SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES
Osudu, Agaram Village, Koodapakkam post, Puducherry - 605502

Date:01.08.2017

From
Dr.G.Somasundaram
Professor and Head,
Department of Pharmacology
Sri Lakshmi Narayana Institute of Medical sciences
Puducherry

To
The Dean,
Sri Lakshmi Narayana Institute of Medical sciences
Puducherry

Sub: **Permission to conduct value-added course:** Applications of Computer in CAL

Dear Sir,

With reference to the subject mentioned above, the department proposes to conduct a value-added course titled: **Applications of Computer in CAL September 2017– January 2018**. We solicit your kind permission for the same.

Kind Regards

Dr.G.Somasundaram

FOR THE USE OF DEANS OFFICE

Names of Committee members for evaluating the course:

The Dean Dr.Jayalakshmi

The HOD:Dr.G.Somasundaram

The Expert: Dr.S.Jaikumar, Dr.J.Jayashree.

OFFICE OF THE DEAN

Sri Lakshmi Narayana Institute of Medical Sciences

OSUDU, AGARAM VILLAGE, VILLIANUR COMMUNE, KUDAPAKKAM POST.
PUDUCHERRY - 605 502.

[Recognised by Medical Council of India, Ministry of Health letter No. U/12012/249/2005-ME (P-II) dt. 11/07/2011]
[Affiliated to Bharath University, Chennai - TN]

Circular Date: 04.08.2015

Sub: Organising Value-added Course: Applications of Computer in CAL

With reference to the above mentioned subject, it is to bring to your notice that a Sri Lakshmi Narayana Institute of Medical science is organizing **"Applications of Computer in CAL" September 2015– January 2016.** The course content is enclosed below.

The application must reach the institution along with all the necessary documents as mentioned. The hard copy of the application should be sent to the institution by registered/ speed post only so as to reach on or before **August 2015.**
Applications received after the mentioned date shall not be entertained under any circumstances.

Dean

Encl: Copy of Course content.

Course Proposal

Course Title: Applications of Computer in CAL

Course Objective:

1. Game and introduction
2. Pharmacy practical with demonstration of various preparations
3. Demonstrations of routes of drug administration using colorful pictures
4. Learning by role play in therapeutics
5. Therapeutic teaching with visual aids
6. Teaching pharmacology theory without visual aids
7. Pharmacokinetic learning with the help of CAL software
8. Pharmacodynamic learning with the help of CAL software
9. Community pharmacological case studies
10. Clinical pharmacology case studies

Course Outcome: Computer-simulated experiments appear to be feasible and effective as a major part of practical lessons of pharmacology. Given the learning objectives of pharmacology practical lessons in medical students is to enhance students' understanding of the subject, computer-simulations may serve as an alternative to the traditional live animal experiments.

