

Original Research Article

Effectiveness of Case Based Learning in First MBBS Students in Physiology: an Educational Strategy to Promote Clinical Diagnostic Reasoning

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ABSTRACT

Objectives: In the present study relatively new approach, Case-based learning (CBL) was used to teach physiology a basic science. The aim was to assess the effectiveness of case-based learning in the first MBBS students. The objectives were to develop interest, motivation for learning physiology & to enhance comprehension, reasoning skills & retention of knowledge in the students.

Methods: Mixed method study was conducted in the department of Physiology. 138 students were examined after traditional teaching & case-based technique by MCQs, pretest & posttest respectively. Scores of the two tests were compared for students' comprehension. Students & faculty feedback evaluated the teaching method using Likert scale. Retention of knowledge was assessed after one month using MEQ. Paired t test & one sample test were used to analyze differences.

Results: The student's performance in MCQ tests was statistically significantly better after CBL (Mean± SD, 10.00735 ± 1.964486) than after traditional teaching (Mean± SD, 7.698529 ± 2.168187) (Paired t test, *p*- value of < 0.05). Mean± SD of MEQ was 5.937984 ± 2.108398, (*p* value < .25 as compared to CI). In students feedback 99% considered CBL more informative and motivating session. 96% agreed that CBL encourages active learning, develops communication & teamwork skills. 84% acknowledged that it develops clinical reasoning, attitudes & interpersonal skills. Facilitators' feedback stated CBL useful for developing interest, improving understanding & clinical reasoning of the students.

Conclusions: Students performance & strong preference for CBL inferred more modules of CBL should be implemented in medical education.

Keywords: Case based learning (CBL), Multiple choice questions (MCQs), MEQ's (modified essay questions), Clinical reasoning.

INTRODUCTION

The student's attitude towards their learning plays an important role in determining the outcome of any educational new effort. It determines the degree of excellence, expanse of education and the learning point of view of the students. [1]

Medical and health care related education is currently undergoing transformation. Since the arrival of adult education, educators have become fully aware that learners need to see the importance and be deliberately, positively involved in the topic under study. [2,3]

Current drift in medical education is a shift from teacher centred submissive learning environment to student centred energetic, positive learning. [4] The Medical council of India has framed the learning process for graduate medical education which incorporates case studies and problem-oriented approach as well as introduction of horizontal and vertical integration throughout the UG curriculum. [5]

Learning is consisting of many interconnecting elements of a experience as it involves composite mental activities such as capacity to resolve the difficult situation and analytical thinking. The aim for the acquisition of knowledge or skills through system of methods with organized human resources is to provide the students to develop with the best learning devices available. So that, they in turn can have in-depth comprehension of cognition and appropriate circumstantial skills of their career. [6] As a part of its accreditation standards there should be encouragement of the rise in analytical thinking and ability to solve problems reinforced through implementation type activities. [7,8] It means that relevant circumstances (environment or classroom activities) of the learner are the controller for the learning to occur. [7]

Medical Council of India also uplifts learner centric attitudes. Various methods are used by many institutes to reinforce lectures in teaching medical education for undergraduate students. These are case based learning, problem based learning and patient centred learning. [9,10] One of such approach is CBL (case-based learning) where the students learn with the help of case scenarios and are actively engaged to solve a problem to attain the learning objectives. CBL is known to transmit analytical skills and ability to solve real medical problems in the students. [11,12]

CBL is the method of learning not perceptibly different from PBL (problem-based learning) but without patient exposure & in a protected environment. [13] Thus, the CBL is defined as learning that is based

upon the description of a health problems faced by patient, scrutiny and understanding of all the related facts obtained from past events, exploration, systematic examination and organizing the further management of the patient. [14] It includes many distinct & unique characteristics of adult learning like dynamic engagement of learners, communication with community, instructors and colleagues input, exchanging information, observational learning, clinical reasoning and organized action, information about reactions and creating a learning together environment, leading to active construction of knowledge. [15]

