

RESEARCH ARTICLE

A comparative study of case-based learning with conventional teaching in undergraduate training of pharmacology

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ABSTRACT

Background: Pharmacology as a specialty deals with drugs, therapies, and their application to clinical medicine. The traditional teaching approach has been through didactic lectures in medical colleges. Case-based learning (CBL) as a teaching-learning method is an inquiry-guided, conceptual, and application-based novel approach in medical education. **Aims and Objectives:** This study aims to evaluate the effectiveness of CBL compared to conventional method among medical graduates and evaluate the perception of students regarding CBL in pharmacology. **Materials and Methods:** After taking ethics committee approval (IEC/ASR APPROVAL/017/2019) and obtaining informed consent from 60 students randomly divided into two equal groups: Group 1 (CBL) and Group 2 (Conventional). Case scenarios in Type 2 diabetes mellitus and bronchial asthma, test questionnaires, and feedback forms on the perception of students for CBL were developed and validated by experts. Group 1 had CBL sessions while Group 2 had didactic lectures and was evaluated immediately after sessions and 4 weeks later. Student perceptions regarding CBL were collected and analyzed. **Results:** In our study, Group 1 (CBL) had significantly higher scores ($P < 0.001$) as compared to Group 2 in knowledge-based questions as well as application-based questions. About 90% of the students had a positive perception of CBL and insisted on its implementation in the curriculum. **Conclusions:** CBL is more effective than conventional teaching in certain topics of pharmacology. Retention of subject and concepts was better as compared to the conventional group.


KEY WORDS: Case-based Learning; Knowledge-based Question; Perception; Application-based Question

INTRODUCTION

Pharmacology is a subject deal with drugs, their chemistry, pharmacokinetics, pharmacodynamics, dosages, therapeutic uses, adverse effects, and important interactions. Conventional teaching methods like didactic lectures are the most common means of teaching in medical institutions. Didactic teaching is teachercentric and has minimal participation in learning

from students' perspectives. Conventional teaching methods such as didactic lecture classes; tutorials and practical sessions are inadequate to fill essential gaps in the acquisition of necessary knowledge and skills needed for Indian medical graduates. Pharmacology taught by the didactic method fails to integrate the subject horizontally and vertically.^[1,2]

Case-based learning (CBL) as a teaching-learning method has its foundation in problem-based learning (PBL).^[3] CBL facilitates analytical thinking (higher cognitive learning domain) as compared to the didactic method which imparts knowledge (low cognitive domain).^[4] CBL helps students strengthen the association of concepts and their application into clinical practice with the help of case scenarios.^[5] CBL being a learner-centric teaching method provides an opportunity for deeper inquiry and immersive learning.

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It reinforces the critical thinking abilities, reasoning, and application of concepts.^[6] The application of basic concepts of pharmacology with clinical medicine lays the foundation for rational therapeutics. In this premise, there arises the necessity of teaching-learning methods like case-based learning in pharmacology to address the unmet needs of students. Recommendations from Erstwhile Medical Council of India for graduate medical education in 1997 emphasize the integration of teaching among pre-clinical and clinical subjects using problem-based learning and case-based learning.^[7]

In wake of the new CBME curriculum rolled out by the National Medical Commission in all medical college, CBL may serve as an effective teaching learning tool in training pharmacology for medical undergraduates. In our medical college, our department faculty in collaboration with the medical education unit got trained in PBL/CBL as a part of improving and introducing new teaching-learning methods in pharmacology teaching.

This study was undertaken to evaluate the effectiveness of CBL as compared to conventional teaching by didactic lectures and to understand the perceptions of students regarding CBL.

Objectives

The objectives of the study were as follows:

- To evaluate the effectiveness of the CBL method as compared to the conventional method among the 2nd year MBBS students.
- To study the perception of students regarding CBL in pharmacology teaching.

MATERIALS AND METHODS

After obtaining ethics committee approval (Vide Approval no: IEC/ASR APPROVAL/017/2019), 60 of the 4th semester studying pharmacology were selected by convenient sampling and randomly divided into two equal groups: Group 1 = CBL group and Group 2 = Conventional (didactic) group.

