

An Observational Study on Student Feedback on Effectiveness of Computer Assisted Learning in Experimental Pharmacology Among Phase II MBBS Students

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DOI: <https://doi.org/10.5281/zenodo.21184828>

Received: 16 June 2026, Accepted: 02 July 2026, Online First: 04 July 2026

ABSTRACT

Introduction: Practical pharmacology is vital for understanding drug actions, mechanisms, and adverse effects. Traditionally, animal experiments were extensively used; however, ethical concerns and practical limitations have led to the increased implementation of Computer Assisted Learning (CAL). CAL enables repetitive practice, enhancing students' conceptual understanding and practical skills. The current study addresses the gap in localized data regarding student perceptions of the effectiveness of CAL and evaluates whether CAL is an effective alternative to animal-based experiments. **Methodology:** An observational study was conducted in July 2025 in the Department of Pharmacology, Andhra Medical College. The sample comprised 200 Phase II MBBS students who consented and attended the CAL session. Students participated in a 90-minute session on "The effects of drugs on dog blood pressure" using conventional blackboard teaching without doing the experiment and CAL methods. Post-session feedback was collected using a validated questionnaire via Google Forms. **Results:** Out of 200 students, 69% reported adequate time allocation for CAL sessions, 71% indicated increased motivation and involvement, and 68% found CAL useful in understanding the topic. Additionally, 65% clearly visualized drug effects, 66% related drug actions effectively to basic mechanisms, 67% applied basic science concepts clinically, and 65% considered CAL beneficial for exam preparation. Furthermore, CAL was easier to remember for 67%, increased interest in experimental pharmacology for 66%, and overall, 70% preferred CAL as an effective teaching method in experimental pharmacology. **Conclusion:** CAL was positively perceived by the majority of students as an effective and feasible teaching method in experimental pharmacology, supporting its continued use and further integration into medical education.

Keywords: Computer-Assisted Learning (CAL), Experimental Pharmacology, Medical Education, Phase II MBBS Students.

INTRODUCTION

Practical pharmacology is crucial for enhancing, developing, and applying theoretical understanding of fundamental drug actions, their mechanisms, and potential adverse effects.¹ In the past, animals have been widely utilized in laboratory settings to demonstrate the effects of different drugs in experimental pharmacology classes.² The easy availability, purchase, and maintenance of animals are major challenges associated with animal experimentation.³ The Committee for Control and Supervision of Experiments on Animals (CCSEA) has established guidelines to promote the humane treatment of animals used in experiments, advocating for the replacement, refinement, and

reduction of animal experiments.⁴ Given the issues surrounding animal experimentation, there has been increasing emphasis on Computer-Assisted Learning (CAL) as an ethical alternative. CAL mimics experimental setups by allowing students to perform experiments multiple times, thus enhancing their understanding and skills.³ As per NMC norms, CAL software programs should be incorporated into the undergraduate curriculum due to the limitations associated with animal experiments.³ This study was initiated due to the lack of localized data evaluating students' perceptions and the effectiveness of CAL. Literature suggests that several computer-based packages that can improve learning are now accessible, and they serve as effective tools in education.⁵ Given

current infrastructural resources, this research aims to assess whether CAL can serve as a feasible, and effective replacement for animal experiments.

There is limited evidence regarding student perception towards CAL among undergraduate medical students in Andhra Pradesh. Therefore, this study was undertaken to evaluate students' feedback regarding the effectiveness of CAL in experimental pharmacology.

AIM

The aim of the study is to evaluate the feedback on effectiveness of computer-assisted learning (CAL) in experimental pharmacology among phase II MBBS students

OBJECTIVES

1. To assess the overall feedback of Phase II MBBS students regarding the effectiveness of computer-assisted learning (CAL) in experimental pharmacology.
2. To identify specific strengths and limitations of computer-assisted learning as reported in student feedback.

MATERIAL METHODS

The study was conducted with the following research plan:

- **Study Design:** Observational study
- **Study period:** One month study period (July 2025)
- **Study center:** Department of Pharmacology, Andhra Medical college, Visakhapatnam.
- **Study population:** Phase II MBBS students of Andhra Medical College, Visakhapatnam.
- **Sample size:** 200

Sample size calculation:

Where, n = required sample size

Z = Z-score for 95% confidence interval = 1.96

p = estimated proportion = 0.85 (85%)

d = Margin of error = 0.05

$$n = \frac{Z^2 \cdot p \cdot (1 - p)}{d^2}$$

By applying the values in the above formula, the minimum sample size required was calculated to be 196. To account for non-responses or incomplete feedback forms, the final sample size was rounded up to 200.

