



# "Computer-Assisted Learning (CAL), a Teaching-Learning and Assessment Tool for CBME Curriculum in Practical Pharmacology for 2nd MBBS Students"

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## ABSTRACT

**Introduction:** The use of Computer-Assisted Learning is an important step to implement recommendations of CPCSEA and recently introduced CBME curriculum in practical Pharmacology. It uses the principles of replacing live animal experiments with animal simulator.

### Objectives:

- 1) Assess the impact of Computer Assisted Learning (CAL) as animal simulator in teaching learning and assessment of 2<sup>nd</sup> MBBS students in practical Pharmacology
- 2) Evaluate feedback responses of these students to CAL

**Methods:** This study was done in Pharmacology department of a tertiary care hospital. Students of 2<sup>nd</sup> MBBS 3<sup>rd</sup> semester, undergoing training in new curriculum of CBME (Competency Based Medical education) as per the directives of NME (old MCI) and MUHS (Maharashtra University of Medical Sciences), Nasik participated in this study. CAL sessions on "effect of drugs on rabbit eye" were conducted using software of Medimation Education Pvt Ltd Mumbai. Pre and post tests were conducted to test the impact of student learning. Feedback questionnaire was filled up by students. Assessment of CAL was done in 1<sup>st</sup> IA (Internal Assessment) of these students and performance was evaluated from the scores. p-value < 0.5 was considered as significant.

**Observations and Results:** It was observed that the performance of the students improved significantly in post- test. Average score increased from 44.4% to 73.5%. The range of scores (1-5 and 6-10) improved significantly in post- test. A positive feedback about CAL was seen in most of structured and open ended questions. Most of the students felt that was that CAL improved their understanding of concepts due to AV impact. The mean score in 1<sup>st</sup> Internal Assessment of CAL was 75%.

**Conclusion:** CAL is an interesting, informative and motivating tool for teaching learning and assessment in practical Pharmacology. It is a good replacement for live animal experiments. It helps students to understand and clarify the basic concepts.

**Key Words:** CAL- teaching-learning and assessment, 2nd MBBS students, CBME curriculum-practical Pharmacology

## INTRODUCTION

The importance of practical Pharmacology is to encourage, build up and apply the theoretical knowledge about basics of drug actions, their mechanisms and adverse reactions. It must help the undergraduate students to choose right drug for right patient and put a step forward to practice rational therapeutics while prescribing the medicines. Live animal experiments have the 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 4<sup>th</sup> 'R' (Rehabilitation) added as an added measure for animal care. <sup>1,2</sup> There have been debates and objections at different levels about using animals in research and repetitive experiments. <sup>2,3</sup>

- The new curriculum of NMC and MUHS for Pharmacology is based on competency based medical education (CBME). It has tremendously changed the viewpoint of practical Pharmacology for undergraduate medical students. Skill building and its clinical application is now important as never before. CPCSEA rules

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ISSN: 2231-2196 (Print)

ISSN: 0975-5241 (Online)

Received: 05.10.2021

Revised: 21.10.2021

Accepted: 08.11.2021

Published: 16.01.2022

and regulations have been adopted in this new curriculum of National Medical Commission (old MCI) and Maharashtra University of Medical Sciences (MUHS).<sup>1, 4, 5</sup> It is now mandatory to stop the older methods of teaching learning and assessing the students through live animal experiments or animal experiments in form of static graphs, data tables, instruments & photographs. Instead, such skill will be developed by animal simulation experiments in Computer Assisted Learning (CAL), which almost mimics reality. This is a welcome change after a wait of many years and will be immensely important in learning systemic Pharmacology especially of autonomic, cardiovascular and central nervous system.<sup>6, 7</sup> It has computer based packages, which focus on interactive animal experiments. Such software versions of CAL are good tools for experimental Pharmacology. Being user friendly, they allow active participation of learner, making it interactive and interesting. Such alternative approach of teaching learning and assessment to the “theoretical” practical sessions on animal Pharmacology, acts as a great motivation for students and teachers alike.<sup>2, 8, 9</sup> The animal simulation has a great advantage of repeated practice as self-learning tool. This improves the performance of the students in OSPE.<sup>10</sup> One such CAL software has been developed for CAL in practical Pharmacology by Medimation Education Pvt Ltd, Mumbai.<sup>11</sup>

- Present study was planned to see the students’ response animal simulator as CAL in teaching-learning and assessment using the software of Medimation Education Pvt Ltd. This was done as per the regulatory requirements of NMC and MUHS curriculum in practical pharmacology. This study is based on one of the 3R (replacement of animal experiments) of CPCSEA directives.