In CBL the faculty formulates the case scenarios and students discuss the case in small groups and attempts to arrive at a solution using the knowledge gained from previously taught curricular content. CBL has been shown to impart early clinical exposure, assist students to link clinical conditions to basic sciences and develop clinical reasoning, improve students score, enhance communication skills and galvanise the students towards self-directed learning. [16]

In CBL the faculty expresses the case scenarios in a concise way and students discourse the case in small groups, explore & analyse it and makes an effort to reach to solve the problem using the facts, information & skills acquired through experience gained from previously taught subject content. CBL has been shown to foster exposure of the medical students to the patients as early as the first year of medical college. It aids students to connect observable conditions of a disease to fundamental sciences and develop strategies to gather & analyse patient information. It also enhances students score; strengthen the process of exchanging, creating & sharing information skills. It motivates the students towards making their own decisions & organizing their own work rather than being told what to do by teachers. [16]

The objectives of the present study were to develop the interest and motivation in first year MBBS students for learning

physiology, to assess effectiveness of CBL in teaching by comparing pre-test & post test scores of MCQs, to assess the retention of knowledge by MEQ'S (modified essay questions) & to analyse the feedback from students and faculty about the perception and effectiveness of CBL method.

MATERIALS AND METHODS

The present qualitative & quantitative (mixed method), prospective, interventional, educational and cohort study was conducted in the department of Physiology, in D Y Patil Medical College, Kolhapur. The present study was approved by the ethical committee of the institute. The sample size was 148. The study populations were the undergraduate students of first MBBS. The study was carried out in 10 weeks.

Inclusion Criteria:

All first MBBS students who voluntarily gave the informed consent were included for the evaluation of performance difference.

Completely & correctly filled questionnaire responses were included.

Exclusion Criteria:

Incompletely or incorrectly filled responses were excluded.

After the ethical committee clearance for the CBL intervention, 5 topics were selected, cases were constructed, and faculty of Physiology was trained. MCQ's and feedback questionnaire for students and the faculty were designed, they were prevalidated and validated.

Before intervention counselling of the students was done. Informed written consent was obtained from first MBBS students who were willing to participate in the study.

All 148 students were taught by traditional method on one topic which was followed by MCQ pre-test in order to elicit their base line knowledge about the given topic. [9] Next day the students were divided into small groups of 16 with one facilitator for each group. CBL session was conducted wherein they were presented with a case scenario. The case scenario included the

clearly written symptoms and signs related to the topic. Adequate time was given for case discussion and solving the Specific Learning Objectives by the students. This was followed by MCQ post-test. The faculty from other Preclinical departments attended the CBL session as observers. Lastly feedback was taken from the students, facilitators & observers.

The feedback survey was based upon 12 questions which were analysed by 4-point Likert Scale and expressed in percentages. Each question was rated as 1= strongly disagree, 2= disagree, 3=agree and 4= strongly agree. The participants were exposed to the questions regarding the perception about the CBL. After one-month retention of knowledge was assessed by MEQ's.

STATISTICAL ANALYSIS:

Quantitative data was analysed using SPSS version 23. Descriptive statistics were used to describe the results for quantitative variable i.e. means & standard deviation (SD). Students' examination performance: MCQs Pre & Post Tests were compared by Paired Sample t test & MEQ analysed by One Sample Test. p - value < 0.05 was considered as significant.

For qualitative data i.e. the perception of the students & faculty about CBL method were obtained through the questionnaire. Students & faculty feedback was analysed by 4-point Likert Scale and expressed as percentages.

