3. Evaluation of Cognitive Domain

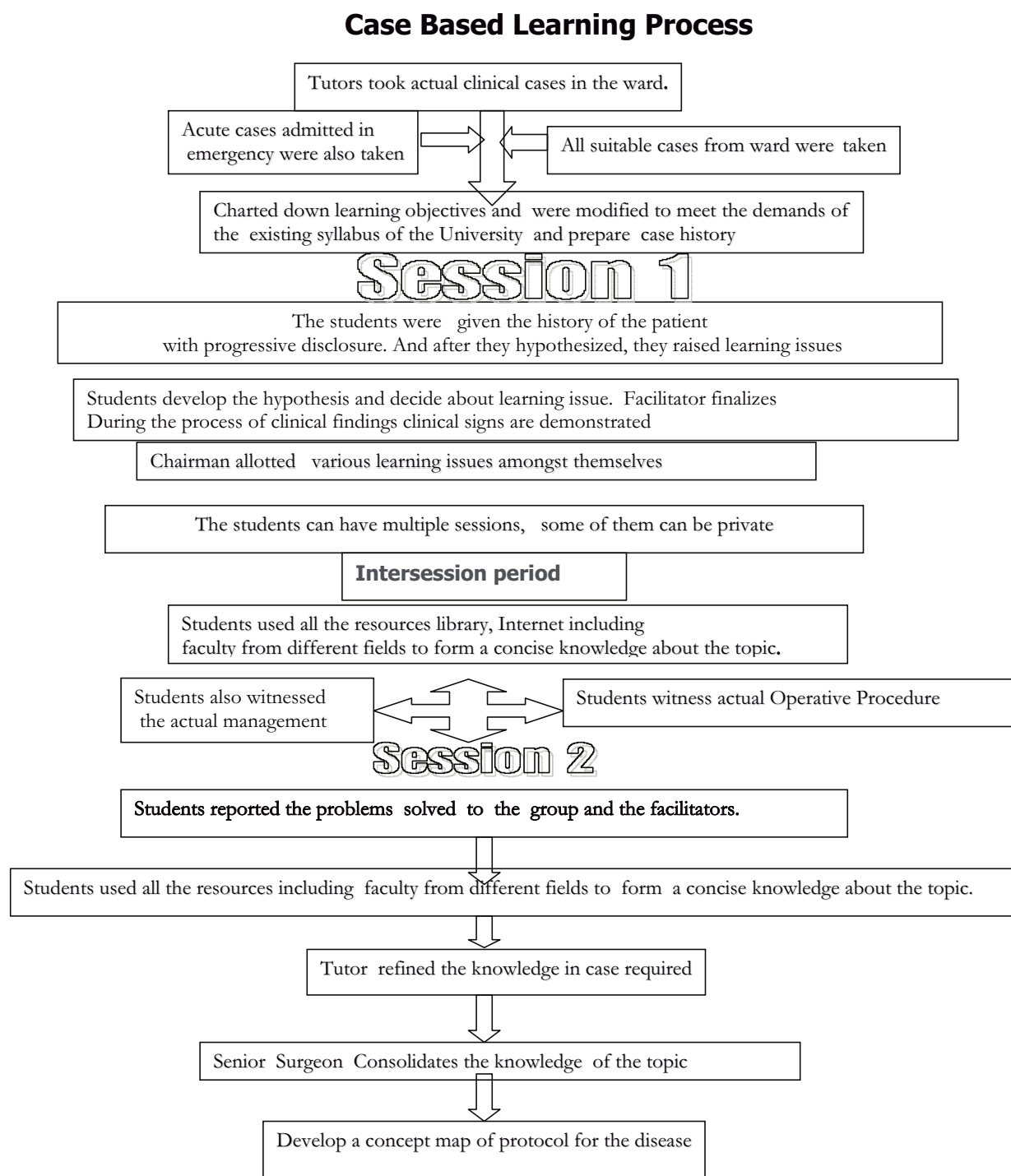
The students were evaluated with specifically designed complex SAQs (short answer question) and Clinical EMQs (extended matching question), keeping in mind the learning Objectives of the CBL cases. The evaluation was done for both, control and study groups.

4. Evaluation of Student Perception

At the end of the term, all students participating in the clinical project, answered a self administered questionnaire with Likert scale, about how this new teaching method is useful, is acceptable and whether it has improved their clinical reasoning skills, self-learning skills, and overall whether it has increased their competence and has motivated them to learn.

5. Faculty Perception about the program

Faculty gave feedback about whether teaching is facilitated; teaching time is reduced, whether faculty endorses the new teaching program and whether CBL model is feasible in other clinical branches.