### Objectives

- Use of CAL as a teaching-learning and assessment tool, as per the Curriculum of MUHS for practical Pharmacology for 2<sup>nd</sup> MBBS students
- Evaluate feedback responses of 2<sup>nd</sup> MBBS students to the software of CAL

### Methods

Ethical consideration: Prior permission to conduct this study was obtained from departmental academic committee, since it was a part of regular academic activity in practical Pharmacology. It was a prospective mixed (qualitative & quantitative) open ended observational study.

### Inclusion Criteria:

- 2<sup>nd</sup> MBBS Students of the institute, present on scheduled days of practical (N-71) participated in the study.
- 2<sup>nd</sup> MBBS Students of the institute, present on scheduled days of 1<sup>st</sup> IA (N-71) participated in the study.

### Exclusion criteria:

- Students not willing to sign informed written consent form
- Students absent on scheduled dates of practical session on CAL and 1<sup>st</sup> IA

### Study population

Students- Students of 3rd semester of 2<sup>nd</sup> MBBS present on scheduled days of practical and scheduled dates of 1<sup>st</sup> Internal Assessment (N-71) participated in the study.

**Study venue:** Department of Pharmacology and Digital Library of tertiary care medical college of central India

**Study tools:** 40 computers with broadband connection facility and CAL software of Animal simulation in Pharmacology “Wonderstand Experimental Pharmacology interactive Assessment modules by Medimation Education Pvt Ltd Mumbai”, installed in all 40 computers

### Documents used:

Informed written consent forms, pre-test/ post-test sheets and feedback questionnaire, practical registers, answer sheets and mark sheet of 1<sup>st</sup> IA of CAL

**Study period-** May- June 2021

CAL sessions were deliberately 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.

### Steps of Procedure were as follows (Fig 1)

A) An introductory session of 2 hours was conducted in lecture hall for 2<sup>nd</sup> MBBS students (71) who participated in study. This session was conducted one day prior to the CAL practical session. They were explained to their satisfaction the contents of the informed written consent form, which was signed by all. Thereafter, the investigators conducted Pre-test of 10 marks with a set of 10 pre-validated single best response MCQs. The time allotted was 10 minutes. They were meticulously selected to cover the methodology, actions of the drugs, their ADR and drug choices, all in relation to CAL experiment of “Effect of drugs on rabbit eye”. This was followed by a 20 minutes video of provided by the Medimation Company. It demonstrated the effect of autonomic nerves and related drugs on eye. It also elaborated the procedure and precautions about the experiment. This created a good background for the students to work on the said software.

The investigators then explained at length the procedure again step by step and any doubt regarding the procedure to be adopted was clarified to the students. Before this introductory session of CAL investigators and other faculty members of the department had trained themselves in CAL simulation exercise by repeated use of practice and examination mode of the said software.

B) Two practical sessions of CAL of 2 hours each were conducted. The software of CAL as animal simulator was “Wonderstand Experimental Pharmacology interactive Assessment modules by Medimation Education Pvt Ltd Mumbai” installed on all 40 computers with BB connection facility. The Experiment of “Effect of drugs on Rabbit Eye” in the software was available in “**practice mode**” and “**examination mode**”. In these two sessions, the students worked in “**practice mode**”

Maximum no of students allowed in each session was 36. Each student worked on separate computer. They performed all by themselves, the CAL-animal simulator experiment in “**practice mode**” as per the stepwise procedure in the flow chart shared with them on whatsapp group (a common flow chart was prepared by departmental faculty to facilitate students to perform experiment with all drugs). They worked with all 4 drugs provided in software. The list of the drugs is given in table 1. 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 as well as in their practical journals, as per the format of tables provided in software. Though the recorded observations of each student were available in the respective computers, the journal record helped them as reference to prepare for assessment of CAL.

