Computer Assisted Learning in Practical Pharmacology for 2nd MBBS Students: Perception of Students and Faculty

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ABSTRACT

Objectives:

1. Assess impact of Computer Assisted Learning (CAL) as animal simulator in practical Pharmacology on 2nd MBBS students
2. Evaluate feedback responses of students & faculty to CAL

Methods: Study was conducted in Pharmacology department of a tertiary care hospital. Students of 2nd MBBS and faculty members of Pharmacology department of this institute participated in the study. CAL sessions on "effect of drugs on rabbit eye" were conducted using software of Animal simulator of Reed Elsevier India. Students took pre and post MCQ tests. Feedback was obtained from students and faculty through questionnaire and interviews.

Statistical analysis was done by student's 't' test (p value < 0.5)

Observations and Results: Significant improvement in performance of students was seen in post-test. Average score increased from 48% to 77% after CAL. Range of score also improved. Most of students and faculty gave positive feedback about CAL in feedback questionnaire and interviews. Most of students opined that CAL helped to improve their understanding and was enjoyable due to AV impact. Faculty felt that most of the students were motivated in session and CAL would help them to retain knowledge about drug.

Conclusion: CAL is interesting, informative and motivating. It helps students to understand concepts about practical Pharmacology. Faculty opined that CAL is a good tool and should be included in regular teaching learning of practical Pharmacology.

Key Words: CAL, Perception, MBBS students, Faculty

INTRODUCTION

Curriculum of Pharmacology forms an integral part of medical education. It encompasses pharmacological actions, their mechanisms, indications, adverse effects, interactions and contraindications of drugs. In the past laboratory based practical classes showing drug effects on tissues or whole animal have been main method in curriculum of practical Pharmacology for 2nd MBBS.

Animal experiments have become difficult due to problems of availability, procurement, cost, maintenance, use of animals and ethics regulations (1,2,3). Guidelines by Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) and Medical Council of India (MCI),

suggest '3 R' i.e. Reduction, Refinement and Replacement in animal experiments, with the 4th 'R' (Rehabilitation) added as an added measure for animal care (4,5,6). Using animals in research and experimentation has been debated and protested at different levels. Practical training with animal experiments were felt unnecessary by medical students and faculty as their learning objectives primarily focus on observational, analytical and interpretative skills, which are components of the cognitive but not psychomotor domain (7). They have been phased out in many institutes (8).

Recent years have seen revolution in training in practical pharmacology for undergraduates (UG). Innovative teaching approaches such as small group discussions, role plays, au-

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dio-visual aids and Computer Assisted Learning (CAL) have been adopted (9,10). The proposed new curriculum of MCI "Vision-2015" for undergraduates has suggested simulation labs for Physiology and Pharmacology in UG curriculum. The required knowledge and skills should be imparted by using CAL, which is mandatory equipment (11). A welcome change in MCI recommendation insists that computerized learning should be an alternative to live animal experiments (12).

Many medical colleges have started implementing such alternatives in undergraduate courses(13). This integrated multimedia software performs as animal simulators which closely mimics reality. It has computer based packages, focusing on interactive instructions in a specific subject area with a collection of animal experiments. (7). One such CAL software from Elsevier is a good alternative (14). It has been found to be a good tool for experimental Pharmacology (15, 16). The present study was planned to assess impact of CAL on students' performance and seek the opinion of faculty and 2nd MBBS students on various aspects of CAL as a teaching learning module of practical Pharmacology.

METHODS

Ethical consideration: Prior permission to conduct this study was obtained from Institutional Ethics committee. It was a prospective mixed (qualitative & quantitative) open ended observational study.

Inclusion Criteria: Students of 3rd semester of second MBBS at Tertiary Medical Institute and faculty members of Pharmacology department of author's institute

Exclusion criteria: Students absent on scheduled date of practical session on Computer Assisted Learning (CAL) or students not willing to sign informed written consent form

Study population

Students-Second MBBS Students of 3rd semester 2nd MBBS, present on scheduled days of practical (N-132) participated in the study.

Faculty- All faculty members of Pharmacology department (N-5) participated in this study.

Study venue: Department of Pharmacology and Digital Library of institute

Study tools: 20 computers with broad band connection facility and CAL software of Animal simulation in Pharmacology obtained from Reed Elsevier India Pvt Ltd.