Table 1 Case based learning in surgery**Results**

- We were successful in establishing Case-based learning with faculty of almost all pre-clinical, para-clinical and clinical departments participating in the project as Resources and Facilitators. Additional members were super-specialists and experts in fields from outside the institute. Total 25 faculty members participated in the study.
- Total 18 CBL cases were completed by students. Total 432 learning issues were raised.
- Students from study group scored better in SAQ and EMQ evaluation. This evaluation is directed towards cognitive domain that is acquisition of knowledge.

Table 2 Marks obtained by Students of Study group and Control group in SAQ and EMQ with statistical analysis

PARAMETE	STUDY GROUP			CONTROL GROUP			‘t’	P’ value	Mann-Whitney test statistic	‘P’ value & Statistical Significance
	‘n’	mean	SD	‘n’	mean	SD				
SAQ	57	3.4561	1.6698	55	2.7273	1.2088	2.6380	0.0095, Highly Significant	1967.5	0.0172, Significant
EMQ	57	18.4912	3.7087	55	17.6364	3.6381	1.2310	0.2210, Not Significant	1802.0	0.1706, Not Significant
TOTAL	57	21.9474	3.8749	55	20.3636	4.3392	2.0390	0.0438, Significant	1920.0	0.0396, Significant

Table 3 Scores obtained by Study group and Control Group in Concept Map by Novak’s Method

Particular	Study Group	Control Group
‘n’	48	48
Geometric Mean (of marks based on structural method)	82.7370	73.9605
G.S.D.*	1.5635	1.5045
‘t’ value, P value & Statistical Significance	1.2836, 0.2024, Not Significant	
Mann-Whitney test statistic, P value & Statistical Significance	921.5, 0.0906, Not Significant	

*G.S.D. = Antilog of S.D. of log transformed marks

Total marks obtained by the study group as compared to the control group were statistically significant both by paired ‘t’ test and Mann-Whitney test (Mean marks study group 21.15+/- 4.0565, control group 18.5357+/- 3.8632, p value 0.01¹⁸).

- Only 48 matched concept maps created by students were available for study. , The concept maps were analyzed by Novak’s Method.¹⁹ The score was high in study group but variation of score was high and the data was not significant statistically. Concept map analyses students ability of self learning, assimilation and analytical capacity.
- Students appreciated the CBL process tremendously. They gave feedback that they accept this teaching method as valuable learning activity and it has improved their clinical reasoning skills, increased their competence and motivated them to learn.
- Students gave feedback that it is very time consuming and that clinical skills are not taught. However it is student friendly but had apprehension that it may not help for their traditional examination.
- The Whole project produced great awareness about Case-based learning and many batches of students posted in the department wanted to have education by CBL even when the project was over, they were willing to come outside hospital hours for the sessions.

Faculty feedback

The faculty was not uniform in their feedback. Some were very proud to be a part of a new modality of education. They

said that it is not possible to evaluate the students when they are exposed for a small period to CBL and rest of the time to traditional method. They felt this education model had stimulated the students to have more active involvement in overall patient management. And that they find students are discussing more with others than after a lecture. Faculty, however, endorsed this model of education (CBL method) as worth trying in other clinical branches but did not agree that teaching time is reduced by CBL method. Only 10 out of 25 faculties recruited were approached by students.

Discussion

It has been argued that the CBL approach satisfies assumptions underlying the adult learning theory and thus facilitates a greater understanding and integration of the basic and clinical sciences. It improves retention and recall of information, fosters life long self-directed learning skills, encourages and strengthens hypothetico-deductive reasoning and hence prepares students better for their future as medical practitioners students determine their own level of ignorance and according to cognitive learning theory of David Ausubel “The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly” [20].

Students using traditional case studies can only rely on the information with no ability to interact with individuals involved in the scenario or to request clarification to better understand the context of the problem. Also, the text book scenario may not adequately depict the problem in a