Faculty members of Pharmacology department were available at all times of the sessions, but intervened only of students asked for help. In all sessions of CAL, practice or assessment, the IT professionals of the institute were also present and were a tremendous support in addition to our departmental support staff.

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

The last activity of 2 hour session for the students was to fill up the feedback questionnaires. It had 7 pre-validated structured Questions<sup>7</sup> responses of which had to be recorded in form of Likert scale.<sup>2</sup> It also had 5 open ended questions too. Revealing of identity in the questionnaire form was optional. But many students wrote their roll numbers and names on the feedback form. The students completed the form in approximately 10 minutes.

C) Two Repeat Practice sessions of CAL-(Teaching learning) of 2 hours each were conducted in the following week. Maximum 36 students were included in each session. Here all of them completed questions related to drugs in their journals and they were initiated by the faculty of department. The Students had to write answers to following questions separately for all 4 drugs:

- i) Write the mechanism of ocular actions of the drug
- ii) Write its ocular adverse reactions
- iii) Write its ocular therapeutic uses

D) Three assessment sessions were conducted on the dates as scheduled in 1<sup>st</sup> IA practical examination. Maximum 25 students worked on each day. Here they worked separately on each computer, in the “**Examination mode**” of the software. The unknown drugs were randomly allocated by default in the software itself. They had to identify 1 unknown drug and write 3 questions related to it (as above). They recorded observations and answers in an answer sheet, they were corrected and marks allotted by departmental faculty according to the correct identification and other answers. This was kept as departmental record, additionally, observations and identity of unknown drug were available as per students’ roll no on the respective computers.

### Statistical Analysis

“Paired Two Sample for Means” was used for differences in score of pre and post MCQ tests and “Two Sample Proportion Test” was applied for differences in range of scores in pre and post-tests. Microsoft Office Excel 2007 was used for these 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 in number.

## RESULTS

There was significant improvement in performance of students in post-test-mean & range of scores ( $p < 0.00005$ ). Chart 1 shows improvement of the mean score of students from pre-test of 44.4% to 73.5% in post-test. The range of score of 1-5 reduced from 87.30% (pre-test) to 1% in post-test. The range of score of 6-10 increased from 12.70% (pre-test) to 99% in post-test (Charts 2 and 3).

Chart 4 shows % responses of students (N-71) to structured questions of feedback questionnaire in Likert scale. The response was 100% (Strongly agree/agree) for questions of Overall the simulations being good, achieving the learning objectives & improved understanding of the subject after CAL. For question on recommending this CAL to others, the response was 98.6 % (Strongly agree/agree) while the questions of CAL being enjoyable, the time of practice session being adequate and the examination mode of simulation being well designed the response was 97.2% (Strongly agree/agree). Salient responses (% or No) of students to open ended questions of feedback questionnaire are given in table 2.

## DISCUSSION

**CAL is mandatory in new CBME curriculum of practical Pharmacology for 2<sup>nd</sup> MBBS.**<sup>4,5</sup>

CPCSEA rules and regulations have abandoned unnecessary repetitive live animal experiments and follow the 4 “R”,<sup>1</sup> in

accordance the CBME curriculum of practical Pharmacology for 2<sup>nd</sup> MBBS has been meticulously revised by NMC and accordingly by MUHS, where the skills of such type can be imbibed by CAL as a replacement to such animal experiments.<sup>4,5</sup> Not only CAL overcome disadvantages of live animal experiments, but the young computer savvy students are “at home” with the user friendly software. 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.<sup>2,9,12</sup> Use of CAL as an animal simulator helps to improve the knowledge and skills in undergraduate practical Pharmacology and has a very good impact in form of a student friendly technology. This interactive method raises the level of imbibing depth of learning which is long lasting. This virtual experience gives near to real idea of experiments and bridges the gap between didactic theoretical lectures and real animal experiments”.<sup>12</sup> Different CAL soft wares have been used for practical Pharmacology.<sup>2,6,13</sup> In the present study the software of Medimation Education Pvt ltd Mumbai<sup>11</sup> was used. In their feedback most of the students wrote that it was very good, enjoyable, interesting and interactive. The AV impact made the understanding and clearing of the basic concepts of Pharmacology easier. All students could achieve their learning objectives and 98.6% wanted CAL for other exercises of practical Pharmacology as summarized in table 2.