Documents used:

For students- Informed written consent forms, pre-test/ post-test sheets and feedback questionnaire

For Faculty- Different sets of documents were used: Informed written consent forms, feedback questionnaire and sheets of interview questions

Procedure

CAL sessions- The investigator conducted in all, 4 CAL sessions. Maximum number of students participating in any CAL session was 40. All faculty members (N-5) of Pharmacology department of institute participated in these 4 sessions. The steps of procedure and time for each are depicted in figure 1 (for students) and figure 2 (for faculty)

Introductory session: It was held a day before taking up CAL in which students and faculty members were explained to their satisfaction, the details of the procedure and contents of informed written consent form. Faculty members were already trained in CAL simulation exercise for the study. Additionally, they were explained about the format of the informed written consent and post CAL interview session.

Pre and post-tests of 10 marks having similar set of 10 pre-validated single best response Multiple Choice Questions (MCQs) were conducted for students. The questions were based on methodology, drug actions, adverse reactions and drug choices in relation to CAL experiment.

The Experiment chosen for CAL was "Effect of Drugs on Rabbit Eye"

Some modifications were done suited to local set up. The software had the inbuilt facility for pre and post -tests, but in author's opinion, the MCQs were based mostly on methodology. Hence they were modified by author and MCQ test was conducted separately to extrapolate the findings of CAL to clinically relevant information like ADR and choice of the drugs. Two students worked on one computer. They recorded the observations in their practical journals as per the format of table in software. Table1 indicates details of drugs and parameters included in CAL. Observations recorded by one student have been shown in it as a representative sample. Thus each student had the record of his own observation for further reference. Students performed all by themselves, the CAL-animal simulator experiment as per the guidelines provided in software. Faculty members, although available at all the time of CAL, intervened only if students asked for assistance.

Separate feedback questionnaires were filled by students and faculty. Some questions were different for faculty and students. Questionnaires had pre-validated structured Questions (7 for students and 8 for faculty), responses of which had to be recorded in form of Likert scale (14,17). They had open ended questions too (3 for each group). Students were informed that revealing of identity in the questionnaire form was optional. Interview session of each faculty was conducted for 30 minutes. The responses were written in in-

terview sheet by investigator and were countersigned after due verification by concerned faculty. To reinforce their understanding, CAL session was planned after lecture sessions on Pharmacology of autonomic nervous system and ocular Pharmacology. This created a good theoretical background for CAL session.

Statistical Analysis

Statistical analysis was done by student's 't' test ("Two-Sample Assuming Unequal Variances"). This was applied for differences in score of pre and post MCQ tests. Probability (p) value <0.05 was chosen for statistical significance. For other parameters, the responses were calculated as %. For open ended questions, common responses were pooled and expressed as % or number.

Observations and results

There was significant improvement in performance of students in post-test-average & range of scores ($p < 0.00005$). The mean score of students in pre-test was 48.7% which increased to 77% in post-test (Chart 1). The range of score of 1-4 reduced from 39 % students (pre-test) to 2% students in post-test. The range of score of 5-10 increased from 61% students (pre-test) to 98% students in post-test (Charts 2A and 2 B). Similarly, it was noted that the score of each student improved significantly ($p < 0.0005$) in post-test.

Chart 3 indicates feedback responses of students and faculty members to the structured questions in Likert scale. More than 80% students and faculty gave positive feedback (Strongly agree/agree) to questions- overall simulations being good, improvement in students' understanding and written instructions of animal simulator being useful. They enjoyed CAL and wanted to recommend it to others. Both groups felt that session time of CAL was adequate. All students opined that they achieved their learning objectives, while all faculty members felt that students showed interest in CAL. Similarly faculty members opined that they had achieved new skills of training.

The notable responses of students and faculty to open ended questions of feedback questionnaire are summarized in table 2. The responses to questions posed to 5 faculty members in interview sessions are summarized in table 3.

The students were instructed to write the answers to 3 short questions (for all 9 drugs tested- Table 1) in form of homework after CAL. They were as follows:

- 1) Write mechanism of ocular action of the drug
- 2) Write ocular adverse effects of the drug
- 3) Write ocular uses of the drug

All students completed the homework to the satisfaction of faculty members.

DISCUSSION

Are live animal experiments necessary?

It is presently felt that some students may have to perform live animal experiments, especially those aiming a career in research. But for many others, these skills are not needed. Many problems are noted with animal experiments like biological variations, time spent, number of drugs tested, difficulties in imparting skills, showing demonstrations to large number of students and overall cost(7,9,18). Ethical issues of live animal experiments have been already mentioned.

CAL is a good alternative:

Computers with audiovisual aid capabilities can be a good alternative to provide an interactive and personalized learning experience which encourages self-directed learning(8). "Use of CAL as animal simulator elevates the teaching learning process to new level of sophistication and better implementation of imparting knowledge and skills to strengthen the learning experience of students. This virtual experience gives near to real idea of experiments and bridges the gap between didactic theoretical lectures and real animal experiments"(19).

