

## Student's perception and experience of computer assisted learning as a teaching method in experimental pharmacology

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### ABSTRACT

**Background:** The decline in the use of animals for teaching in experimental pharmacology due to ethical concerns has led to the introduction of non-animal alternatives. These methods not only try to simulate the live experiment results but also offer the advantages of being time saving, reproducible and have minimum errors. One such alternative is computer assisted learning (CAL) which demonstrates the effect of drugs on living tissue in a virtual environment. In the present study, we assessed the outcome of CAL session among the medical students with the help of a questionnaire and compared it with the pre-CAL questionnaire to study the effectiveness of simulation experiments.

**Methods:** A total of 109 students participated in the study. They were divided into two Batches I and II. Batch I students were given a pre-CAL questionnaire on a selected topic, followed by a CAL session on that topic and a post-CAL questionnaire. Whereas for Batch II students, we directly started with demonstration of CAL session on the same topic followed by a post-CAL questionnaire. A student feedback form based on five point Likert scale was also given to all the students to get their views about the simulation experiments.

**Results:** The students in Batch I, after the CAL session had better average score % as compared to pre-CAL test (80.7% vs. 32.4%). Furthermore, when we compared the post-CAL scores of Batch I and Batch II, it was seen that the average score % was higher for Batch I (80.7%) than Batch II (55.4%).

**Conclusion:** The study demonstrates the effectiveness of CAL in teaching experimental pharmacology concepts and the students felt that this method helped them in a better understanding of the topic as the effects were clearly visualized on the screen and that such simulations need to be a part of the standard curriculum.

**Keywords:** Computer assisted learning, Pharmacology, Simulation experiment

### INTRODUCTION

Pharmacology as a medical subject is constantly updated with new discoveries and latest concepts. It involves the study of effect of drugs/chemicals on the living tissue and how the tissues deal with these drugs. Laboratory practical demonstrations on live animals (tissue/whole animal) done previously along with the traditional didactic lectures offered better conceptualization of the subject. The learner during the practical sessions had an opportunity to apply his/her theoretical knowledge in the experiment, which helped him/her to imbibe the subject matter better. However, now due to increasing ethical issues associated with use of animals in experimental pharmacology, various non-animal alternatives are being designed and developed.<sup>1,2</sup> One of such methods is computer assisted learning (CAL) which is becoming a fast acceptable method of teaching experimental pharmacology

in various medical institutions. The CAL softwares try to simulate animal experiments by demonstrating the effect of various drugs/chemicals on animal tissues and the student can view and even perform them which give him/her a chance to have hands on experience with these virtual experiments. There have been few studies in the past which have shown that CAL is accepted by the undergraduates well enough, and they are comfortable with the use of multimedia due to prior exposure at school level.<sup>3,4</sup>

The present study was conducted to evaluate and compare the performance of the students on the selected topic by giving them pre-CAL and post-CAL questionnaire. In the end a feedback form with close-ended questions, based on five point Likert scale (with one being strong disagreement and five being strong agreement) was given to all the students to get their views about the simulation experiment.

## METHODS

A 109 students of MBBS second professional participated in the present study. They were divided in two batches and the demonstration for them was held on 2 separate days. They were explained about the whole procedure and an informed consent was taken from them. All the students had prior theoretical knowledge of the topic selected for CAL session.

The first batch was given an anonymous, pre-validated, pre-CAL questionnaire (Annexure 1) on the topic “effect of drugs on dog blood pressure and heart rate.” After this, a CAL demonstration of ½ hr on the same topic was held. The software used was Ex Pharm 2.0.0, simulated experiments in pharmacology which is developed by Dr. R Raveendran and Dr. C H Shashindran from JIPMER, Pondicherry, India. The CAL session was followed by a post-CAL questionnaire, and the students were supposed to answer the same questions as in pre-CAL questionnaire. For the second batch on the next day, the topic was taught directly by CAL demonstration followed by post-CAL questionnaire. For both the batches, student feedback form (Annexure 2) was given at the end of the CAL sessions. Both days session were of 2 hrs duration. The evaluation of all the pre-CAL and post-CAL questionnaire was done by manual scoring.