INCLUSION CRITERIA:

1. Students of phase II MBBS who were present on the date of practical session with CAL
2. Students who gave valid consent to participate in the study

EXCLUSION CRITERIA:

1. Students who were absent on the date of practical session with CAL
2. Students who did not give valid consent to participate in the study

STUDY TOOLS:

A pre-structured, validated feedback questionnaire was used to assess the feedback regarding effectiveness of CAL as a teaching method

10 computers with broadband connection facility and Ex PHARM software of animal simulation in experimental pharmacology for CAL

METHODOLOGY:

The study was carried out in the Department of Pharmacology, Andhra Medical College, Visakhapatnam, after obtaining prior approval from the Institutional Ethics Committee (IEC). Eligible undergraduate medical students were screened based on predefined inclusion and exclusion criteria and were enrolled in the study. The academic purpose and objectives of the study were explained to the students before enrolment. Participant information sheets were provided and written informed consent was obtained from all the participants prior to initiation of the study. A total of 200 undergraduate medical students were included in the study. Before commencement of the teaching sessions, an orientation program was conducted to familiarize the students with the objectives of the study and the structure of the teaching sessions. All enrolled students attended a structured teaching session of 1 hour and 30 minutes duration on the topic "Effect of drugs on dog blood pressure (vasopressors and vasodepressors)". The session was conducted using the conventional teaching method, followed by Computer Assisted Learning (CAL) method for demonstration and reinforcement of concepts. At the completion of the CAL session, feedback was obtained from all participants using a structured and validated feedback questionnaire.

DATA COLLECTION:

A structured feedback questionnaire was developed specifically for the study and was validated prior to administration. The questionnaire consisted of items assessing students' perceptions regarding clarity of concepts, understanding of pharmacological mechanisms, visualization of experimental procedures, comparative effectiveness of teaching methods, and overall satisfaction. The feedback questionnaire was administered electronically using Google Forms immediately after completion of the CAL session to ensure unbiased and immediate responses. All responses were recorded and compiled in a structured database for further statistical analysis.

STATISTICAL ANALYSIS:

After collection of all completed feedback questionnaires through Google Forms, the responses were compiled and exported into Microsoft Excel for data organization and coding. The cleaned dataset was subsequently analysed using IBM-SPSS trial version 27. The analysed data were presented in the form of tables and pie charts.

RESULTS:

A total of 200 Phase II MBBS students participated in the study and completed the feedback questionnaire. Regarding adequacy of time allocated for the CAL session, 69 students strongly agreed, 61 agreed, and 70 remained neutral (Table 1, Figure 1). When asked whether CAL increased their involvement and motivation to learn more, 65 students expressed strong agreement, 57 agreed, and 78 were neutral (Table 1, Figure 2). With respect to usefulness of CAL in understanding the topic, 58 students strongly agreed, while 65 agreed and 77 were neutral (Table 1, Figure 3). For visualization of drug effects by CAL, the responses

showed 61 students in the strongly agree category, 69 in the agree category, and 70 in the neutral category (Table 1, Figure 4). On assessing whether CAL helped in relating drugs with their basic mechanisms, 74 students strongly agreed, 68 agreed, and 58 were neutral (Table 1, Figure 5).

Similarly, 67 students strongly agreed that CAL improved their ability to apply concepts of basic sciences to clinical situations, whereas 66 agreed and 67 remained neutral (Table 1, Figure 6). In relation to preparation for the final university examination, 64 students strongly agreed that training with CAL would be helpful, 70 agreed, and 66 were neutral (Table 1, Figure 7). For the statement that CAL is easier to remember, 67 students strongly agreed, 65 agreed, and 68 were neutral (Table 1, Figure 8). Increased interest in pharmacology through CAL sessions was strongly agreed upon by 79 students, agreed upon by 68 students, and 53 students were neutral (Table 1, Figure 9). Acceptance of CAL as a teaching method was reflected by 79 students in the strongly agree category, 59 in the agree category, and 62 in the neutral category (Table 1, Figure 10).