Two cases, one from type 2 diabetes mellitus treatment and a case of treatment of bronchial asthma, are selected for teaching in both methods. Cases, test items, and students feedback questionnaires were developed and validated by peer review by subject experts from our institute. The senior 3rd year students who participated in a pilot study for questionnaire validation are excluded from the study. The case scenario includes the clinical problem, history of the patient, laboratory investigations, provisional diagnosis, and treatment chart of the patients. Faculty trained in CBL is included in the study. Trained faculty choose either CBL session or conventional teaching. The salient features of the

two cases and their teaching method are discussed by faculty acting as facilitators in the CBL method in advance. Group 1 is further randomly subdivided into two subgroups with 15 students each for CBL session in type 2 diabetes mellitus treatment and treatment of bronchial asthma, respectively. Similarly, in Group 2, two subgroups with 15 students each had didactic lecture class. The CBL has 2 h sessions. In the 1st h session, both groups of 15 members each selected their group leader and recorder to coordinate and record details of the session, respectively. Case-based learning starts from known to unknown as the session moves forward. Discussion among the group transcends from integrating concepts in pharmacology to correlating with the clinical case provided based on signs, symptoms, diagnostics, and their mitigation through rational application of pharmacology. The facilitator ensures smooth conduct of the session by only guiding the students for a comprehensive discussion without really involving directly. The facilitator ensures students emphasize pharmacological application with analytical thinking in the context of a clinical case. In the 2nd h session, the facilitator will help students with doubts and elaboration of pertinent learning aspects of a clinical case concerning therapeutics. Students in Group 2 will be given an hour didactic lecture on the same topics as CBL. On the other side, Group 2 revised the topic on their own.^[4]

Immediately after the sessions, both groups attend a test for the assessment of the effectiveness of learning methods. The assessment was conducted for both groups with validated multiple-choice questions (20) each carrying 1 mark (10 = knowledge based and 10 = application based), which are the same for both groups. Perception of students for feedback on case-based learning was obtained by giving them validated questionnaires in Group 1 (30 students)

At the end of 4 weeks, students from both groups were assessed again using the same questionnaires and evaluated for retention of the subject in both groups.

Statistical Analysis

Quantitative data were expressed as Mean \pm standard deviation. Unpaired Student's *t*-test was used to compare mean scores between study groups. Paired Student's *t*-test was used to compare mean scores between tests conducted immediately after sessions and 4 weeks later in both groups. A power of 80% with a significance value of $P < 0.05$ was set for analysis using Microsoft Excel 2021. Likert scores on student perception of CBL as feedback questionnaires were expressed as percentages.

RESULTS

A total of 60 students of 4th semester second professional MBBS of either gender were enrolled in the study after

obtaining written informed consent for participation in the study. There were 38 females and 22 males with a mean age of 20.12 ± 0.32 years. To assess the effectiveness of teaching methods, a test questionnaire with 20 questions (10 – knowledge based and 10 – application based) each carrying 1 mark for correct response is analyzed in both study groups.

The first test was conducted immediately after teaching/learning sessions for both groups in two topics (Type 2 DM and bronchial asthma), as shown in Table 1. Scores in both groups are compared and analyzed statistically using an unpaired *t*-test.

The second test was conducted 4 weeks after teaching/learning sessions for both study groups in two topics (Type 2 DM and bronchial asthma), as shown in Table 2. Scores in the second test in the study group are compared and analyzed statistically using an unpaired *t*-test.

On further analysis for evaluating the retention of the subject, after 4 weeks scores from the first test and second test in Group 1 for two topics are compared using paired *t*-test, as shown in Table 3.

Similarly, the first test and second test scores in Group 2 are compared using paired *t*-test, as shown in Table 4.

In Group 1, feedback from the students was taken regarding their perceptions about CBL in pharmacology as a teaching-learning method. Students gave responses to a pre-validated questionnaire on CBL sessions on a 5-point Likert scale, as shown in Figure 1.

DISCUSSION

In the present study, CBL was compared with the conventional method for its effectiveness as a teaching/learning tool. Two tests were conducted 4 weeks apart in which results were found to be significantly higher in the CBL group as compared to conventional teaching in both knowledge- and application-based questions. Further CBL group performed significantly better in application-based questions in the second test emphasizing better retention of the subject. More than 90% of the students in the CBL group expressed positive perceptions regarding CBL sessions in pharmacology teaching.