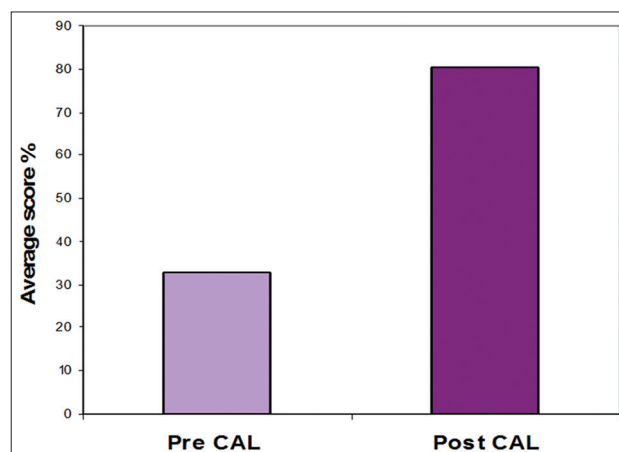
### Statistical analysis

The mean score and average score percent (%) were analyzed for the all the groups. Pre-CAL and post-CAL average score % was compared for the first batch and the post-CAL average score % of the second batch was also compared to the pre- and post-CAL score % of the first batch. The data obtained from the student feedback form was compiled and analyzed manually by frequency analysis.

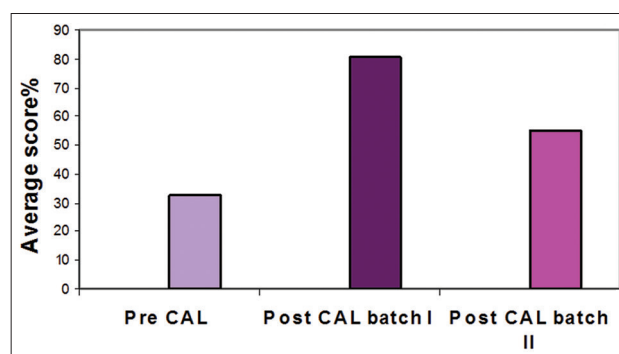
## RESULTS

In the first batch, the mean score and average score percent were seen to increase from pre-CAL test (7.2; 32.7%) to post-CAL test (17.7; 80.5%) (Figure 1). When score of post-CAL questionnaire of second batch was compared to pre- and post-CAL scores of first batch, it was seen that the mean score and average score % of second batch (12.2; 55.4%) after the CAL demonstration was higher than the pre-CAL test score of Batch I (7.2; 32.7%) but less than post-CAL score of Batch I (17.7; 80.5%) (Figure 2).

The data obtained from feedback form showed that the students could visualize the effect of drugs clearly on computer screen (93.6%) which offered them a better understanding of the topic (94.5%). Only about 30% of students felt that technical knowledge could be a hindrance in acceptance of these softwares to be incorporated in routine teaching. Majority (89%) felt that these experiments should become a part of regular experimental pharmacology teaching (Table 1 and Figure 3).



**Figure 1: Average score % of pre-computer assisted learning (CAL) questionnaire versus post-CAL questionnaire of Batch I.**



**Figure 2: Average score % of pre-computer assisted learning (CAL) and post-CAL questionnaire of Batch I versus post-CAL questionnaire of Batch II.**