RESULTS

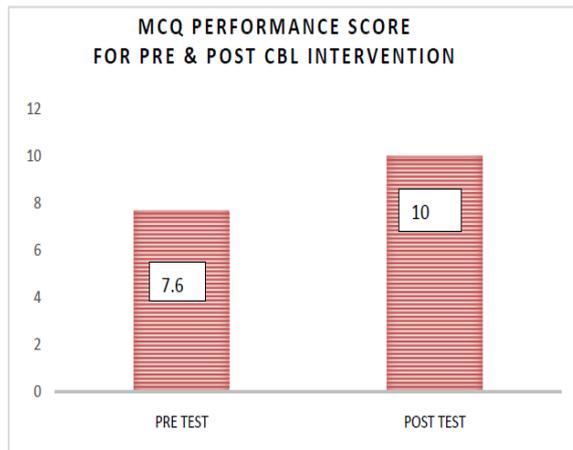
Students examination performance like MCQ's pre and post-test was analysed by paired sample 't' test.

Mean± SD of MCQ Pre - test was 7.698529±2.168187

Mean± SD of MCQ Post - test was 10.00735±1.964486

(Difference in means was 2.309121)

The paired sample test for both showed a highly statistical significance ($p=0.0001$) Graph No-1.



Graph 1-

The statistical analysis of students feedback by 4 point Likert scale (Table -1) showed that percentage of students agreeing (agree & strongly agree) for most of the questions posed to them was in the range 85 to 99 % . The maximum scoring was for questions 4, 8 & 11- stating that clinical case was in context of the system taught currently followed by questions stating that CBL methodology was useful for them to improve the knowledge & generating new ideas in relation to the topic in human physiology.

Table -1 Percent score of students' feedback after CBL

SR NO	QUESTIONNAIRE	STRONGLY DISAGREE (%)	DISAGREE (%)	AGREE (%)	STRONGLY AGREE (%)
1	Method used in teaching (CBL) in physiology was enjoyable?	1.54	0.00	37.69	60.77
2	I developed interest in topic	0.00	0.77	34.62	64.62
3	I was attentive throughout the class	0.77	1.54	42.31	53.85
4	Method stimulated me to think on that topic and generated new ideas	0.00	4.62	38.46	55.85
5	I actively participated in the group discussion	0.77	2.31	57.69	39.23
6	I freely exchanged my ideas/thoughts with group mates	0.77	2.31	43.08	53.08
7	My angle of thinking diversified due to discussion with my group mates	1.54	12.31	37.69	47.69
8	Facilitators were supportive in clearing the doubts regarding the topic	0	0	28.46	71.54
9	Interactive session was useful for better understanding of the topic	0	0.77	39.23	59.23
10	It helped me to solve the questions confidently	0	4.62	45.38	49.23
11	This method will help me in applying the knowledge in my clinical practice	0	0	23.08	76.92
12	I would like more topics to be covered by this method	1.54	0.77	26.92	70.00

Table-2

One-Sample Test MEQ -Modified essay question						
	Test Value = 5					
	t	df	Sig. (2-tailed)	Mean Difference	75% Confidence Interval of the Difference	
					Lower	Upper
MEQ	1.963	128	0.052	0.3023	0.124	0.48
p = 0.05 is significant.						