In the present study, significant improvement in score of post-test in students confirms that CAL is a good learning approach to imbibe long lasting knowledge and emphasize basic concepts of practical Pharmacology. Earlier studies have shown similar results. The 2 hour session is adequate to achieve the objectives according to earlier studies, and pointed out by our students in feedback and reported in earlier studies.<sup>14,15,16</sup>

The feedback questionnaire has been used to evaluate opinion of students and faculty about a new teaching learning module for e.g. CAL as alternative to animal experiments.<sup>2,10,16</sup> In the present study the questionnaire (with structured and open ended questions) was found to be very effective method to find students’ opinion about CAL. They filled up the questionnaire quite elaborately, seriously and firmly expressed their opinion. They were very much positive, satisfied and accepted the software that was used as CAL for teaching learning as well as in assessment. Similar responses have been recorded in earlier studies also.<sup>2,3,14,17,18</sup> Answers to the open ended questions showed overwhelming positive responses, they found it very interesting and effective method of teaching learning. It was possible to repeat the procedure at their own speed to their satisfaction. Students were happy that CAL could fetch them very good marks (maximum 10). They could overcome few technical snags and operational difficulties in repeat sessions and were well prepared for 1<sup>st</sup> IA. Faculty members and IT professionals clarified these is-

ues. The module of assessment has been used successfully as reported in earlier studies.<sup>6,13</sup> The performance of students was very good in “examination mode” added with answers to 3 questions, they had already practiced. The mean score here was 75%.

### Future prospects and limitations

As CAL is mandatory for 2<sup>nd</sup> MBBS curriculum of practical Pharmacology,<sup>4,5</sup> the department has used it for teaching learning and 1<sup>st</sup> IA and will use it for all future IA and university practical examinations. Another CAL software for “Effect of drugs on dog blood pressure” by Medimation Education Pvt Ltd is awaited in department. As soon as it is procured, it will be used for teaching learning and assessment. We are confident that this new software will help students to learn autonomic and cardiovascular Pharmacology in better manner. The limitations of CAL have been reviewed in details by Lishaet al.<sup>6</sup> We did face problem of availability of departmental faculty and IT personnel in the sessions. At times we faced technical snags and problem of continued broad band network during the CAL sessions. The high initial and maintenance cost of CAL lab is definitely an important limiting factor, but now being mandatory in curriculum, administrative authorities have to procure it. Unlike reports of earlier studies,<sup>6</sup> we have observed that our faculty welcomed the change, rather they adapted themselves very well to it and trained themselves in CAL with great enthusiasm as shown by their feedback in our earlier study<sup>2</sup> and present study.

### CONCLUSION

CAL is good replacement to live animal experiments for 2<sup>nd</sup> 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.<sup>8,17</sup> Role of faculty members of Pharmacology is extremely important for implementation of this change in curriculum of practical Pharmacology.

### ACKNOWLEDGEMENTS

The authors humbly acknowledge whole hearted support from Dean, Dr Dharmaraya Ingale, Medical Director, Dr Pradeep Kulkarni, our colleagues in Pharmacology, Dr Vidya Mali (Tutor), Shri Aniket Shinde, Sr. Clerk, Shri Prasad Patil, Technician, Shri Swapnil Kamble (IT Professional),



Shri Vishwas Salagare (Statistician) and participant students of 2<sup>nd</sup> MBBS, 2019 batch of Prakash Institute of Medical Science and Research, Islampur..