In this study, significant improvement in score of post-test in students as a group as well as individual student indicates that CAL is a good learning method to impart knowledge of experimental Pharmacology. Earlier studies have shown that the students had a better average score in CAL module as compared to the method using animals. They found that it took only 2 hours for each student to understand the whole topic of CAL (14, 20,21). In this study too, students pointed out in their feedback that time of CAL was adequate. The improvement of performance in post-test in individual student emphasizes that CAL can be a very good tool for all type of students, especially below average students. This is in agreement with study done by Kopal Sharma et al(19).

The feedback in form of questionnaire and interviews is very good method to evaluate opinion of students and faculty about a teaching learning module (9,15). They were used to seek the opinion of students and faculty about CAL. There was a positive responses from both groups (80% and above) and showed that they accepted CAL as a very good method to impart training in experimental Pharmacology. They opined that the software was good, enjoyable and its audio-visual impact helped to improve students' understanding, clarify concepts and achieve their learning objectives. 94% and above expressed that CAL should be conducted for other experiments of Pharmacology. Students had enough time at individual level to perform CAL, as observed by faculty members. Some students (52%) in their feedback to open questions opined that CAL should be conducted for other subjects like Physiology. All faculty members felt they

were satisfied and motivated to conduct CAL sessions. In the interview sessions, faculty opined that CAL had a great role to play in practical Pharmacology. Previous studies have also conducted such feedback surveys. According to their undergraduate students CAL was good, quick, effective, interesting and improved their understanding. It made them confident since it was time independent, had no errors and was repeatable and was self-explanatory. It could be repeated several times as per need of students in contrast to animal studies (3,13,15). However the student population of this study have not been exposed to live animal experiments. They did not get opportunity to perform repeat session of CAL due to tight schedule of teaching.

In this study feedback of faculty members (who worked on live animals in their student life) is important. It is in agreement with previous studies in which teachers opined that CAL was much better than practical animal experiments for undergraduates. The audiovisual impact clarified the topic in better manner (14,22). CAL is feasible and very effective module in Pharmacology with huge potential to change the way of teaching learning activities, as it meets majority of the learning objectives (2).

Status of CAL in Practical Pharmacology

In this study a single session of CAL with one experiment was conducted for one batch of 2nd MBBS students. It has been indicated by Lexin Wang (17) that "Timetabled CAL" is a good tool under close supervision by faculty and it is better if preceded by lectures and hand-outs. The author agrees with this view, since in present study 15% students needed help and guidance from faculty while performing CAL. These students felt time was less due to difficulty in operating software. Here faculty members suggested that 2-3 sessions of CAL per semester for each batch (6-10 in total) should be conducted. However, it may not be feasible to accommodate big batches with limited number of computers and time constraints of curriculum. Even if many students were comfortable in using computer, if students are left to themselves, some may lose time and direction of study. Though it is a module of self-study, faculty must be present during such sessions for supervision. Faculty members appreciated the contribution of CAL in improving understanding of subject, 2 members had doubt about long term benefit of CAL in Rational Use of Drugs (RUD) and its clinical extrapolation.

Earlier studies have pointed out shortcomings of CAL. Commonest reasons given by the students (92%) is that, experiment is programmed with prefixed doses, therefore the exploration with different doses is not possible. Lack of interaction with live animals was also considered as a negative point of CAL. Students opined that it didn't teach laboratory skills (1). However, author feels that for undergraduate students of MBBS it is not necessary. In the study by Tarun

Sharma et al (9), 97% students believed that the experiments on living tissue in laboratory are easier to remember. They also observed that CAL required expertise to handle technical errors related to computers and is an expensive method of teaching. In present study few students had such technical difficulties and the institutional IT team had to help them. In study by Lisha et al (7), faculties often lack time to develop skills to integrate this new method of teaching-learning strategies. On the contrary here, faculty members gave feedback that they were happy, enthusiastic and motivated to have learnt a new technique. However they were concerned about set up and availability of IT persons for all CAL sessions. Presence of dedicated IT staff is indeed necessary on days of CAL sessions and maintenance of the software and hardware.

Future prospects

CAL is student-centric tool for self-study and self-assessment. One computer per student would be ideal to enable paperless practical, use of tutorial mode and examination mode of CAL in Elsevier animal simulator. We may start with formative assessment. Present recommendations of MCI (11) is to provide minimum 1 computer for 10 students, but this enables only demonstration of CAL, which is not its ideal use. Further, such CAL should be made mandatory in summative university practical examinations. It may take quite some time to make it feasible in all medical colleges because of high initial and maintenance cost of digital library with CAL facility.