## DISCUSSION

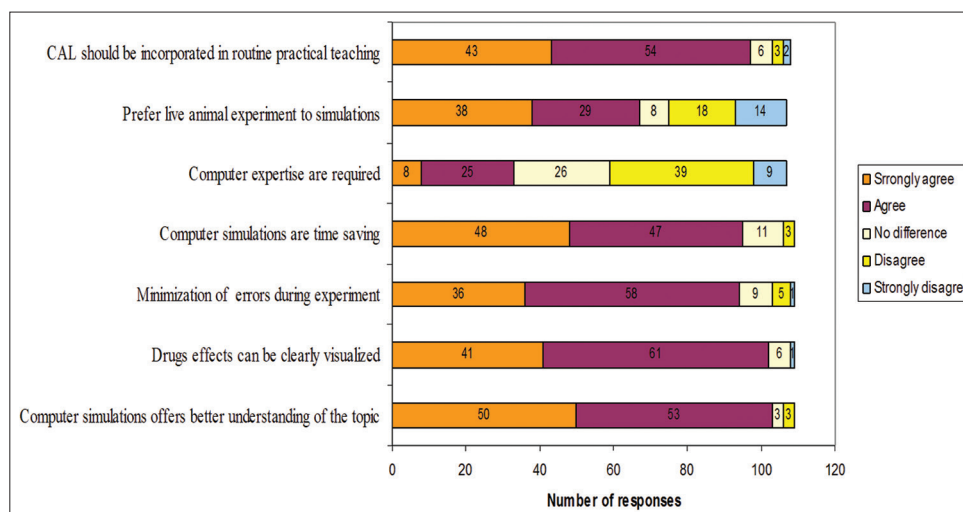
The role of innovative teaching tools such as CAL seems promising in better understanding of the subject as is evident from the improvement in scores of the students in post-CAL test. The post-CAL scores of Batch II were more than pre-CAL scores of Batch I but less as compared to post-CAL scores of Batch I. The reason could be that the students from first batch had prior exposure to the questionnaire, and they may have paid more attention to these specific questions during the CAL demonstration while the students from second batch were exposed for the first time to the questions after CAL. Improvements in student knowledge and performance after CAL has also been observed in other studies.<sup>3-5</sup>

The students felt that they could understand the concepts better through CAL and agreed that these had less chances of error in performance which makes these programs more time saving than the actual experiments. We were able to cover the topic in 2 hrs as compared to 9-10 hrs which used to be the time taken for the actual performance of the experiment. The students if provided with the software can study at their own pace and practice as many times as he/she desires.<sup>6</sup> The other advantages with this method are that less

**Table 1: Student's response on their perception and experience of CAL**

Questions	Response (n (%))				
	SA	A	ND	D	SD
Computer simulations offers better understanding of the topic	50 (45.9)	53 (48.6)	3 (2.75)	3 (2.75)	Nil
Drugs effects can be clearly visualized	41 (37.6)	61 (56)	6 (5.5)	Nil	1 (0.9)
Minimization of errors during experiment	36 (33)	58 (53.2)	9 (8.3)	5 (4.6)	1 (0.9)
Computer expertise are required	8 (7.3)	25 (23)	26 (23.8)	39 (35.8)	11 (10.1)
Prefer live animal experiment to simulations	38 (34.9)	29 (26.6)	8 (7.3)	18 (16.5)	16 (14.7)
CAL should be incorporated in routine practical teaching	43 (39.5)	54 (49.5)	6 (5.5)	3 (2.75)	3 (2.75)

SA: Strongly agree, A: Agree, ND: No difference, D: Disagree, SD: Strongly disagree, CAL: Computer assisted learning

**Figure 3: Student feedback on their perception and experience of computer assisted learning.**

biological variations are observed, results are reproducible, many students can perform the experiment at the same time and cost of animal procurement is reduced.<sup>2</sup>

The main drawback in this method can be the technical knowledge of computers which should be present in faculty as well as students. Though many students did not feel that computer expertise can be a hindrance in such experiments which may be because of their prior exposure to the computers at school level. These softwares presently are expensive, and the high startup cost of their installation in an institution is a limitation too.<sup>7</sup> The software developers and the higher medical authorities will need to come together and address this issue if we plan to incorporate them in mainstream curriculum all over the country.

Many students feel that these experiments lack direct interaction with the living tissue and as the doses are prefixed, they cannot appreciate the biological responses at their desired doses. They instead would have preferred to do the actual experiment themselves for a thorough understanding.

## CONCLUSION

Our study shows that incorporation of CAL is feasible in the experimental pharmacology teaching, and it offered a

better understanding of the subject. There should be the proper selection and design of these simulation experiments according to the curriculum learning objectives, and then amalgamation of these sessions with the mainstream teaching for the desired outcome should be undertaken. Proper resources and training should be provided to the teachers and students who will facilitate the acceptance of such methods and raise the standards of conventional teaching methodology.

