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The Clinical Problem-Based Learning (PBL) Approach for the Effective Delivery of Pharmacology Courses

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Key words
Problem based learning, Pharmacology, group study, lecture based learning, research.

Abstract
This paper presents the cognizance of learning and the change in attitude of pharmacy students who were part of the Problem Based Learning (PBL) approach to the pharmacology course. This also explores the student's perception of a clinical-based approach to learning pharmacology course. The PBL was instigated for the course in two successive years, i.e., 2018 and 2019, in anticipation that the use of this qualitative paradigm would seek students' engagement at a higher level and learning pharmacology with a research attitude. For this study, data was collected through structured feedback from the students, feedback from the course instructor, and final exam results. For the 2018 batch, the traditional approach of classroom teaching i.e. didactic instruction was followed, whereas; PBL approach was implemented during the year 2019. There was a significant improvement in the exam scores in year 2019 compared to the year 2018, when students were only exposed to classroom teaching. The average score of the students was also found to be higher compared to the previous year. Moreover, structured feedback from the students shows positive agreement with using PBL as part of teaching and learning. The implementation of the PBL approach in the pharmacology course has increased students' engagement, which ultimately enhances their understanding and ability to engage in critical thinking.

1 Introduction

Teaching and learning are self-motivated processes, and in the case of educational learning, teachers play a very important role. The teaching and learning process is usually based on the course and subject. This research is based on the use of problem-based learning in the pharmacology subject for second year B.Pharm. students and compares the outcomes with those of classroom-based learning or lecture based learning. The effectiveness of teaching and learning methods is generally determined on the basis of exam scores. However, PBL is a student-centric approach that is totally based on the nature of the problem. Here, students learn by analysing and solving the problems in the subject. The main aims of PBL are to facilitate the students in developing flexible knowledge, to enhance their effective problem-solving skills, to develop self-directed learning skills, to foster effective teamwork skills, and, with this, to enhance intrinsic motivation [1].

In the Krishna Institute of Medical Sciences, deemed to be university, Karad, Maharashtra, India, the Krishna Institute of Pharmacy College has started problem based learning for various courses, including pharmacy. In the pharmacy course, there is a Pharmacology subject that is totally based on the pharmacokinetic and pharmaco-dynamic parameters of drugs, classification of medicinal drugs on the basis of their structure, function, etc., receptor studies, the modes of action of various drugs, adverse effects, contraindications, and multiple uses [2]. Typically, teaching pharmacology to pharmacy students entails two major challenges: (i) learning

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how various drugs are used for disease management and treatment, and (ii) learning in depth information about the classes and actions of many drugs on various body parts, as well as their mechanisms. Hence, considering the existing trend for programme revision in pharmacy education, conventional lecture-based learning or classroom-based learning has been criticised as it lacks the student's proficiency to connect basic sciences with clinical relevance [3, 4].

It was found that more than 70% of students in the IV semester of B. Pharmacy faced difficulties while studying pharmacology. Then, a controlled, randomised study of an average number of students in the IV semester of B. Pharmacy would provide additional confirmatory measures to elucidate the role of PBL in the attainment of factual knowledge in comparison to traditional teaching [5-7].

PBL is an "active learning" teaching technique in which complex factual problems are used as the medium to encourage students' learning of basic concepts and principles, as opposed to the submissive, spoon-feeding rote learning based on teacher-designed didactic lectures and instructions typical of the conventional curriculum [8,9].

It was found that the initial experience of problem-based learning followed by various methods proved to be difficult and also stressful for several students, especially those who were not familiar with learning separately, those who faced communication problems, stage fright, a lack of confidence, and those who were hesitant about how to come up with the formative report. In spite of an end-of-semester tutorial to give specific direction on this aspect to students, many of the groups did not follow this guidance [10-12].

2 Methodology

Traditionally, pharmacology is being taught by means of instructive lectures, which include tutorials and practicals that mostly result in teacher-directed and also uni-directional learning. While PBL encourages students to develop problem-solving skills, it also improves analytical skills, which improve decision-making capacity, which is necessary for clinical practice. Hence, intrusion in the form of the introduction of case-based learning and open debate learning was done in the present study. The objectives of this study are to find out the benefits of PBL in the teaching of pharmacology in a pharmacy course as compared to didactic lecture, and to assess the perceptions of participating students regarding PBL.