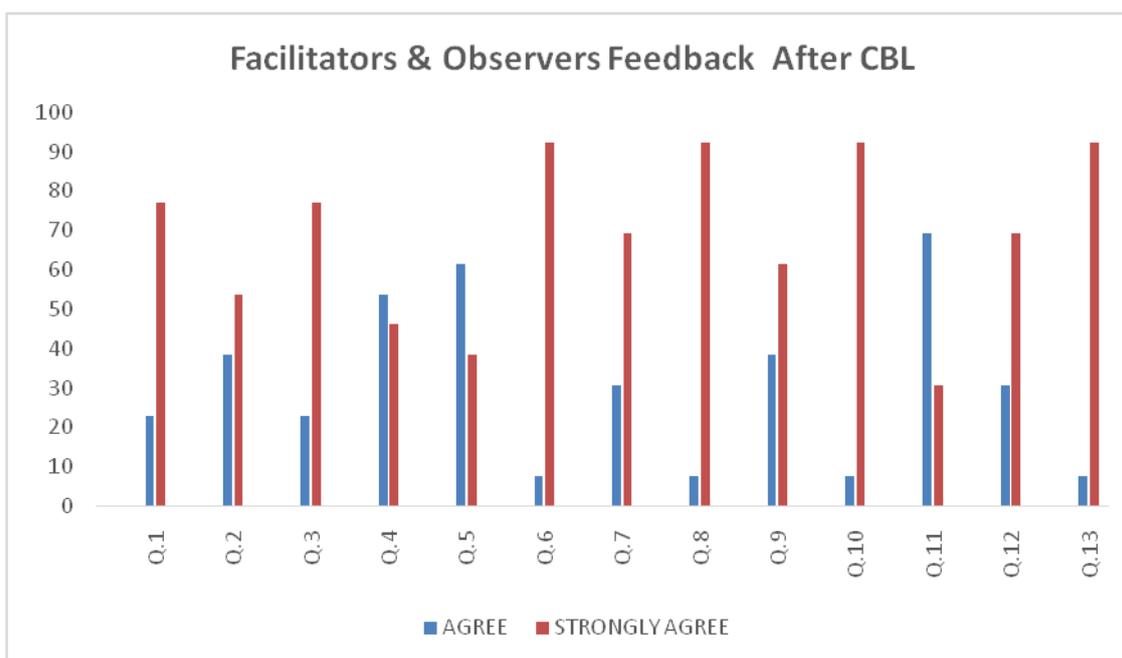
MEQ was analysed by one sample test. Mean± SD of MEQ was 5.937984 ± 2.108398 (p value < .25 as compared to Confidence Interval).(Table -2)

One sample test showed highly statistical significance p=.0001

The descriptive statistical analysis of facilitators & observers by 4 point Likert scale (Table - 3, Graph 2) showed that percentage of faculty strongly agreeing for most of the questions posed to them was in the range 38 to 92 % . The maximum scoring was for questions 6, 8, 10 & 13 stating that all of them agreed it as a useful method for developing interest, improving understanding & clinical reasoning of the topic.

Table -3 Facilitators & Observers Feedback after CBL

Sr.No	Questionnaire	Strongly Disagree(%)	Disagree (%)	Agree (%)	Strongly agree(%)
1	Students enjoyed the CBL session.	0	0	23.08	76.92
2	Students actively participated in group discussion.	0	0	38.46	53.85
3	It gave opportunity to cooperate with other students & improve communication skills.	0	0	23.08	76.92
4	Students were stimulated to think & generated lot of new ideas.	0	0	53.85	46.15
5	Students were attentive throughout the class	0	0	61.54	38.46
6	It gave students more freedom to learning.	0	0	7.69	92.31
7	Students understanding of the topic was better.	0	0	30.77	69.23
8	Students developed interest in the topic.	0	0	7.69	92.31
9	Students were motivated to solve the problems on that topic.	0	0	38.46	61.54
10	Role of teacher as facilitator is important in this method.	0	0	7.69	92.31
11	Students solved the problems confidently.	0	0	69.23	30.77
12	More topics can be covered using this method.	0	0	30.77	69.23
13	CBL method is student & activity oriented style of teaching.	0	0	7.69	92.31



Graph- 2

DISCUSSION

Many universities have shown that CBL could be conducted as a teaching module in basic sciences courses. [1] Our study used a case-oriented format to promote this teaching method. Out of 148 students, those who were absent for any of the test (pre-test, post-test or MEQ test) were exempted from the study. Also, the incomplete feedback responses were excluded for the analysis. So, 130 students represented the final study sample.

In our study 96% of the students enjoyed, developed interest & were attentive during the CBL session. [4] 94% of the students thought that the CBL method stimulated them to think on that topic & were happy to generate new ideas. [2] Such

innovative learning methods need to be a priority in teaching and learning methodologies.