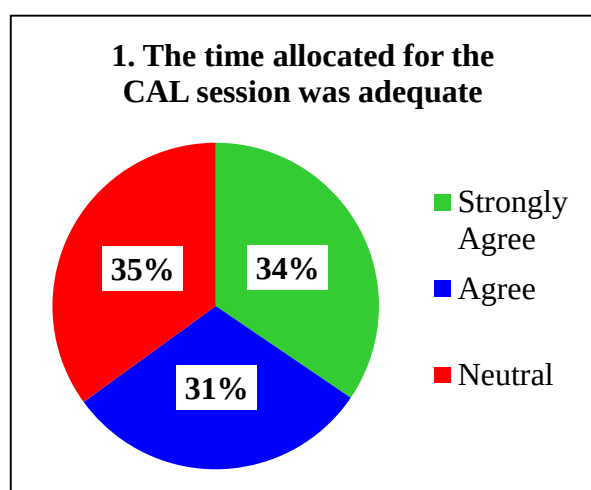


Figure 1

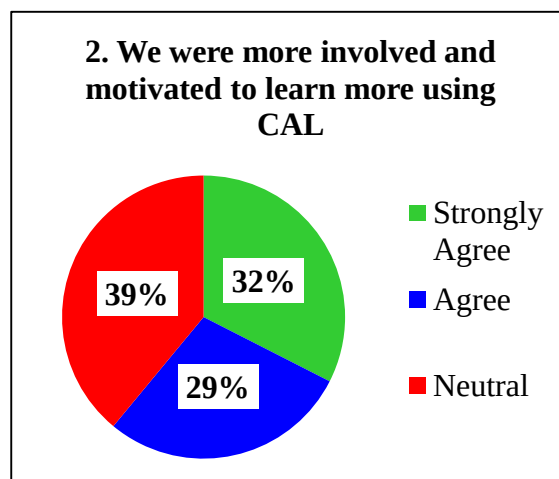


Figure 2

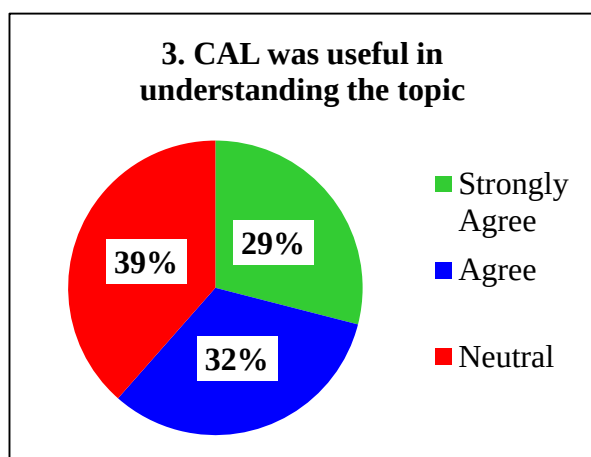


Figure 3

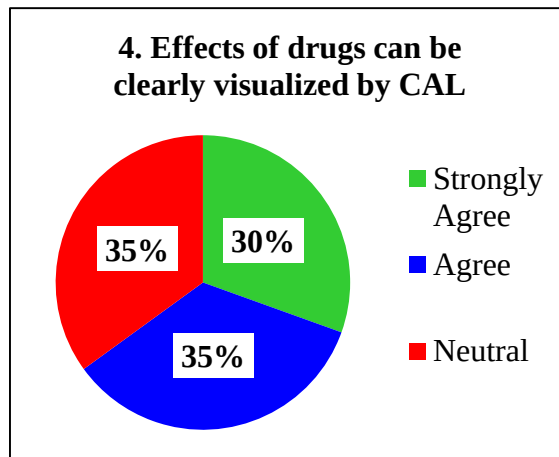


Figure 4

5. By virtue of CAL, the drugs could be better related with their basic mechanisms

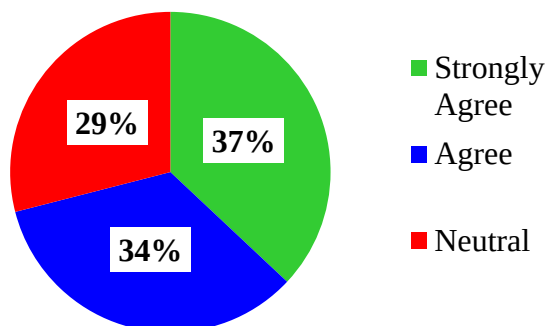


Figure 5

6. CAL improved my ability to apply concepts of basic sciences to clinical situations

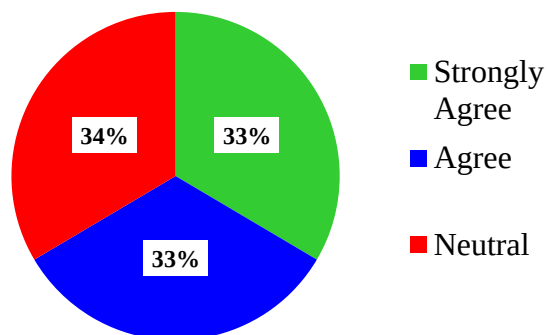


Figure 6

7. Training with CAL will help me in preparing better for the final university examination

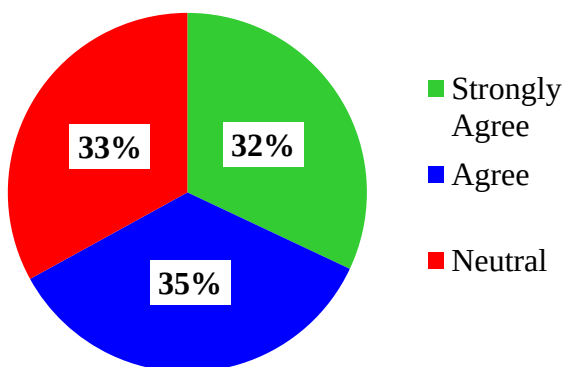


Figure 7

8. CAL is much easier to remember

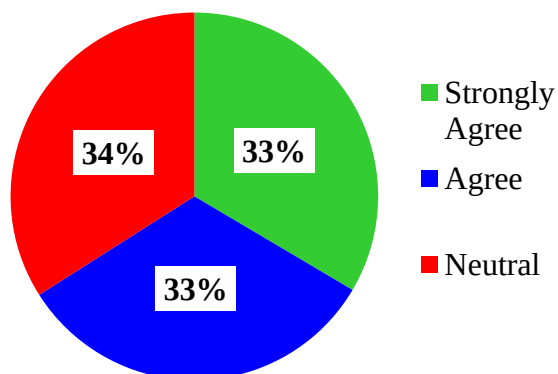


Figure 8

9. CAL sessions would increase my interest in pharmacology

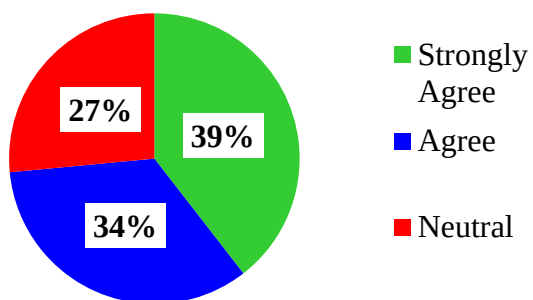


Figure 9

10. I am accepting CAL method as teaching method

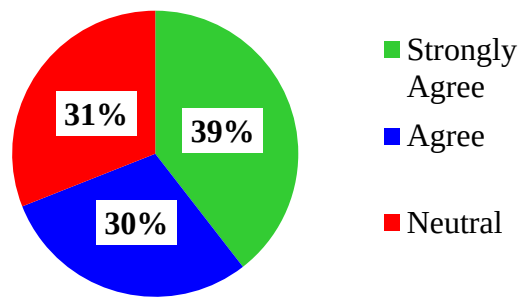


Figure 10

Table 1: Feedback Questionnaire Responses

Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. The time allocated for the CAL session was adequate	0%	0%	31%	34%	35%
2. We were more involved and motivated to learn more using CAL	0%	0%	29%	32%	39%
3. CAL was useful in understanding the topic	0%	0%	32%	29%	39%
4. Effects of drugs can be clearly visualized by CAL	0%	0%	35%	30%	35%
5. By virtue of CAL, the drugs could be better related to their basic mechanisms	0%	0%	34%	37%	29%
6. CAL improved my ability to apply concepts of basic sciences to clinical situations	0%	0%	33%	33%	34%
7. Training with CAL will help me in preparing better for the final university examination	0%	0%	35%	32%	33%
8. CAL is much easier to remember	0%	0%	33%	33%	34%
9. CAL sessions would increase my interest in pharmacology	0%	0%	34%	39%	27%
10. I am accepting CAL method as a teaching method	0%	0%	30%	39%	31%

Majority of students either agreed or strongly agreed with all questionnaire items. Very few students expressed disagreement.