The PBL approach was implemented to second year undergraduate pharmacy students for the Pharmacology course and compared the end semester result with previous year result. After the completion of the course, feedback was received from students from which it was found that problem based learning overcomes various problems appearing through traditional method and improves the learning quality of students through self-motivation, active learning, life-long learning, critical thinking, and even better professional manners. It also helped to enhance effective communication and the collaborative spirit of teamwork among the students.

This type of method features a chronological organisation of problems. 40 B.Pharmacy students were arbitrarily divided into two equal groups: Group A (20 students) is the PBL group derived from the first method, case-based learning, and Group B (20 students) is the didactic lecture group. Two cases were selected for teaching through these methods,

1. Sympathetic nervous system Vs the parasympathetic nervous
2. Epilepsy and the effects of antiepileptic drugs.

The test items, cases and student feedback forms were prepared and peer reviewed by pharmacology experts from the institute. The case scenario included the various clinical problems, patient history, including family history, laboratory investigation details, an interim diagnosis, and the available management and treatment chart for the patients. The institute organised one separate session for all the faculty

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members regarding training for problem-based learning. A faculty had a sovereignty to choose the method on the basis of the curriculum, either a PBL session or didactic lecture. Group A was further subdivided into two sub-groups, PBL-1 and PBL-2 (no. of students: 10 in each group). PBL-1 and PBL-2 were given symptoms of patients and suggested treatment of doctors. This inculcated the deep understanding of sympathetic and parasympathetic nervous systems, the case of epilepsy and the effects of antiepileptic drugs. The same topics were taught by didactic lecture as per regular academic teaching schedule (1-hr lecture format) in case of Group B simultaneously.

In the case-based PBL, students received some information about these cases, and on the basis of the given criteria, like signs and symptoms, patient history, etc., they were asked to make a decision. The schematic presentation of case-based learning (CBL) is represented in fig.1. The case-based learning in PBL involved two main sessions. Each had at least 2 hrs sessions. In the first session, the group has to select a leader and a recorder in order to lead the session and with this record all the related points regarding the given case.

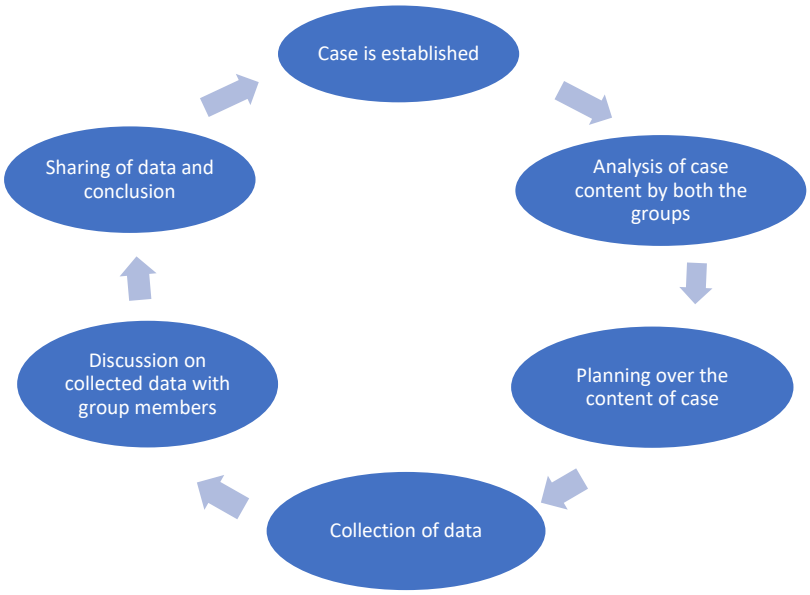

Fig 1. Schematic presentation of CBL

The case progressed step by step, from the known details to the unknown facts. The given case was primarily focused on identifying major learning issues, patient problems, investigations, and also their treatment from a basic pharmacology point of view. The students in this particular group were encouraged to work on the case and discussed all the details of the pharmacological basis of treatment, possible adverse effects, and other things related to the topic with the group members and get their query addressed with a faculty member who is acting as facilitator. However, after the completion of their first session and concluding remarks, they have to work on the second session. In the second session, all the points were revisited, and the doubts of students about the case circumstances were clarified by the facilitator.

In Group B, however, all 20 students in the didactic lecture group were advised to revise the topic independently. Topics were covered during the daily lecture hour; hence, no extra hours were allotted for study and discussion.