The Authors hereby also sincerely acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript and are grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

**Source of Funding-** We hereby declare that this research work has not been funded by any agency in any form.

**Conflict of interests:** We hereby declare that there are no conflicts of interests, whatsoever, in any form, in relation to this research work and its publication

#### Authors' Contribution:

Meena Shrivastava

Planning of the research project, preparation of the protocol, supervising the research project and its progress, collection of references and writing the manuscript

Anjali Ravindra Shinde

Conducting and supervising the research project and helping to prepare the protocol and analysis of the data

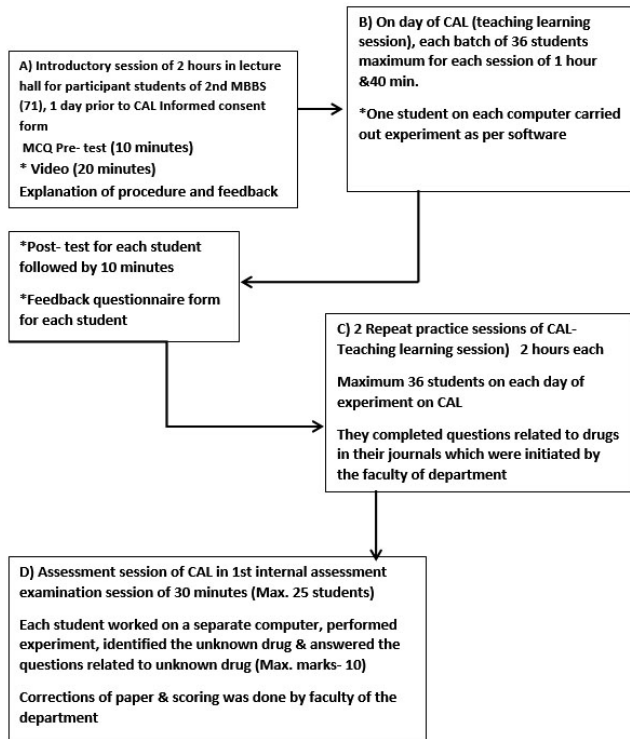
Suraj Patil

Conducting the research project and compilation of the data

Copy of informed consent form is attached separately with the mail.

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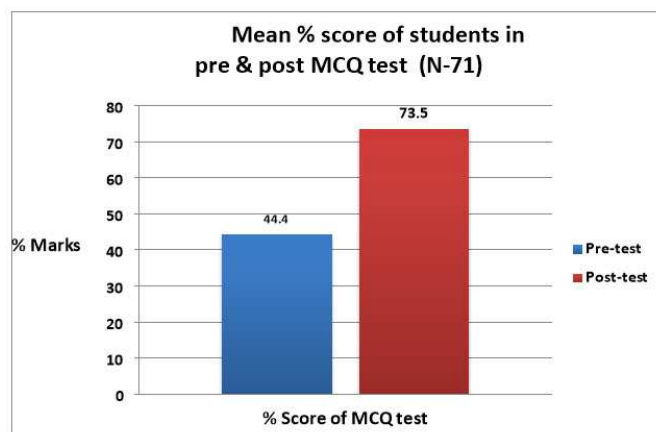
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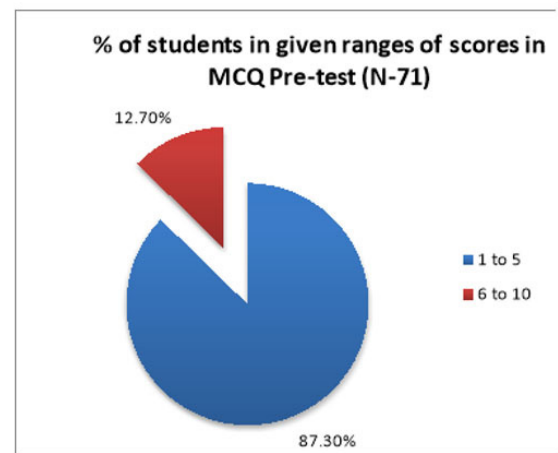
**Table 1: List of drugs in CAL software of “Effect of drugs on rabbit eye” (Medimation Education Pvt Ltd)**

SN	Drug group	Drug
1	Miotic	Pilocarpine
2	Active mydriatic	Phenylephrine
3	Passive mydriatic	Atropine/Tropicamide
4	Local anaesthetic	Lidocaine