DISCUSSION:

The present observational study demonstrated a predominantly favourable perception of Computer-Assisted Learning (CAL) among Phase II MBBS students in experimental pharmacology. Regarding adequacy of time allocation, 69% of students in our study reported that the time provided for the CAL session was sufficient. This finding is comparable to Shrivastava et al.¹, where 97.2% of students expressed satisfaction with the time allotted for CAL practice sessions, and to Mirza et al.², which reported majority (74%) agreement on adequacy of session duration. These similarities indicate that structured CAL sessions are generally perceived as appropriately timed for effective learning.

Student motivation and involvement were positively influenced in our study, with 71% reporting increased engagement during CAL sessions. Similar enhancement in learner involvement has been documented in Mirza et al.², where a substantial majority (77%) reported improved participation and motivation. Although Dhanasekaran et al.³ reported that 64% preferred conventional animal experiments for interactive learning, this difference may be attributed to direct comparison with live animal demonstrations rather than structured simulation following conventional explanation, as done in our study.

With respect to conceptual understanding, 68% of our students found CAL useful in understanding the topic. This aligns with Selvan et al.⁵, where 88% reported

better understanding with computer simulation, and with Mirza et al.², where 85% agreed that CAL enhanced comprehension. These findings collectively support the role of CAL in improving clarity of pharmacological concepts.

Visualization of drug effects, particularly blood pressure responses to vasopressors and vasodepressors, was positively perceived by 65% of our participants. A higher proportion (98%) in Selvan et al.⁵ reported improved visualization through simulation, indicating strong support for CAL in demonstrating physiological drug responses. In our study, 66% of students agreed that CAL helped relate drugs to their basic mechanisms of action. This is comparable to Mirza et al.², where 83% reported improved correlation between drug effects and mechanisms. Similarly, 67% of our students perceived improved application of basic science concepts to clinical situations, closely aligning with Mirza et al.², where 80% reported enhanced clinical application.

Regarding examination preparedness, 65% of our students believed CAL would aid in final university examination preparation, which is comparable to the 61% reported in Mirza et al.² Additionally, 67% of our participants found CAL easier to remember, consistent with findings from Dhanasekaran et al.³, which highlighted improved retention and user-friendliness (reported as 69%). Interest in pharmacology increased in 66% of students in the present study, comparable to

the approximately 70% reporting increased interest in Mirza et al.²

Overall acceptance of CAL as a teaching method was 70%, with positive responses (Agree + Strongly Agree) in the present study, comparable to majority (95%) accepted CAL as teaching method as documented in Selvan et al.⁵

Strengths

- Large sample size
- First study in this institution
- Standardized CAL session

CONCLUSION:

This study found that Computer-Assisted Learning (CAL) was positively received by most students, improving their motivation, understanding, visualization of drug effects, recall, exam preparation, and overall interest in pharmacology, with many accepting it as a preferred teaching method supporting its continued use and further integration into medical education. Future multicentric studies with objective assessment are recommended.

LIMITATIONS:

- This study was limited by its single-center design and inclusion of only one batch of Phase II MBBS students, which may affect the external validity of the results.
- The evaluation relied on subjective perception-based feedback rather than objective assessment of academic performance or practical competency.
- Self-reported responses may introduce response bias.
- Long-term learning outcomes were not assessed.
- No comparison group was included.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available to protect the privacy and confidentiality of the study participants.

Author Contributions

Dr. Ch. Kalyan Murthy: Conceptualization, study design, data collection, data analysis, interpretation of results, manuscript drafting, and final approval of the manuscript.

Dr. K. Hima Bindu: Study supervision, methodology, critical revision of the manuscript for important intellectual content, and final approval of the manuscript.

All authors have read and approved the final version of the manuscript.

Acknowledgement

The authors sincerely thank the Department of Pharmacology, Andhra Medical College, Visakhapatnam, for providing the necessary facilities and support to conduct this study. The authors are also grateful to all the Phase II MBBS students who voluntarily participated in the study and provided their valuable feedback.

Source of Funding:

Nil

Conflict of Interests:

Declared none.

Abbreviations

CAL – Computer Assisted Learning
IEC – Institutional Ethics Committee
MBBS – Bachelor of Medicine and Bachelor of Surgery
CCSEA – Committee for Control and Supervision of Experiments on Animals

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