Table 4. Student Feedback of Perception On Case Based Learning in Lickert Scale

Item	Median Class	Median (actual as calculated)	95% Confidence Interval	Inference : inclusion of '4' in CI indicates non-significance
CBL method has improved my clinical reasoning skills. And clinical competence	6	6.41	6 to 7	*
CBL method requires too much of time and is not worth All the efforts	4	4.25	3 to 5	Not Significant
The concept of CBL method of education is interesting	6	6.65	6 to 7	*
CBL method has developed positive attitudes towards medical education resulting in increased satisfaction with the course.	6	6.10	4 to 6	Not Significant
CBL method has trained me in self learning skills	6	6.46	5 to 6	*
I find I was discussing more with others than after a lecture	6	6.33	5 to 7	*
CBL method is a valuable learning activity	6	6.30	6 to 7	*
I have better skills of gathering information , organizing them and store in usable form for future use	5	5.89	5 to 6	*
After CBL method I have better presentation skills	5	5.64	4 to 6	Not Significant
CBL method has motivated me to learn	6	6.50	6 to 7	*
CBL process enabled you to access a greater variety of resources	6	6.50	6 to 7	*
I find that the CBL process has changed the way I study	5	5.50	4 to 6	Not Significant
CBL process enabled you to develop a good relationship with my teachers	6	6.94	6 to 7	*
Overall during our discussion faculty I approached was very helpful and the discussion has helped me in learning	5	6.00	4 to 6	Not Significant
CBL method is useless for our traditional examination pattern	4	4.4375	2 to 5	Not Significant
I find myself sharing knowledge with my colleagues and there by inculcating positive competitive spirit	6	6.07	5 to 7	*
I have better interpersonal skills in terms of Listening, Giving, and receiving criticism etc	6	6.46	5 to 7	*
I have ability to accept and work with students of different background.	7	6.33	5 to 7	*
A senior surgeon consolidated the knowledge at the end of session II is a good idea	5	7.00	7 to 7	*
I learn accepting CBL method as teaching method and should be utilized for MBBS course		5.73	5 to 6	*

* Significance (at 5%) i.e. Median response for this item is significantly different than just a neutral response [21]

way that a student can ultimately relate it to a real world situation. A medical student, for example who has learnt diagnostic skills through a text based scenario may be at loss when confronted with a real world patient [20].

To best of our knowledge, this is the first time a pilot project based on case based learning has been undertaken in India. The most defining feature of the CBL curriculum was its student directedness. Except for the selection by faculty of patient cases to promote acquisition of essential knowledge, skills, and behaviors, students decided the remainder (with the guidance of their small group tutors). Students also determined what they needed to know, as well as the resources, they should use to gather the pertinent information. Out of the III MBBS students, 57 who undertook teach-

ing as per our CBL Programme showed statistically significant results in performance evaluated by EMQs, SAQs and concept map evaluations.

CBL can undoubtedly encourage useful discussion among highly motivated students who already understand the factual background. The limitation of our study is the small group of our students, limiting the significance which could be applied to our results of evaluating the study and control groups of the Programme.

We are trying to modify Barrows Model of PBL [6] suitably to suit to the Indian Conditions. We encourage Medical Educators in India to apply this model.

The subsequent and arguably the most important work of studying the outcome of medical education is yet to be

Table 5 Faculty feedback form for perception and their Experience of Case Based Learning

Faculty Feedback questions	Median Class	Median (actual as calculated)	95% Confidence Interval	Inference : inclusion of '4' in CI indicates non-significance
In your opinion whether students had nicely prepared the topic and were clear about what they wanted from you	5	5.5	4 to 6	Not Significant
CBL method has improved the teaching and learning is facilitated	4	4.0	4 to 6	Not Significant
It is not possible to evaluate the students when they are exposed for a small period for CBL and rest of the time on traditional method	6	7.0	4 to 7	Not Significant
CBL method has developed positive attitudes in students towards medical education resulting in increased satisfaction with the course	4	4.9	4 to 6	Not Significant
By CBL method I feel that teaching time is reduced	2	2.25	1 to 4	Not Significant
I find students are discussing more with others than after a lecture?	6	6.083	4 to 7	Not Significant
This model of education(CBL method)adopted is worth trying in other clinical branches	6	6.4375	5 to 7	*
This model has produced integration of thoughts to modify the curriculum	5	5.5	4 to 7	Not Significant
By CBL method student-teacher interaction has improved	6	6.3333	5 to 7	*
CBL method is useless for our traditional examination pattern	3	4.0	2 to 6	Not Significant
This model of education has stimulated the students to have more active involvement in overall patient management	6	6.20	4 to 7	Not Significant
CBL Method has produced awareness about the teaching in other departments are related subjects	5	5.5	4 to 6	Not Significant
I endorse this method of teaching for MBBS Course	5	5.83	4 to 7	Not Significant
Student have reported that the method is too much time Consuming	4	4.90	4 to 7	Not Significant

* Significance (at 5%) i.e. Median response for this item is significantly different than just a neutral response [21]

done, that of examining the performance of graduates in practice. The medical education establishment desperately needs studies that examine the skills that really count – the ability to care for the patient in a knowledgeable and compassionate way.

Conclusion

The training of doctors is too important an activity for bold experiments to be conducted without knowing what really happens. We had success in establishing Case-based learning with faculty of almost all preclinical, para-clinical and clinical departments participating in the project as Resources. Student-centered Case-based Learning is found to be an effective modality of imparting medical education with effective integration of all departments.

Orienting students before actual CBL process is very important. They should be taught about adult learning principles and small group dynamics. This improves student motivation and fosters better interaction amongst them.

The size of our sample is small, hence further studies are required. This will stimulate medical colleges in the developing world to use it.

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