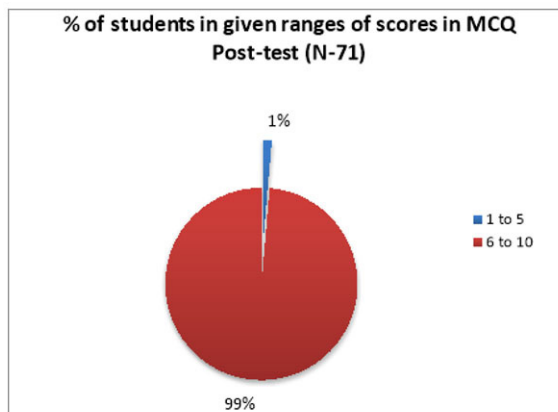
Mean score (%) improved significantly ( $p < 0.00005$ ) in post-test in comparison to that of pre-test



**Chart 1**



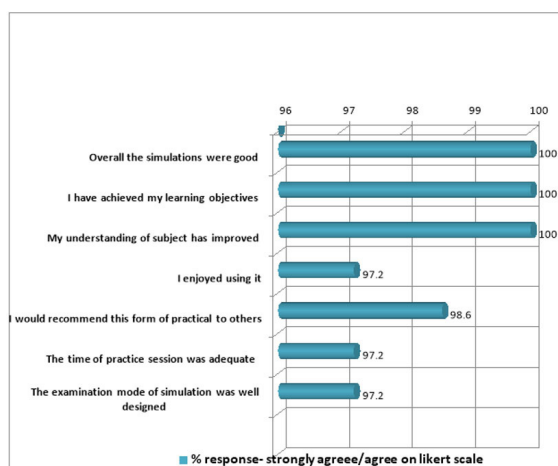
**Chart 2**



**Chart 3**

\*% of students in score range of 1-5 decreased significantly in post-test ( $p < 0.00005$ )

\*% of students in score range of 6-10 increased significantly in post-test ( $p < 0.00005$ )



**Chart 4:** % responses of students (N-71) to structured questions of feedback questionnaire form.

**Table 2: Responses of students (N-71) to open questions of feedback questionnaire form**

SN	Question	Responses (% or no of student/s) 90% or >* 70%** 60%*** 1 student #
1	What according to you will be long term benefits of this CAL on your learning of Pharmacology?	<p>*Simplified, easy &amp; interesting practical training</p> <p>*Improves understanding &amp; remembering</p> <p>*Cleared concepts about actions ADR and therapeutic uses of drugs</p> <p>*Better visualization, unforgettable visual experience giving pictorial memory, longer retention of knowledge &amp; removes confusion</p> <p>almost like performing experiment,</p> <p>**use of computer as alternative is very good enjoyable way and gives chance of repeated practice</p> <p>**Very good hands on experience rather than reading from books or learning in a class room</p> <p>***No harm to animals</p>
2	How far this software is likely to assist you for OSPE session in future Pharmacology practical examinations?	<p>*Very likely to be useful, as it is easy to understand</p> <p>*Software is very nice and easy to operate, hence experiment can be completed in time</p> <p>*practice will help in OSPE and fetch good marks</p> <p>*Beneficial and effective due to visual impact and photographic memory</p> <p>*Completely different experience which will be a boon in exams to earn 10 marks</p>
3	What difficulties did you face while performing this exercise?	<p>Minor issues of technical snag in PC (11 students)</p> <p>Instructions were shared in whatsapp, but very few found it difficult to understand them for drug no 1. (5 students), but the teachers helped and could perform smoothly for remaining drugs.</p> <p>Practice helped to resolve these minor issues</p> <p>As such the students did not have any problem in operating software</p> <p>The IT professionals helped to resolve these technical snags</p>
4	Any other comments / suggestions?	<p>*Teach more drugs by using CAL, we want such experience for other systems</p> <p>*Arrange more of such practical sessions in coming days with CAL, it is a very effective method of teaching learning</p> <p>**It is an amazing, enjoyable and unforgettable experience, it is as if I am doing experiment</p> <p>Well organized and oriented session (3 students)</p>
5	Your feedback on this feedback form	<p>#Feeling so good that someone is asking my opinion</p> <p>#It is very good that immediate feedback is being taken</p> <p>#It has given me a good opportunity to express myself</p> <p>Overall the feedback includes all aspects and is well designed (5 students)</p>