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ROLE OF COMPUTER ASSISTED LEARNING (CAL) AS AN EFFECTIVE TEACHING LEARNING METHOD AND AN ASSESSMENT TOOL IN PRACTICAL PHARMACOLOGY

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Keywords:

Computer-assisted learning, Pharmacology education, Animal simulation, CBME, CPCSEA regulations

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ABSTRACT: Background: Pharmacology education has evolved with the introduction of competency-based medical education (CBME). Traditional live animal experiments in pharmacology practical face ethical, logistical, and regulatory challenges. Computer-assisted learning (CAL) using animal simulation software offers an alternative that aligns with CPCSEA guidelines, emphasizing the 4Rs (Reduction, Refinement, Replacement, and Rehabilitation). **Objectives:** This study aims to evaluate the effectiveness of CAL as a teaching-learning and assessment tool for 2nd MBBS students and to analyze student feedback on the use of CAL software in pharmacology practical. **Methods:** A prospective observational study was conducted among 125 2nd MBBS students at Tezpur Medical College. Students participated in a CAL session on the "Effect of drugs on the rabbit eye". Pre-test and Post-test MCQs scores were recorded. Assessment was conducted using CAL software in an examination mode. Feedback was collected using a structured questionnaire based on the Likert scale. Data analysis was done. **Results:** The mean pre-test score was 36%, while the post-test score improved significantly to 71% ($p<0.05$). The proportion of students scoring between 6-10 increased from 22% in the pre-test to 88% in the post-test ($p<0.05$). Feedback analysis showed that 99.2% of students found CAL simulations beneficial, 98.4% agreed that CAL helped achieve learning objectives, and 96.8% recommended it to others. **Conclusion:** CAL is an effective alternative to live animal experiments in pharmacology practical, enhancing student engagement, comprehension, and assessment. It aligns with CBME requirements and offers an ethical, interactive, and flexible learning experience. Faculty support and infrastructure are crucial for its successful implementation.

INTRODUCTION: Pharmacology, as a discipline, is the study of how drugs exert their effects on the living systems. It involves understanding the properties of drugs and their actions, including interactions between drug molecules and receptors and how these interactions elicit an effect.

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Laboratory based practical classes, which includes the demonstration of drug effects on tissues or on whole animal, has been the central feature of undergraduate pharmacology learning [1].

The new curriculum of NMC for Pharmacology is based on competency based medical education (CBME). In recent years the UG training in pharmacology has been revolutionized with the adoption of several innovative teaching approaches such as small group discussions, role plays, computer assisted learning (CAL) and use of audiovisual aids [2, 3]. It has tremendously changed the viewpoint of practical Pharmacology for

undergraduate medical students. CPCSEA rules and regulations have been adopted in this new curriculum of National Medical Commission [4, 5, 6]. Live animal experiments have problems of availability, procurement, cost, and maintenance, use of animals and ethics regulations. The basis is '3 R' *i.e.* Reduction, Refinement and Replacement in animal experiments, with the 4th'R' (Rehabilitation) as an added measure for animal care [7]. In this changing scenario, development of alternatives is the need of the day. The use of live animal experiments is decreasing in many medical colleges across India [8]. Replacement of animal dissection by computer simulated model (CSM) has made pharmacology learning highly interactive and motivating. Various computer animal experiments simulated software are now being used to teach the pharmacokinetics, pharmacodynamics, effects of drugs on autonomic nervous systems, cardiovascular system *etc* [9, 10]. CAL in pharmacology includes collection of animal experiments on software package which helps in understanding concepts and techniques in pharmacology [11]. The present study is planned to see the students' response to animal simulators as CAL in teaching-learning and assessment using the software of EX PHARM. This study is based on one of the 3R (replacement of animal experiments) of CPCSEA directives.

Objectives:

1. Use of CAL as a teaching-learning method, as per CBME curriculum for practical Pharmacology for 2nd MBBS students.
2. Use of CAL as an assessment tool, as per CBME curriculum for practical Pharmacology for 2nd MBBS students.
3. Evaluate feedback responses of 2nd MBBS students to the software of CAL.

MATERIALS AND METHODS:

Ethical Consideration: The study was conducted with prior permission of Institutional Ethical committee (No.105/2022/TMCH). It is a prospective qualitative and quantitative observational study.

Inclusion Criteria: 2nd MBBS Students of Tezpur Medical College, present on scheduled days of practical participated in the study. 2nd MBBS Students of the institute, present on scheduled days of Assessment in the study.

Exclusion Criteria: Students not willing to participate in the study. Students absent on scheduled dates of practical session on CAL and Assessment.

Study Population: Students of 2nd MBBS of Tezpur Medical College present on scheduled days of practical and scheduled dates of Assessment participated in the study.

No. of students- 125.

Study Venue: Department of Pharmacology, Tezpur Medical College.

Study Tools: Computers with broadband connection facility and CAL software of Animal simulation in Pharmacology.

