Indian J Physiol Pharmacol 2017; 61(2) : 202–207

Medical Education / Original Article

Impact of Computer Assisted Learning as Teaching Modality on Learning & Understanding of Pharmacology Among Undergraduate Medical Students

R. Amirtha[1], Rachna Gupta[2], Harmeet Singh Rehan[1] and Lalit Kumar Gupta[1]*

[1]Department of Pharmacology,
Lady Hardinge Medical College,
New Delhi – 110 001 (India)

[2]Department of Pharmacology,
University College of Medical Sciences,
New Delhi – 110095 (India)

Abstract

Computer Assisted Learning (CAL) can replace animal experiments to a large extent. The objective of this study was to assess the effectiveness of various teaching modalities including CAL over students' learning and understanding of pharmacology.

Conventional teaching of autonomic nervous system (ANS) was done. Following it, a written theory examination was conducted. CAL was demonstrated and performed during practical sessions. Students were assessed using Objective Structured Practical Examination (OSPE), CAL viva followed by general viva covering ANS. The scores of written theory were compared with written CAL and scores of CAL viva-voce with general viva-voce.

There was a significant difference in mean scores obtained in written theory and written CAL quiz (30.4% vs 47%; ≤0.01). No difference in the scores was observed in CAL viva and general viva. Students scored more in CAL viva compared to CAL written (47% verses 57%).

In conclusion, CAL is an effective mode of teaching pharmacology. Available software can be used in assessment of the students.

Introduction

The subject of pharmacology is a broad one and embraces the knowledge of the source, physical and chemical properties, compounding, physiological actions, absorption, fate, and excretion, and therapeutic uses of drugs (1). Pharmacology deals with study of substances that interact with the living system through chemical process by binding to regulatory molecules and activating or inhibiting normal body process. Pharmacology has its power to integrate physiology, molecular and cell biology

***Corresponding author :**

Lalit Kumar Gupta, Department of Pharmacology, Lady Hardinge Medical College, New Delhi – 110001 (India)
Email: lkg71@rediffmail.com

(Received on January 12, 2017)

and has its application as basic science over which clinical practice of drug therapy is based.

Learning pharmacology at undergraduate level involves comprehending the core concepts i.e. important pharmacological terms, information on the effect of drugs on physiological systems to gain perspectives on how drugs are administered and understanding drug dosing. Besides teaching tools like group discussions, tutorials, audio-visual aids, clinical and community pharmacology, e-learning, practical sessions are an important part of pharmacology curriculum. Laboratory based practical classes have traditionally been key aspect of both teaching and learning pharmacology (2). Theoretical concepts learnt can be strengthened by demonstrating the effect of drugs on isolated tissues or intact animals (3).

Although use of animals for research purposes is inevitable, the same may not be the case for teaching and learning. Ethical concerns have been raised for the use of animals purely for learning purpose (4). Computer Assisted Learning (CAL) can replace laboratory based animal experiments to a large extent and prevent the unnecessary harm or killing of animals (5).

Regulators of medical education across the world have been expressing their concern for this issue. Recently, the National authority that governs medical education in India, the Medical Council of India (MCI) has issued guidelines underlining that at undergraduate level, animal experiments need not be performed and instead use of CAL should be incorporated (6). Many studies have described CAL as a teaching-learning tool (7, 8). However, studies regarding its effectiveness are limited. In the earlier years animal experiments were integral part of under-graduate pharmacology-practical curriculum. However due to concerns regarding use of animals for teaching purposes these experiments were phased out. In the authors' personal experience it was observed that many students had difficulty in learning theoretical concepts of autonomic nervous system in the absence of a robust practical curriculum.

Previous studies have shown that computer simulations are more enjoyable and time saving as compared to laboratory practical. In these studies, students' feedback regarding CAL was obtained (7, 8). In the present study, data on the psychometric and logistic characteristics of an under-graduate pharmacology-practical curriculum and assessment based on CAL is reported. Students' knowledge was compared following conventional and CAL modalities of teaching. The objective of this study was to assess the effectiveness of various teaching modalities over students' learning and understanding of pharmacology and to evaluate the correlation between assessment using written and viva-voce.