The first test was conducted immediately after the teaching-learning session in both groups. Scores were evaluated based on their performance in knowledge-based and application-based questions separately. Group 1 (CBL) was better as compared to Group 2 in both knowledge- and application-based questions. While students in CBL had significantly higher scores in application-based questions as compared to knowledge-based ones. The reason could be probably attributed to the qualities of the CBL method. CBL method has an inquiry-driven learning model motivating students

Table 1: Comparison in study groups of test scores in the first test

Topic	Question type	Group 1	Group 2	P-value
Type 2 diabetes mellitus	Knowledge-based questions	6.40±0.83	6.07±0.96	0.43 (NS)
	Application-based questions	7.33±0.62	4.2±0.86	<0.001
Bronchial asthma	Knowledge-based questions	6.67±0.72	6.2±0.77	>0.05 (NS)
	Application-based questions	7.13±0.74	4.4±0.83	<0.001

Table 2: Comparison in study groups of test scores in the second test (after 4 weeks)

Topic	Question type	Group 1	Group 2	P-value
Type 2 diabetes mellitus	Knowledge-based questions	5.67±0.72	4.60±0.91	>0.05 (NS)
	Application-based questions	6.60±1.12	4.4±0.51	<0.001
Bronchial asthma	Knowledge-based questions	5.2±0.56	4.0±0.38	>0.05 (NS)
	Application-based questions	5.93±0.70	3.79±0.80	<0.001

Table 3: Comparison of scores between the first and second tests in Group 1

Group	Type 2 diabetes mellitus		Bronchial asthma	
	Knowledge based	Application based	Knowledge based	Application based
1				
1 st test	6.40±0.83	7.33±0.62	6.67±0.72	7.13±0.74
2 nd test	5.67±0.72	6.73±1.16	5.20±0.56	5.93±0.70
P-value	0.04	NS	NS	NS

Table 4: Comparison of scores between the first and second tests in Group 2

Group	Type 2 diabetes mellitus		Bronchial asthma	
	Knowledge based	Application based	Knowledge based	Application based
2				
1 st post-test	6.07±0.96	4.40±0.63	6.20±0.77	4.40±0.83
2 nd post-test	4.60±0.91	4.33±0.49	4.00±0.38	3.73±0.80
P-value	0.002	NS	NS	0.03

to reason, discuss, collaborate, and apply pharmacology in clinics. Our results are in line with work done by Vora *et al.* in which they compared scores in the CBL group and didactic lecture group in questions based on knowledge and critical thinking.^[4] Another study by Tushar *et al.* done on a large group of students ($n = 186$) demonstrated a significant increase in post-test scores in CBL groups as compared to didactic groups.^[8] Similarly, in our study also, CBL group

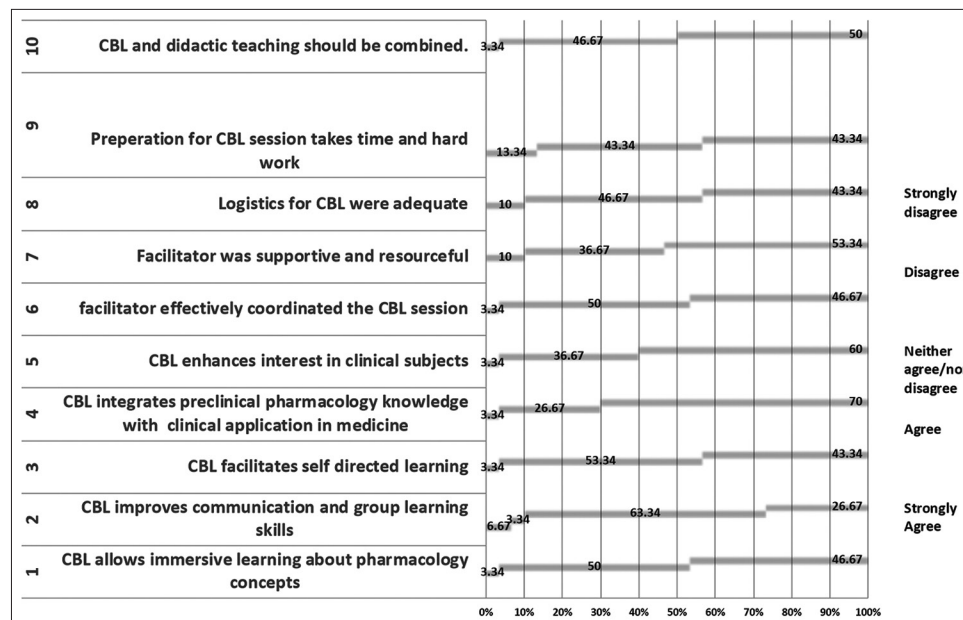


Figure 1: Perceptions of students regarding case-based learning. Likert scale: 1: Strongly disagree; 2: Disagree; 3: Neither agree/nor disagree; 4: Agree; and 5: Strongly agree

had shown a slight increase in scores over the conventional group which is not statistically significant.