Documents used: Informed written consent forms, Pre-test/ Post-test sheets and feedback questionnaire, practical registers, answer sheets and mark sheet assessment of CAL.

Study Period: January- February 2023.

CAL sessions are planned after large group teaching learning sessions on Pharmacology of autonomic nervous system and ocular Pharmacology. This created a good theoretical background for this module.

Study Conduct:

1. There will be Pre-test of 10 marks with a set of 10 pre-validated single best response MCQs. The time allotted - 10 minutes.
2. Experiment planned is "Effect of drugs on rabbit eye".
3. The experiment procedure will be explained step by step and any doubt regarding the procedure will be clarified to the students.
4. Each student works individually on a separate computer. They will perform all by themselves, the CAL-animal simulator experiment in "practice mode" as per the stepwise procedure.

5. They worked with all 4 drugs provided in software. The time of 1 hour and 45 minutes was adequate for them to record effects of drugs as given in software. They carefully recorded the observations for all 4 drugs in computer.

6. This Practical was followed by Post-test (same 10 MCQS as in pre-test) of 10 minutes.

7. The students were asked to fill up the feedback questionnaires. It has 7 pre-validated structured Questions responses of which had to be recorded in form of Likert scale.

8. Assessment sessions will be conducted on the dates as scheduled for CAL practical examination. Here they work separately on each computer, in the "Examination mode" of the software. The unknown drugs are randomly allocated by default in the software itself. They have to identify 1 unknown drug and write 3 questions related to it. They will record observations and answers in an answer sheet, will be corrected and marks allotted. This is kept as a departmental record.

Statistical Analysis: "Paired Two Sample for Means" will be used for differences in score of pre and post MCQ tests and "Two Sample Proportion Test" will be applied for differences in range of scores in pre and post-tests. Microsoft Office Excel 2007 is used for these tests. Probability (p) value <0.05 was chosen for statistical significance. For other parameters, the responses are calculated as percentage. For open ended questions, common responses were pooled and expressed as % or in number.

RESULTS: List of drugs in CAL software of "Effect of drugs on rabbit eye" Drug.

1. Miotic- Pilocarpine
2. Active mydriatic -Phenylephrine
3. Passive -tropine/Tropicamide
4. Local anaesthetic – Lidocaine

TABLE 1: MEAN SCORE IN PRE TEST AND POST TEST (IN %)

	Pre test score (N=125)	Post test (N=125)	
Mean score (%)	36	71	P<0.05*

Difference between mean pre test score and post test score is statistically significant (p<0.05).

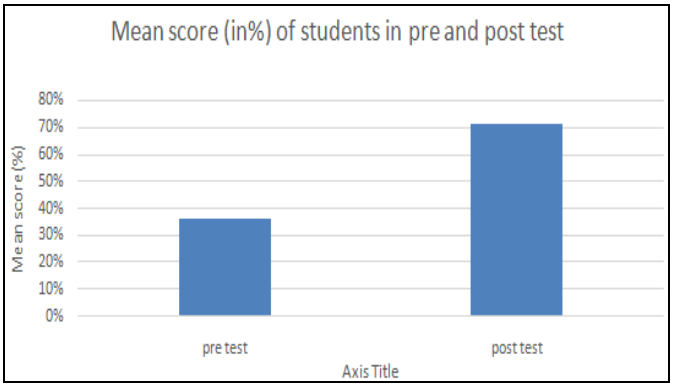

FIG. 1: MEAN SCORE IN PRE TEST AND POST TEST (IN %)

TABLE 2: PERCENTAGE OF STUDENTS IN GIVEN SCORE RANGE IN PRE AND POST TEST

Score Range	1-5	6-10	P value
Pre test	78	22	P<0.05
P0st test	12	88	P<0.05

Difference between pre test and post test score range is statistically significant (p<0.05)