Materials and Methods

The study was conducted at Department of Pharmacology, Lady Hardinge Medical College, New Delhi during the period of 6 months from January to June 2015. The schedule of teaching was approved by Departmental Academic Committee. The study included 200 undergraduate medical students (2nd year MBBS).

Conventional teaching, using blackboard and audio-visual aids, covering topics of autonomic nervous system was conducted in classes for a total duration of 14 hours. Following these, a written theory examination (first term) was conducted to assess their conceptual and factual knowledge of the autonomic nervous system.

Demonstration of CAL

CAL experiments were taught during practical sessions using available softwares (ExPharm T1.00 for windows and Organ bath simulation J. Dempster, University of Strathclyde 2009-11 V1.8). Experiments included were

1. Effect of histamine and antihistaminic on guinea pig ileum
2. Effects of various drugs on rabbit eye when applied topically.
3. Effect of cholinomimetics and sympathomimetic

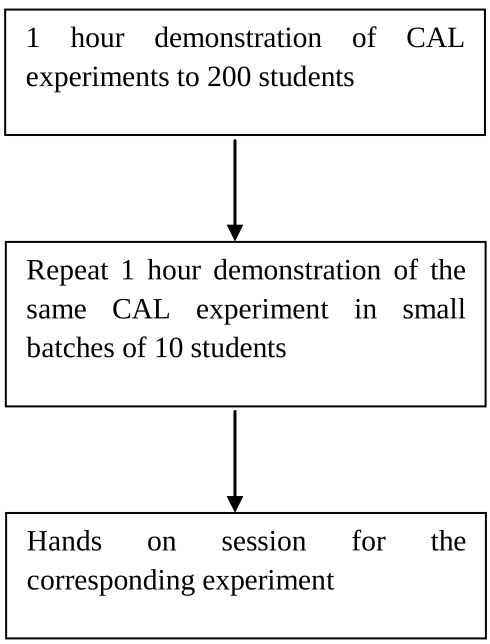
on blood pressure and heart rate of dog, demonstrate Dale's vasomotor reversal and re-reversal and tachphylaxis phenomenon.

4. Effect of cholinergic and anticholinergic drugs on the motility of frog's oesophagus.

5. Effect of sympathomimmetics, cholinergics, anticholinergics, potassium and calcium on isolated preparation of frog's heart.

6. Effect of sympathomimmetics and sympatholytics, plot graded Dose Response Curve for agonists; demonstrate competitive antagonism and non-competitive antagonism using isolated preparations of rabbit jejunum.

Each of the CAL experiment was demonstrated to the students for one hour at a time. Then the same experiments were again demonstrated to the students in batches of 10 students each in the succeeding hour. At all the difficult levels students were encouraged to redo the steps by repeated administration of the drugs. The effects of various drugs were demonstrated by observing the response on graph paper.



Scheme of CAL teaching

Practical examination

200 students were divided into 5 batches (40 students each) attending practical examination on consecutive days. Students were assessed using Objective Structured Practical Examination (OSPE), CAL viva followed by general viva covering different aspects of autonomic nervous system.

Each OSPE session included 20 stations which had written quizzes on spotting of drugs, clinical case charts and on computer assisted learning. The total length of each session was 40 minutes.

Summative assessment of the students was done using written theory examination conducted at the end of conventional didactic teaching and after the CAL (2nd term). 2nd term assessment comprised of written CAL quiz, CAL experiments in presence of assessor followed by viva –voce and general viva-voce covering several topics in pharmacology.

The scores of first term written theory were compared with 2nd term written CAL because both assessed similar knowledge domains. Further, scores of CAL viva-voce and general viva-voce were also compared.

Statistical Analysis

For parametric data, Student's *t* test was used. For non-parametric data, Chi-square test was used. Statistical significance was considered at $p<0.05$.