A second test was conducted 4 weeks after the first test, mainly aimed to analyze the retention of subjects and concepts in both study groups. It was found that a statistically significant increase in scores was observed in Group 1 as compared to Group 2 in application-based questions. These results are consistent with the study conducted by An *et al.* in microbiology with a post-test conducted after 6 weeks.^[9] The reason for this finding could be probably due to the deeper learning based on concepts and guided inquiry into the subject.

In questions based on knowledge, there was no statistically significant difference in scores between CBL and conventional groups though marginally higher scores were seen in the CBL group.

In this study, the CBL group has better scores compared to the conventional group in both knowledge- and application-based questions in both tests conducted 4 weeks apart.

A better understanding of the subject facilitated by the correlation of clinical cases with rational application of pharmacology concepts in CBL helped students perform better in the second test.

On further analysis, a statistically significant decrease in scores for knowledge-based questions between the 1st and 2nd test is seen in the CBL group, while the decrease in scores in application-based questions is not statistically significant in the CBL group. As a method of teaching and learning, CBL helps students build concepts based on analytical thinking and higher cognitive domains. CBL method of instruction

may substantiate the retention of scores in application-based questions as compared to knowledge-based ones.

On analysis of scores between two tests in the conventional method, a statistically significant decrease in scores was observed for knowledge-based questions in students for type 2 diabetes topic and application-based questions in bronchial asthma. However, statistically, no significant difference was found in scores between two tests for application-based questions in students for type 2 diabetes topic and knowledge-based questions in bronchial asthma. Scores in this study may not be accurate indicators for ascertaining the effectiveness of learning methods. However, data generated from this study provide a perspective to understand the numerous benefits the CBL method offers in deeper learning of concepts and their application to cases in clinics. Further CBL allows for guided inquiry, outcome-based learning resulting in better learning outcomes.

Deeper learning of concepts as compared to mere factual knowledge will make a better clinician. CBL as a learning tool when used regularly invokes rational thinking for the application of pharmacology subject for each case individually rather than generalizing standard treatment protocols.

In this study, perceptions of students from the CBL group are collected. It shows that more than 90% of the students were combined agreeing or strongly agreed with the positive aspects; CBL has to offer as a learning method in pharmacology. Further 86.7% of students opined preparation for CBL takes a lot of time hard work. About 510% neither agreed nor disagreed regarding the benefits of CBL. Only 6.67% of them disagreed with one perception regarding improvement in communication skills with CBL.

The majority of students in the CBL group appreciated the benefits such as immersive learning, improvement in communication, and group learning skills. They felt CBL integrates pre-clinical pharmacology with clinical application in medicine and enhances interest in clinical subjects. Most of the students agreed that facilitators were supportive, resourceful, and effectively coordinated the CBL session. A combination of CBL and didactic teaching was insisted by 97% of students in this study. The findings in our study regarding perceptions on CBL are consistent with other studies conducted in different subjects in medical colleges training medical graduates in our country.^[10-14] In a cross-sectional study by Mani *et al.*, importance of learning by visual, auditory, and kinesthetic modalities is emphasized.^[15] Similarly, CBL utilizes multiple modalities of students in learning subject. This study necessitates the imminent need to induct CBL as an effective teaching-learning method into the curriculum along with conventional teaching methods for the larger benefit of medical undergraduate students.

The strength of this study is that CBL is evaluated as a learning tool in students in pharmacology that demands knowledge plus application. This study helps us to understand the benefits of CBL in the long-term retention of subjects as a study tool. In wake of new curriculum, feedback on perceptions on CBL from students helped us to include more CBL sessions in our teaching curriculum. Limitations regarding the study are, results are based on a limited sample size to generalize the findings. Further studies with a larger sample size may be planned based on these results.

Implications of this study are to necessitate the imminent need to induct CBL as an effective teaching-learning method into the curriculum along with conventional methods for the larger benefit of students.

CONCLUSION

CBL is more effective than conventional teaching in certain topics of clinical/systemic pharmacology. Retention of subject and concepts was better as compared to the conventional group at the end of 4 weeks in the CBL group. Students perceived increased engagement, interest, motivation to learn, and stated preference for CBL relative to didactic lectures. CBL is more interactive and facilitates active learning. More such training sessions on specific topics aligned for CBL would benefit students immensely in undergraduate pharmacology training.

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