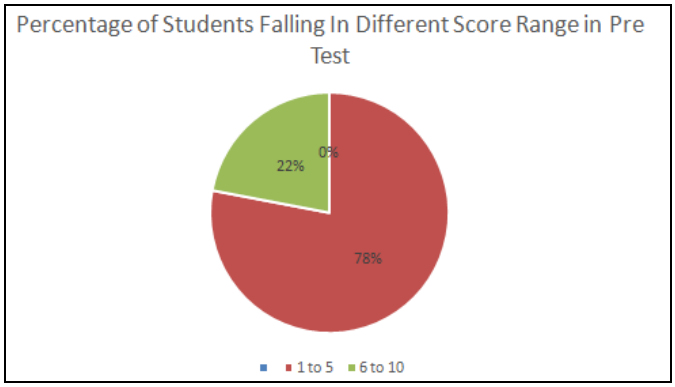

FIG. 2: PERCENTAGE OF STUDENTS IN GIVEN SCORE RANGE IN PRE TEST

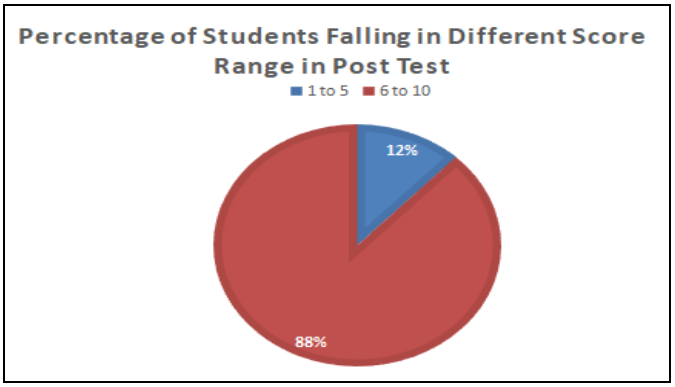

FIG. 3: PERCENTAGE OF STUDENTS IN GIVEN SCORE RANGE IN POST TEST

Fig. 4 shows % responses of students to structured questions of feedback questionnaire in Likert scale. The response was 99.2% (Strongly agree/agree). Overall the simulations being good, 98.4% for achieving the learning objectives, 99% for improved understanding of the subject after CAL. For question on recommending this CAL to others, the response was 96.8 % (Strongly agree/agree) while the questions of CAL being enjoyable is 95%, the time of practice session being adequate is 95% and the assessment of simulation being well designed the response is 93% (Strongly agree/agree).

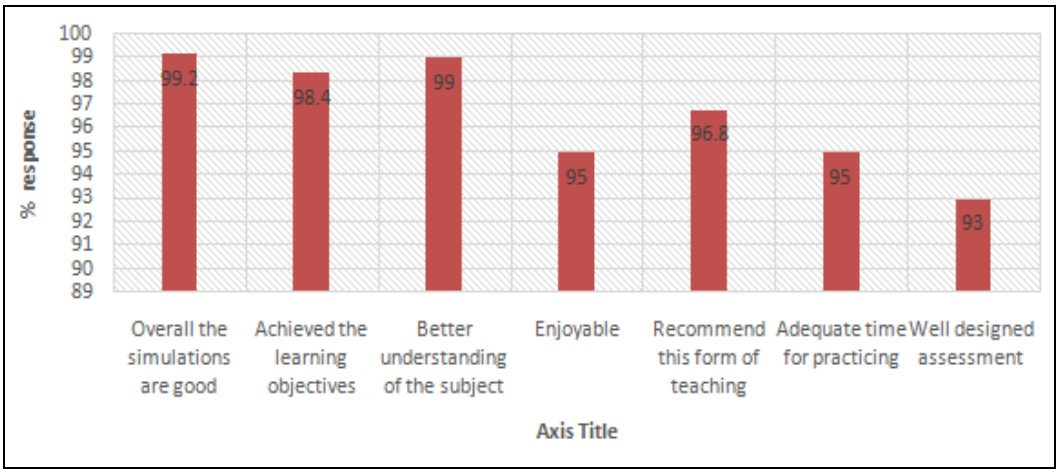

FIG. 4: PERCENTAGE RESPONSE OF STUDENTS TO STRUCTURED QUESTIONS IN FEEDBACK FORM

DISCUSSION: CPCSEA rules and regulations have abandoned unnecessary repetitive live animal experiments and follow the 4 "R" [3] in accordance with the CBME curriculum of practical Pharmacology for 2nd MBBS has been meticulously revised by NMC [4, 5]. The A-V impact, the interactive, interesting and personalized learning is a pleasant experience, as noted by users in earlier and in the present study. Meena S, Anjali R and Suraj P in their study found CAL as an effective educational and assessment tool for teaching Pharmacology to 2nd MBBS students from both student and faculty perspective which is similar to our study [7].

A study done by DK Badyal, Modgill V and J Kaur noted ethical advantage of Computer Simulated model and supports its use as a viable replacement for animal experiments avoiding unnecessary experimentation causing pain and trauma to animals [12]. Another study by Kopal S showed that students reported better comprehension and retention of pharmacological concepts with CAL. The study also identified challenges like technical issues, lack of hands-on experience and accessibility limitations in implementing CAL [13]. With basic infrastructure support, and proper faculty training is readily adaptable for use in many institutes [14]. Kuruvilla *et al* findings show that CAL experiments are less time consuming, many experiments can be performed and there was better visibility of the drug effects performed by CAL [15].

CONCLUSION: CAL is a good replacement to live animal experiments for 2nd MBBS students. It helps the students to understand concepts of drug actions, ADR and their choice. It is an interesting study tool equally acceptable to students & faculty. It reinforces lectures and provides an enriching experience of learning. The advantage of CAL is self- directed learning at his/her own speed and as per personal choices of time slot which will follow the general timetabled teaching learning sessions. This is of special importance in slow learners. Role of faculty members of Pharmacology along with basic infrastructure support is extremely important for implementation of this mode of teaching in curriculum of practical Pharmacology.

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