## ACKNOWLEDGMENT

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*Ethical approval: Not required*

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## ANNEXURE 1

### DEPARTMENT OF PHARMACOLOGY, SRI GURU RAM DAS INSTITUTE OF MEDICAL SCIENCES AND RESEARCH, AMRITSAR

#### MBBS II<sup>nd</sup> professional Batch – 2013

Pre-computer assisted learning feedback questionnaire

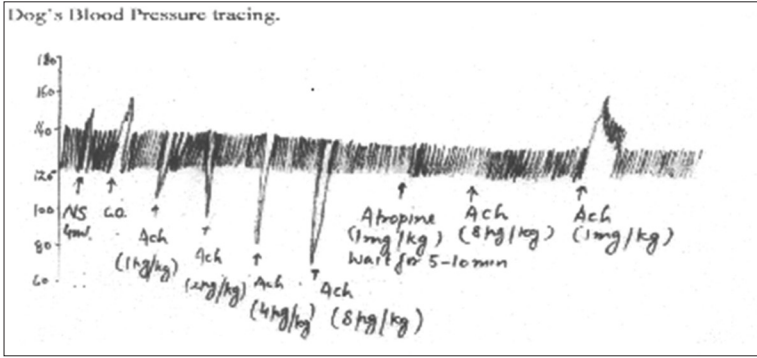
Topic: To study the effects of various drugs on Dog's blood pressure.

*Instructions:*

1. This is an anonymous feedback questionnaire. Please do not sign/write your name.
2. Your feedback is important in evaluating the whole program. It will especially help to determine how to further teach this topic to undergraduate students in the future.
3. Please consider each of the following items and descriptors and write the one you readily agree with.

Q. No.	Questions	Key
1.	Effect of carotid artery occlusion on dog blood pressure is: a. Increase in BP b. Decrease in BP c. No effect on BP d. Biphasic response	
2.	Biphasic response is seen with: a. Carotid artery occlusion b. Adrenaline c. Noradrenaline d. Isoprenaline	
3.	Which receptor is stimulated by adrenaline at low dose? a. Alpha 1 receptors b. Alpha 2 receptors c. Beta 1 receptors d. Beta 2 receptors	

(Cond...)

Q. No.	Questions	Key
4.	Which of the following drugs is a pressor agent? a. Adrenaline b. Nor adrenaline c. Isoprenaline d. Dobutamine	
5.	Tachyphylaxis is seen with: a. Adrenaline b. Noradrenaline c. Ephedrine d. Isoprenaline	
6.	What is the effect of isoprenaline on systolic BP and diastolic BP? a. Rise in systolic BP, fall in diastolic BP b. Rise in systolic BP and diastolic BP c. Fall in systolic BP and diastolic BP d. Fall in systolic BP, rise in diastolic BP	
7.	Persistent rise in BP by nor adrenaline is due to stimulation of which receptor? a. Alpha receptors b. Beta receptors c. Both alpha and beta receptors d. None of the above	
8.	What is phentolamine? a. Non-selective alpha blocker b. Selective alpha 1 blocker c. Selective alpha 2 blocker d. Both alpha and beta blocker	
9.	If in a patient phentolamine test is positive; what does it indicate? a. Benign prostatic hyperplasia b. Pheochromocytoma c. Raynaud's disease d. Congestive heart failure	
10.	When is the vasomotor reversal of dale seen? a. Adrenaline is given after the alpha blocker b. Adrenaline is given after the beta blocker c. Adrenaline is given after the alpha blocker and beta blocker d. All of the above	
11.	Which of the following causes fall in BP due to histamine? a. H1 receptor stimulation leading to vasodilatation b. H2 receptor stimulation leading to vasodilatation c. Beta 2 receptor stimulation leading to vasodilatation d. H3 receptor blockade leading to vasodilatation	
<p>Questions No. 12-15 are based on the following graph:</p>  <p>The graph, titled "Dog's Blood Pressure tracing", shows a baseline blood pressure of approximately 120 mmHg. The y-axis is labeled with values 60, 80, 100, 120, 140, 160, and 180. The x-axis represents time. The following interventions and their effects are noted:</p> <ul style="list-style-type: none"> <li><b>NS (1mg/kg)</b>: No significant change.</li> <li><b>CO (1mg/kg)</b>: Slight increase in pressure.</li> <li><b>Ach (1mg/kg)</b>: Sharp increase in pressure.</li> <li><b>Ach (2mg/kg)</b>: Further increase in pressure.</li> <li><b>Ach (4mg/kg)</b>: Further increase in pressure.</li> <li><b>Ach (8mg/kg)</b>: Further increase in pressure.</li> <li><b>Atropine (1mg/kg)</b>: Pressure falls back to baseline.</li> <li><b>Wait for 5-10 min</b>: Pressure remains at baseline.</li> <li><b>Ach (8mg/kg)</b>: Pressure rises again.</li> <li><b>Ach (1mg/kg)</b>: Pressure rises further.</li> </ul>		