Results

There was a significant difference in mean scores obtained in written theory and written CAL quiz (30.4% vs 47%; $p\leq0.01$). Also, number of students scoring > 50% marks was significantly higher in written CAL quiz compared to written theory. (n= 88 vs n= 44; $p<0.05$) (Fig. 1A & 1B)

In viva-voce, number of students scoring >50% marks was significantly higher in comparison to written examination (n=116 vs n=88 for CAL, $p<0.05$ and n= 116 vs n= 44 for general theory, $p<0.05$). There was no significant difference in the mean scores of CAL viva and general viva ($p=0.44$). (Fig. 2A & 2B)

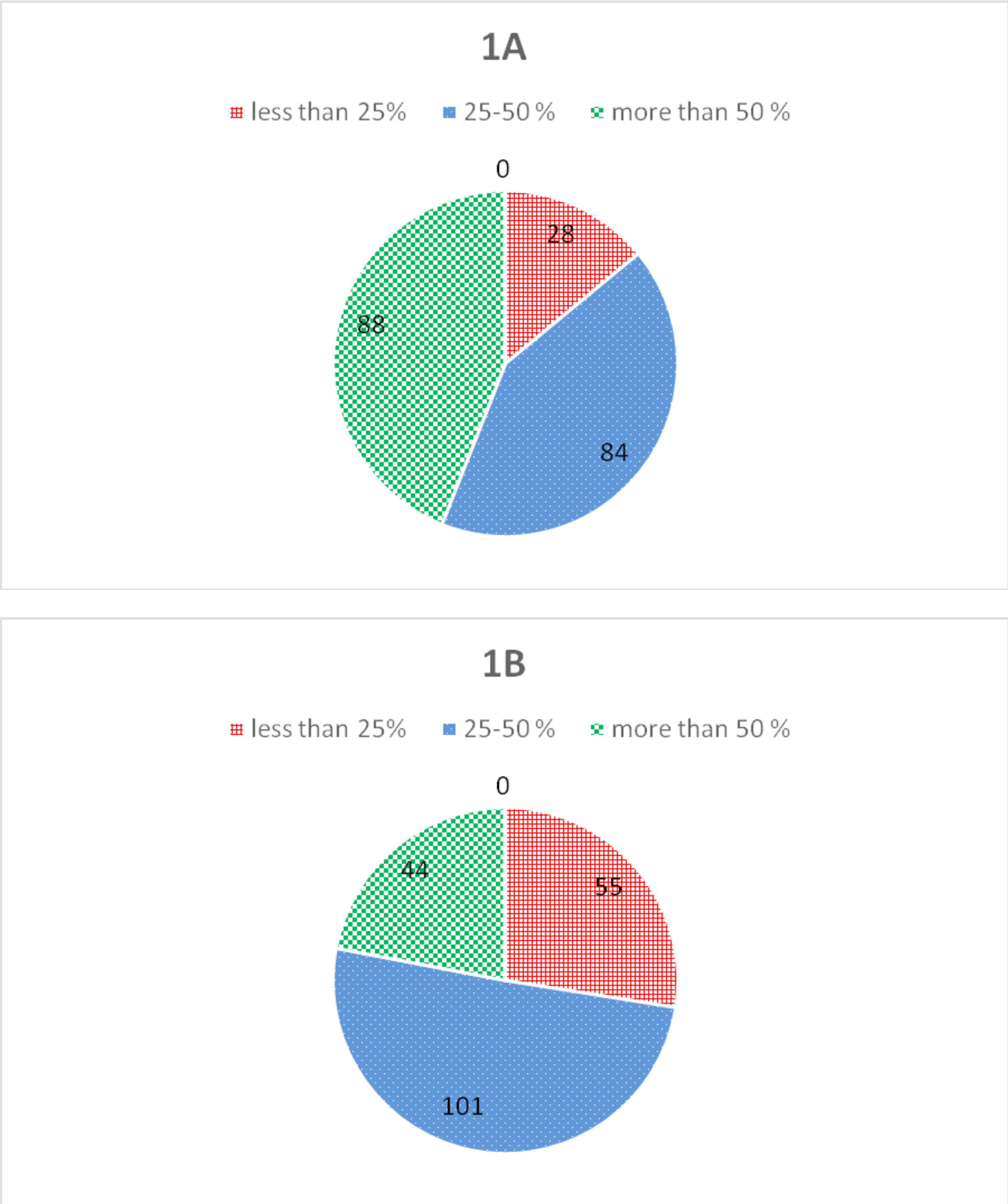


Fig. 1: Distribution of scores obtained in written assessment of (A) theory and (B) CAL.