99% of students considered CBL more informative, good learning experience and motivating session as compared to traditional teaching. Students accepted that cases taught posed challenging questions that helped them develop analytical and critical thinking which was more than other studies. [1,2,9,17-19] 98% of students supported that CBL improved their understanding of the topic. [4-6] 96% of students agreed that CBL encourages active learning, develops communication & teamwork skills. It develops clinical reasoning, attitudes & interpersonal skills [2,5] 94% of students actively participated in discussion & 96%

have asked for more CBL sessions. 98% of students thought that more time should be given to CBL. [4,9] Students demanded that more such topics should be covered by this method.

Case based teaching methodology allowed students to relate the course content with a clinical situation thus boosted active learning which was agreed by 99 % of students. [4,21]

Some of the responses written in the open-ended remarks section were, "it was a change from routine sessions, we liked the concept of learning in groups and interacting with the faculty members". When asked in open-ended question regarding suggestions, most students said that no improvement was required. Most of the students emphasized that such kind of sessions should be repeatedly done for more topics and by trained teachers.

94 % of students accepted that this method will boost their learning skills which can be applied in clinical practice. As they work on a case to answer the questions; it helps them to develop reasons of the illness and that lead them to differential diagnosis interpretation, which provided them early clinical exposure. [9]

In the present study significant differences were observed between the responses in the pre and post-test. There was improved learning capability in students as shown by their better performance in MCQ post - test session. This method had a favourable impact on student retention of knowledge regarding the topic as observed in MEQ test after one month. [7]

Students had a positive perception about CBL and the results of the study are statistically highly significant; which shows that perception of students regarding CBL is affected by usefulness of the session, usefulness of clinical cases, their ability to correlate clinical cases, group discussion, interpersonal skills, feedback by students, feedback by faculty and their overall impression. [13]

Many studies have shown that increased faculty involvement led to

increased student satisfaction. [20] Our study also supports the same as 96 % students acknowledged that the presence of the facilitators was one of the advantages of CBL. But also, about 1.54% students preferred the traditional methods because of theoretical knowledge base provided by them.

Faculty feedback was also taken for practicability and execution of CBL. Faculty observed that students developed interest in the topic & were attentive throughout the class. [7] Faculty agreed improvement in student comprehension of the subject material. [2,4] Thus, giving them ample motivation to do self-directed learning. [7] It boosted their learning skills. [5] Faculty observed that the students solved the problems confidently. They also felt that such sessions should be conducted on regular basis. In open ended questions few faculties felt that developing CBL modules would be a challenging task, but training and interdepartmental integration will help in preparing and implementing CBL. [9]

Faculty also acknowledged that CBL develops group dynamics, also brings a sense of healthy competition in between the groups and increases the collaborative and communication skills of students. [9] Faculty members interpreted that working with the cases helps students develop clinical reasoning & provides them early clinical exposure which would help in diagnosing the underlying cause of disease. The authors feel uplifted by the results of the study and hope that this study can serve as a milestone to develop more such modules for other systems in physiology and can be reproduced by the other departments also for the benefit of the students.

Limitations of the present study were the students could not be exposed to real-life patients due to time constraints of the first year MBBS course. Few participants stated that it was time consuming & comparatively tough as it needs a lot of brainstorming, good administrative and time management skills.

Hence, faculty training is essential for effective implementation of CBL.

CONCLUSION

The CBL teaching method is a learner centred teaching methodology. It is an interesting and effective active learning strategy. Overall results indicate that students expressed strong preference for CBL compared to traditional methods. Students & teachers enjoyed CBL, partly because it engages, and is perceived to motivate, students. It provides opportunity for good quality group discussions, development of interpersonal skills, critical thinking and the ability to solve clinical cases. Hence more modules of CBL should be implemented for better understanding in medical education.

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