(Cond...)

Q. No.	Questions	Key
12	Ach in low doses causes decrease in BP. What can be the cause? a. Muscarinic receptor (M3) stimulation b. Nicotinic (Nn) receptor stimulation c. Muscarinic receptor (M3) blockade d. Nicotinic (Nn) receptor blockade	
13	What is action of atropine? a. It blocks the muscarinic action of Ach b. It blocks the nicotinic action of Ach c. It blocks both muscarinic as well as nicotinic action of Ach d. It neither blocks muscarinic nor nicotinic action of Ach	
14	Atropine is highly effective as an antidote in the following poisoning: a. Belladonna poisoning b. Organophosphorous poisoning c. Hallucinogenic type of mushroom ( <i>Amanita muscaria</i> ) poisoning d. Morphine poisoning	
15	What is the cause of rise in BP when we give high dose of Ach (1 mg/kg)? a. Spare receptor stimulation b. Nicotinic (Nn) receptor stimulation c. Muscarinic (M3) receptor stimulation d. Nicotinic (Nm) receptor stimulation	
Questions No 16-20 are open-ended question. Give their appropriate answer in the given space		
16	What do you mean by tachyphylaxis?	
17	What is a vasomotor reversal of dale?	
18	Name at least two muscarinic receptor blockers and two nicotinic receptor blockers	
19	Name two alpha blockers and two beta blockers	
20	What do you mean by spare receptors?	

Ach: Acetylcholine, BP: Blood pressure

## ANNEXURE 2

Department of Pharmacology Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar

MBBS II<sup>nd</sup> professional Batch – 2013

Student feedback form for perception and their experience of computer assisted learning

Topic: To study the effects of various drugs on dog's blood pressure.

Instructions:

- 1 This is an anonymous feedback questionnaire. Please do not sign/write your name.
- 2 Your feedback is important in evaluating the whole program. It will especially help to determine how to further teach this topic to undergraduate students in the future.
- 3 Please consider each of the following items and descriptors and tick the one you readily agree with.



Q. No.	Questions	Response				
		SA	A	ND	D	SD
1	Computer simulation technique gives a better understanding of the topic than traditional method of teaching by pre-formed graphs					
2	Effects of drugs can be clearly visualized by computer simulation					
3	Errors in experiments can be reduced by computer simulation					
4	Computer simulations are time saving than the actual experiments					
5	This method has a disadvantage of computer expertise being required to perform these experiments					
6	CAL requires resources and is an expensive method					
7	CAL is more interesting than the traditional method					
8	If given a chance I would like to perform the actual experiment with the live animal rather than a computer simulation					
9	I think that CAL techniques should be incorporated in other pharmacology experiments also where ever possible					
10.	I am accepting CAL method as teaching method and should be utilized for MBBS course					

SA: Strongly agree, A: Agree, ND: No difference, D: Disagree, SD: Strongly disagree, CAL: Computer assisted learning