At the end of each unit, as per the university guidelines, the assessment was done by conducting a unit test examination for both the groups which comprised of 10 multiple choice questions, 5 short answer questions, and 2 long

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answer questions, out of which 8 questions were knowledge-based, and 9 questions were critical thinking-based. The level of difficulty of question paper was same for both the groups. Once all the students submitted their answer books, the assessment was done by the respective faculty, who were part of both didactic and PBL teaching. However, the answer sheets from both groups were mixed as usual, and it was not made public which student belonged to which learning group in order to avoid bias. Unit test was the first method of evaluation of PBL-based learning. End semester examination results were also considered the final method of evaluation. Moreover, students' perceptions toward the PBL were also evaluated by validated feedback questionnaires and statistical analysis was done on the questionnaires.

The PBL through case study method was followed by open debate of method. Debate which is also called as argumentation, is a thought process that involves working out antagonistic issues with no evident answers [12-14]. Here, Bloom's taxonomy identifies critical thinking and reasoned argument as top-order thinking skills connected with assessment skills [15,16]. In the picture of today's composite health care system, pharmacy graduates should always set to be critical thinkers and even good communicators; in addition to this, they should have thorough psychomotor skills [17,18]. Many pharmacy institutes across the world have adopted problem-based learning (PBL) by using the open debate method in their curriculum in order to implant the requisite qualities in their pharmacy graduates. Krishna Institute started to implement the PBL regime in 2019, which aims to help all students to become independent pharmacists. The present curriculum is a thematically integrated programme that places prominence on acquiring communication skills as well as critical thinking skills. Generally, a debate is an opportunity for students in order to identify that there is an issue to determine and also to express the analysis of that issue in depth, including critique, appraisal, and reasoning about that issue. These skills are also essential because healthcare professionals are frequently teeming with new evidence, and the only way to separate the valid from the invalid is to review and critique the evidence [19]. In the pharmacy profession, debate is considered a helpful learning tool in undergraduate, postgraduate residency, and training programmes [20-22].

For the open debate method, Undergraduate second year B. Pharmacy, semester IV, students enrolled for this learning activity. 50 students were selected for this learning activity, each group was randomly split into 05 small PBL groups (Group A, Group B, Group C, Group D, and Group E), each group has 10 students, and they are exposed to weekly PBL activities. Each group of students was exposed to a minimum of two debate sessions per month for semester IV. The topic of debate is usually based on the most confusing chapter of Pharmacology II. Topic selection is done after discussion with all the group members. Probably a minimum of 3–4 days are given to all the group members for topic preparation. This practise facilitates alternate points of view and also critical thinking. The debate topics included the points that students felt were difficult to remember, viz., areas of debate in medicine, such as drug-drug interaction, receptor study, the role of generic medicines, alcohol abuse, and the effects of antibiotics. This was to complement the PBL delivered during that week. Prior to the start of the debate, all enrolled students were divided into two groups within the same one: the proponents of the proposition and the opponents. Guidelines and all the rules are provided to everyone for the aims and objectives of the debate, which include the structure, format, and time limit for each stage (proposition, opposition, rebuttal, closing statements followed by open discussion), as well as the judging criteria to be provided. They were given a maximum of 10-15 minutes for debate and 5 minutes for faculty feedback. The faculty members acted as observers too in these sessions and were briefed before each session to critically check the students' performances, to identify the

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student's skill demonstrated and area of content explored, and give feedback according to the standardised outlines for which the students were being trained.

Every week, on the day of the debate, students usually start by making partitioned seating arrangements. One group will debate on positive points, while the opposite group will debate on the drawbacks. Candidates will be evaluated based on their aggression, defence capability, confidence, and evidence provided for a specific point. At the end of the semester, feedback and filled-out questionnaires from students were collected.

3 Result and discussion

PBL using a case-based study showed a significantly increased score, and it was observed after the end-of-semester examination that the student who belongs to PBL group scored higher marks in the Pharmacology course. Table 1.1. shows that students feedback for case study method of PBL followed by open debate. At the end of semester IV, student feedback forms were collected which showed very positive feedback. In the first method of problem-based learning, approximately 98% of students believe that a case study will assist them in improving their research knowledge, critical thinking skills, and practical knowledge; 96% of students believe that a case study will assist them in improving their literature search and changing their perspective on the world around them. After this study, students learned to handle things practically and try to solve the health issues on their own with the help of the pharmacology course.