CONCLUSION

CAL is 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 best benefit for students is drawn if it allows personalized self-learning at their own pace, which is preceded by CAL sessions with time-tabled slots (8, 17). Faculty of Pharmacology should play vital role to insist on inclusion of CAL as an essential component of the standard curriculum of practical Pharmacology.

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Figure 1: Procedure of CAL for students of 2nd MBBS.

Figure 2: Procedure of CAL for Faculty members of Pharmacology department.

Table 1: Format of observations: CAL on “Effect of drugs on rabbit eye”

(Sample observations-as noted by one student during experiment)

Rabbit no	Eye	Drug/ Normal saline Eye drops	Intraocular tension (mmHg)			Light reflex		Corneal reflex		Pupil size (mm)		
			Before	After	Difference	Before	After	Before	After	Before	After	Difference
1	Left	Normal saline	15.4	15.4	0	+	+	+	+	6	6	0
2	Right	Pilocarpine	15.4	14	-1.4*	+	+	+	+	6	2	-4*
3	Right	Physostigmine	15.4	14	-1.4*	+	+	+	+	6	1	-5*
4	Right	Atropine	15.4	15.6	+0.2	+	-*	+	+	6	10	+4*
5	Right	Epinephrine	15.4	14	-0.4	+	+	+	+	6	10	+4*
6	Right	Ephedrine	15.4	15.6	+0.2	+	+	+	+	6	8	+2
7	Right	Phenylephrine	15.4	15.3	-0.1	+	+	+	+	6	9	+3*
8	Right	Amphetamine	15.4	18.6	+3.2*	+	+	+	+	6	8	+2
9	Right	Cocaine	15.4	14.3	-1.1*	+	+	+	-*	6	8	+2
10	Right	Lignocaine	15.4	15.8	+0.4	+	+	+	-*	6	6	0

Note: *Observations to be noted carefully

Chart 1: Mean % score of students in pre & post MCQ test (N-132)*Significant difference in score of pre and post-test($p < 0.00005$) **Chart 3:** Feedback of students (N-132) and faculty (N-5) on structured questions. **Chart 2A and 2B:** Comparison of range of marks in pre & post-test (N-132)*Significant decrease in % of students scoring range of score (zero to four) in post-test ($p < 0.00005$)**Significant increase in % of students scoring range of score (five to ten) in post-test ($p < 0.00005$)

Table 2: Responses of students (N-132) and faculty (N-5) to open questions of feedback questionnaire

Question	Salient comments (% students)
Long term benefit of CAL on learning of Pharmacology	90% found it as enjoyable learning, easy to remember Cleared concepts due to visual impact Actual feel of performing practical Simple procedure, better approach to teach and learn Pharmacology Very good technique of TL of practical
Difficulties faced while performing CAL	15% had initial problem in working on computer and felt time was less
Any other suggestions	Would like to have other experiments of CAL more frequently (80%) Other subjects should take it up (30%)
Question	Salient comments Faculty (All)
Long term benefit of CAL on students' learning of Pharmacology	Active participation of students Visual impact made it easy to remember and understand concept Students were satisfied & motivated (90%) CAL will help them to retain long lasting knowledge about drugs
Difficulties faced by you during CAL	Had to help many students in beginning
Any other suggestions	2-3 sessions of CAL per semester (6-10 total) Introduce CAL for more experiments Software must be available at all times

Table 3: Responses of faculty (N-5) in interview sessions. Number in bracket indicates N of faculty members responding to question

SN	Question	Responses
1	Your opinion about replacement of animal experiments with CAL	For students: Visual impact & easy to remember, clears concepts Students more interactive and interested, can do it repeatedly
2	How was your learning and teaching experience of CAL?	For Students: They were satisfied, motivated and happy, For us :Interesting & informative, got satisfaction of training
3	How to improve upon this module at our institute?	More time and more sessions, lectures and demonstrations should precede CAL Make available one computer/student
4	Can CAL be a module for self- driven learning in students?	Yes, in other experiments and in form of tutorials
5	Will CAL help the students to understand drug actions, ADR and their clinical use?	Yes (3), to some extent (2) ,
6	Impact of CAL on students for RUD in clinical practice?	Good (3) some (2)
7	How many sessions of each CAL?	2 sessions (2), 1 session (3)
8	How many CAL for each batch?	6 (3), 8 (1) , 10 (1)
9	Your opinion about including this module for assessment of students?	(All 5) Good, objective and interesting module to assess Cost of set up, IT staff must cooperate