Course Audience: 2nd Year MBBS Students

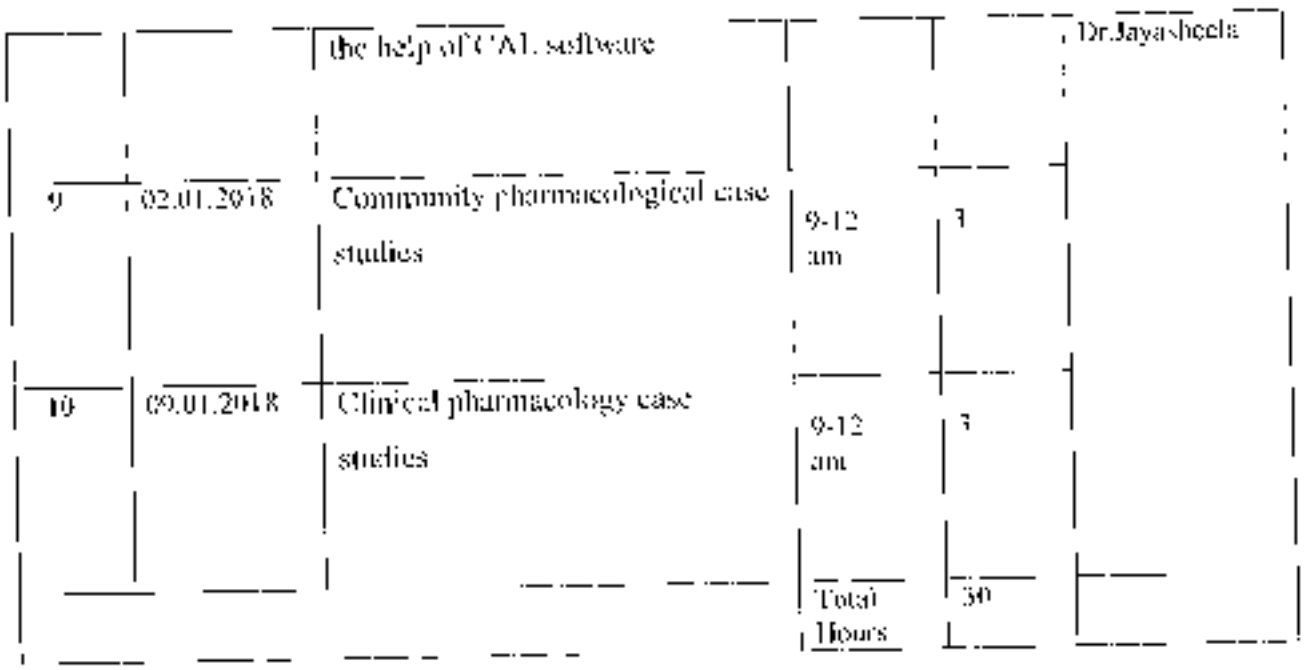
Course Coordinator: Dr.G.Somasundaram

Course Faculties with Qualification and Designation:

1. Dr.Jaikumar Associate Prof. Dept of Pharmacology
2. Dr.Jayasheela.J Assistant Prof. Dept of Pharmacology

Course Curriculum/Topics with schedule (Min of 30 hours)

S/No	Date	Topic	Time	Hours	Name of The Faculty
1	05.09.2017	Game and Introduction	9 - 12am	3	
2	19.09.2017	Pharmacy practical with demonstration of various preparations	9-12 am	3	Dr.Jaikumar
3	03.10.2017	Demonstrations of routes of drug administration using colorful pictures	9-12 am	3	
4	24.10.2017	Learning by role play in therapeutics	9-12 am	3	
5	21.11.2017	Therapeutic teaching with visual aids	9-12 am	3	
6	28.11.2015	Teaching pharmacology theory without visual aids	9-12 am	3	Dr Jayasheela
7	05.12.2017	Pharmacokinetic learning with the help of CAL software	9-12 am	3	
8	12.12.2017	Pharmacodynamic learning with	9-12 am	3	



Reference books

1.Applied Computing in Medicine and Health

1st EditionAuthors: **Dhiya Al-Jumeily Abir Hussain Conor Mallucci Carol Oliver**

2. **Visual Computing for Medicine**

2nd EditionAuthors: **Bernhard Preim Charl Botha**

VALUE ADDED COURSE

1. Name of the programme & Code

Applications of Computer in CAL

2. Duration & Period

30 hrs & September 2017 - January 2018

3. Information Brochure and Course Content of Value Added Courses

Enclosed as Annexure- I

4. List of students enrolled

Enclosed as Annexure- II

5. Assessment procedures:

Short answers *Enclosed as Annexure- III*

6. Certificate model

Enclosed as Annexure- IV

7. No. of times offered during the same year

September 2017– January 2018

8. Year of discontinuation: 2018

9. Summary report of each program year-wise

Value Added Course- September 2017 - January 2018

Sl. No	Course Code	Course Name	Resource Persons	Target Students	Strength & Year
1	PH05	Applications of Computer in CAL	Dr.Jayasheela.J Dr.S.Lalkumar	2nd MBBS	30 (Sep 17 Jan 18)

10. Course Feed Back

Enclosed as Annexure- V

RESOURCE PERSON **COORDINATOR**

Applications of Computer in CAL

Particulars	Description
Course Title	Applications of Computer in CAL
Course Code	PH05
Objective	1. Game and introduction 2. Pharmacy practical with demonstration of various preparations 3. Demonstrations of routes of drug administration using colorful pictures 4. Learning by role play in therapeutics 5. Therapeutic teaching with visual aids 6. Teaching pharmacology theory without visual aids 7. Pharmacokinetic learning with the help of CAL software 8. Pharmacodynamic learning with the help of CAL software 9. Community pharmacological case studies Clinical pharmacology case studies
Further learning opportunities	Computer-simulated experiments appear to be feasible and effective as a major part of practical lessons of pharmacology. Given the learning objectives of pharmacology practical lessons in medical students is to enhance students' understanding of the subject, computer-simulations may serve as an alternative to the traditional

	live animal experiments
Key Competencies	On successful completion of the course the students will have skill in Handling the computer and able to apply the knowledge in forensic aspects
Target Student	II MBBS Students
Duration	30hrs Every Sep 2017 to Jun 2018
Theory Session	10hrs
Practical Session	20hrs
Assessment Procedure	Short notes