Table 1.1. Students feedback for Case study method of PBL followed by open debate

Statement	Responses	No. of students	%
Exploring knowledge of research/topic	Agreed	19	95
	Neutral	01	5
	Disagree	00	00
Improved critical thinking skill	Agreed	19	95
	Neutral	01	5
	Disagree	00	00
Improved communication	Agreed	18	90
	Neutral	01	5
	Disagree	01	5
Changed perspective towards surrounding things	Agreed	18	90
	Neutral	02	10
	Disagree	00	00
Enhanced skill of literature study	Agreed	18	90
	Neutral	02	10
	Disagree	00	00
Enhanced Practical knowledge	Agreed	19	95
	Neutral	01	5
	Disagree	00	00

Table 1.2. shows students feedback for didactic method of instructions. After collecting feedback forms from students who are a part of didactic method groups, it was found that 48 out of 50 students agreed that debate will enhance their critical thinking, communication skills, decision-making capacity, and analytical abilities. Table No. 1.2 indicates that the average number of students evaluated themselves as more efficient, confident, and competent. Very few students (2-4%) believed that the debate method was ineffective in improving the aforementioned skills. 98% of the students were of the opinion that the debate method helps to enhance research knowledge, the learning of controversial topics, convincing ability, confidence, body language, and boldness. Whereas 96% of students were of the opinion that the debate method enhances critical thinking skills, decision-making ability, communication, analytical ability, listening ability, and the skill of answering questions.

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Table 1.2. Students feedback for didactic method of instructions

Statement	Responses	No. of students	%
Exploring knowledge of research/topic	Agreed	49	98
	Neutral	01	2
	Disagree	-	00
Learning of controversial topic	Agreed	49	98
	Neutral	-	00
	Disagree	01	2
Improved critical thinking skill	Agreed	48	96
	Neutral	01	2
	Disagree	01	2
Improved communication, decision making capability, analytical ability	Agreed	48	96
	Neutral	01	2
	Disagree	01	2
Improved listening ability towards different viewpoints	Agreed	48	96
	Neutral	02	4
	Disagree	-	00
Improved convincing ability	Agreed	49	98
	Neutral	-	00
	Disagree	01	2
Enhanced skill of answering to question	Agreed	48	96
	Neutral	02	4
	Disagree	-	00
Improved confidence, body language and boldness	Agreed	49	98
	Neutral	01	2
	Disagree	-	00

4 Discussion

The majority of faculty members at the Krishna Institute of Pharmacy use active learning tools for undergraduate pharmacy students to enhance the curriculum delivery. This study represents the importance and implementation of PBL through a case study on a selected topic and the didactic method of instruction method. The motive was to make Pharmacology course interesting to undergraduate B. Pharmacy students in their fourth semester. Through this study, it was found that a case study enhances the students' critical thinking, imagination, reading, and observing things in their surrounding environment, and apart from this, it helps to enhance their practical knowledge. Whereas, the debate method enhances critical thinking, communication skills, listening ability, body language, boldness, convincing ability, decision-making capacity, and analytical ability [20, 21, 22].

A study conducted by the Krishna Institute of Pharmacy for its Pharmacology subject proposed student-cantered approaches to the education system. Problem-based learning (PBL) via case studies and open debate will develop critical thinking skills more than traditional lecture-based learning in this context. The most important aspect of case-based learning in PBL is that it begins with real-life problems; thus, this method engages students in the study while also allowing them to determine the solution on their own. Around 96% of students agreed that this case based study helped them learn faster than conventional lecture-based learning. In the case of the debate method for active learning, around 98% of students agreed that this method helps them to enhance critical thinking, decision making ability, and analytical ability. The provision of debate method in collaboration with PBL requires the active involvement of students; usually, debate is more effective when the topic is controversial. Students need to collect all the information related to the topic of the debate and prepare for that before the activity. Even they need to think about the topic from different perspectives, so that they are ready for any kind of question asked by opponents. Moreover, case-based studies usually include real life problems, which encourage students to think about solutions. This study concluded that around 95% of students agreed that they learned many things from a case based study and worked as a group during the session. At the end of semester

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IV, during the oral examination, it was found that students involved in PBL learning are more familiar with the concept compared to other students who are not a part of this learning method.

5 Conclusion

With the help of end-of-semester examination results, questionnaires, and feedback collected from students, it was found that both methods of PBL help to enhance student skills, which include critical thinking, analytical skills, communication skills, practical knowledge, and other skills mentioned in tables 1.1 and 1.2. During the oral examination, it was observed that students involved in PBL learning activities are more confident, bold, and clear about the concept compared to students those who are a part of conventional learning methods.

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