CAL viva and general viva, although knowledge domains are different, were compared because both included viva-voce as method of assessment. No difference in the scores between them indicates that viva is inherently a biased method of assessment. This is further shown when we compare scores of CAL written (47%) and CAL viva (57%) where students scored more in CAL viva.

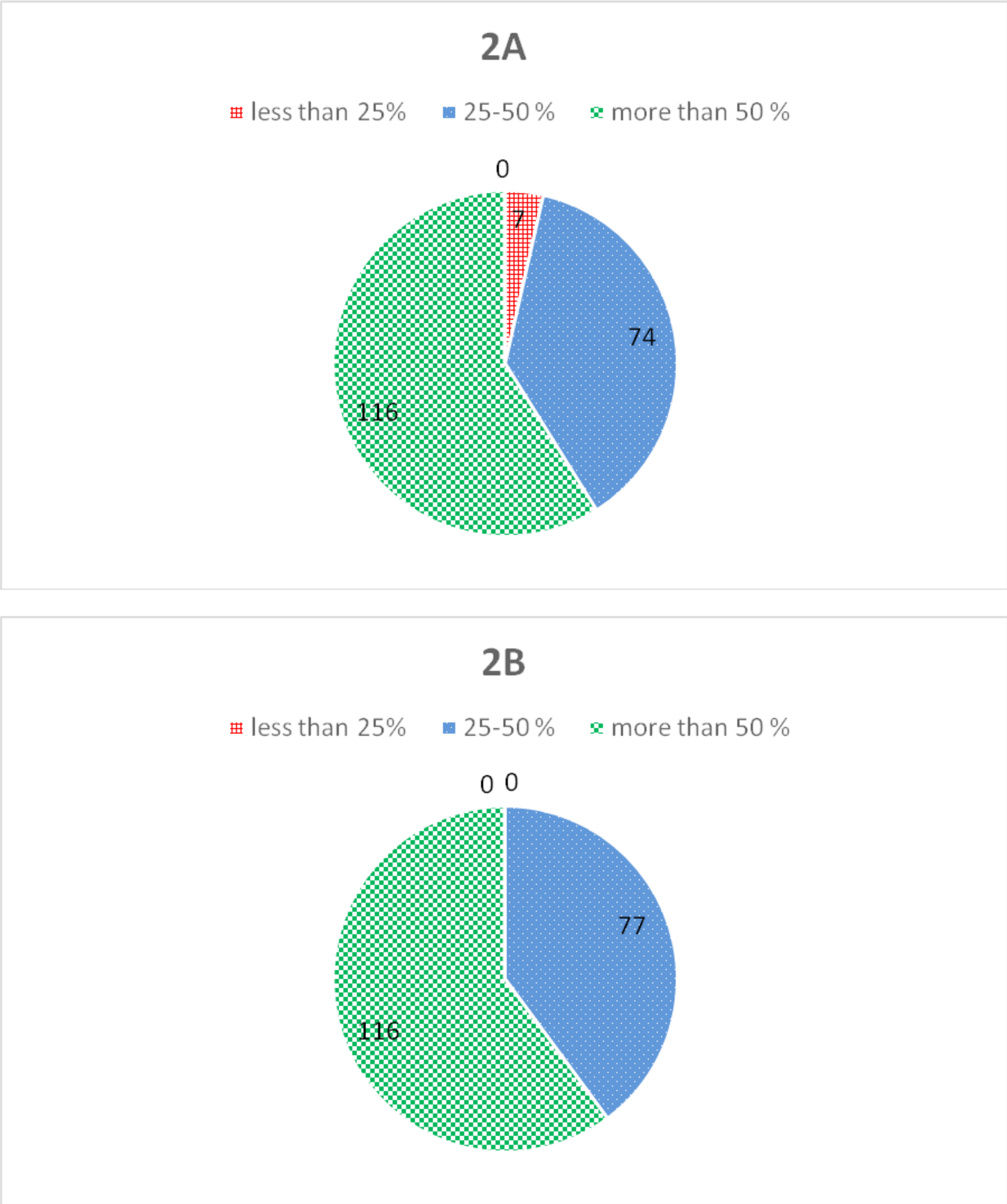


Fig. 2 : Distribution of scores obtained in viva-voce assessment of (A) theory and (B) CAL.

Discussion

This study describes our observations and practical considerations on the use of CAL to demonstrate drug effects in animals and in isolated tissues.

Effectiveness of CAL as a teaching modality is not well established. Earlier studies in India have taken feedback from the students regarding advantages and disadvantages of CAL and have not objectively assessed the knowledge of students after performing CAL. In the present study we taught and assessed the students by 2 methods OSPE and CAL and calculated the correlation between the two.

As seen in our results, improved performance of undergraduate students in terms of mean score and number of students scoring more than 50%, shows superiority of CAL over conventional teaching as a teaching tool. Students get demotivated when they are not able to set up practical experiments or when they are unable to reproduce the results. However, while performing CAL, theoretical concepts are better applied and understood as at each step students can stop and redo that step of the experiment. This reinforces their knowledge from lectures and textbooks. Moreover, the computer savvy generation of students easily takes up this method of learning (9).

CAL has overcome many difficulties associated with practical learning. Another major drawback of practical experiments is the variability in tissue response, time constraint for setting up of the experiments and inexperience and lack of competence associated with early learning phases for undergraduate students. Lesser availability of animals for experiments, lack of trained laboratory personnel and ethical concerns regarding the use of animals for teaching purposes are the other limitations. Handling of large animals is also tedious and only a limited number of drugs can be tested.

CAL is flexible and convenient, easier to perform and user friendly. Drug effects can be visualized very clearly and it has unique presentational benefits. Many students can observe the experiment at the same time. Experiments can be observed without the loss of animals. Experimental errors also do not affect the response with CAL.

However, performing CAL experiments does need a certain level of technical competence to operate computers. Nevertheless, introduction of CAL in medical curriculum can very efficiently and positively impact the learning and understanding aspect of pharmacology for medical graduates.

In conclusion, this study shows that CAL is an effective mode of teaching pharmacology to MBBS students. Available software can be used in formative and summative assessment of the students.

References

1. Rivera SM, Gilman AG. Drug Invention and the Pharmaceutical Industry. In: Brunton LL, Chabner BA, Knollman BC, editors. The pharmacological basis of therapeutics. 12th ed. New York: McGraw-Hill Medical 2011; p. 3–16.
2. Lisha J. John. A review of computer assisted learning in medical undergraduates. *J Pharmacol Pharmacother* 2013; 4: 86–90.
3. Govindaraja C, Jaiprakash H, Annamalai C, Vedhavathy SS. Computer assisted learning : Perceptions and knowledge skills of undergraduate medical students in a Malaysian medical school. *National Journal of Physiology, Pharmacy and Pharmacology* 2011; 1: 63–67.
4. Solanki D. Unnecessary and cruel use of animals for medical undergraduate training in India. *J Pharmacol Pharmacother* 2010; 1: 59.
5. Badyal DK, Desai C. Animal use in pharmacology education and research: The changing scenario. *Indian J Pharm* 2014; 46: 257–265.
6. Medical Council of India (2014). Notification, New Delhi, the 18 March 2014. No. MCI-34(41)/2013-Med./64022. In The Gazette of India, Part III, Section 4, No. 19. New Delhi, India: Government of India Press. Available at: http://www.mciindia.org/Rulesand-Regulation/Gazette%20Notifications%20-%20Amendments/msr-50-100-150-200-250.pdf (Accessed 02.12.14).
7. Vadivelan R, Santilna KS, Elango K, Sirisha S. Alternatives to animals experimentation in teaching pharmacology: Computer assisted learning techniques in pharmacy curriculum; *Indian J Physiol Pharmacol* 2015; 2: 70–73.
8. Kuruvilla A, Ramalingam S, Bose AC, Shastri GV, Bhuvaneshwari A, Amudha G. Use of computer assisted learning as an adjuvant to practical pharmacology teaching: Advantages and limitations; *Indian J Pharm* 2001; 33: 272–275.
9. GR S, Kamath L, R JC. Reassessment of dispensing pharmacy and animal experiments in undergraduate practical pharmacology curriculum: feedback from students. *Int J Basic Clin Pharmacol* 2016; 5: 285–292.