PARTICIPANT HAND BOOK

Introduction

In the present century, pharmacology has turned out an emerging area with great career orientation. Recently the undergraduate teaching in pharmacology has been revolutionized with adoptions of newer teaching tools like group discussions, role plays, using audio-visual aids, clinical and community pharmacology studies. Nowadays, these are being adopted by many colleges at both postgraduate and undergraduate levels. Today, computer assisted learning has become a vital part in the pharmacology curriculum. Recent trends in the developments of information technology support such methods. Both CAL and laboratory practical classes are valuable tools for pharmacological experiments. Further, it is quite time consuming to demonstrate minute details of pharmacological procedures and drug effects to a batch of students and the increasing strength of practical batches is making it difficult to interact with each student. Hence CD containing CAL software for teaching animal experiments is becoming a revelation in pharmacological teaching.

The term Computer Assisted Learning deals with a range of computer based packages, which are focused on to provide interactive instruction usually in a specific subject area. CAL packages are designed in such a way that it helps to

around. It has several advantages over the traditional lectures. [illegible] sophisticated and expensive commercial packages for application developed by projects in higher educational institutions to personal small scale, simple solutions developed by individuals with no funding or support to tackle a very local problem. They offer numerous benefits like it is convenient and flexible. It has got unique presentational benefits, helps in personalized learning and helps in achieving the ultimate goal of higher education.

This paper aims to convey information about the useful web resources available for handling pharmacology practicals with special emphasis on its advantages and limitations.

CAL in pharmacology

Computer assisted learning is almost similar to the experiential model of learning. Demonstration of the effect of drugs on various models like tissues or on whole animal is an integral and essential part of practical pharmacology teaching for medical students. But it requires the usage of a large number of animals and a lot are sacrificed during each experiment even for studying and demonstrating the action of drugs which are already established. With our own experience we felt that this affects the mental state of the student also. So it should be the constant effort of a pharmacology teacher to bring down the usage of animals and increase the teaching quality in pharmacy. One of the best ways to achieve this is to utilize

[illegible] available [illegible] pharmacology [illegible]

[illegible] need, how to learn from computer based learning and read and have to integrate this learning tool in their learning strategies. Thus by the use of CAL we can replace the use of animals in pharmacology practical classes.

A few use of CAL in pharmacology is listed below

- Pharmacy practical with demonstration of various preparations
- Demonstrations of routes of drug administration using colorful pictures
- Learning by role play in therapeutics
- Therapeutic teaching with visual aids
- Teaching pharmacology theory without visual aids
- Pharmacokinetic learning with the help of CAL software
- Pharmacodynamic learning with the help of CAL software
- Community pharmacological case studies
- Clinical pharmacology case studies etc.[15]

Figure 1

Figure 1: An interface showing video demonstration of effects of drugs on dog blood pressure and heart rate

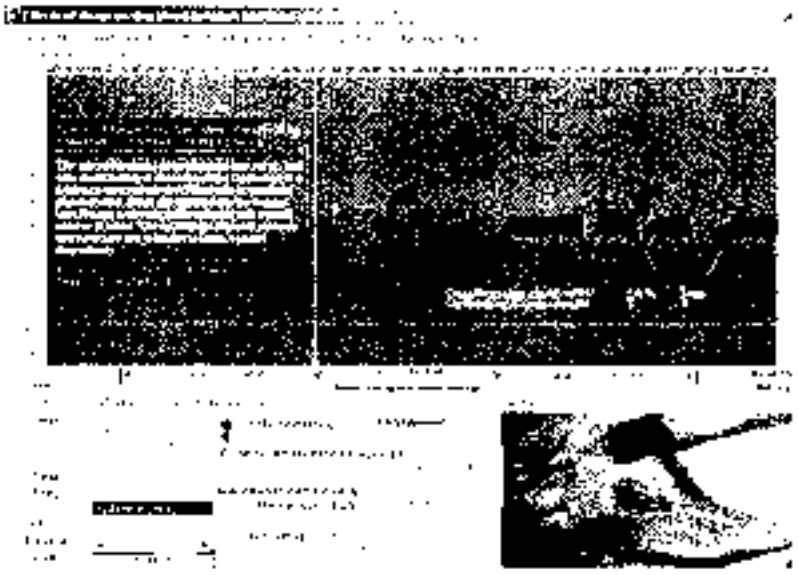
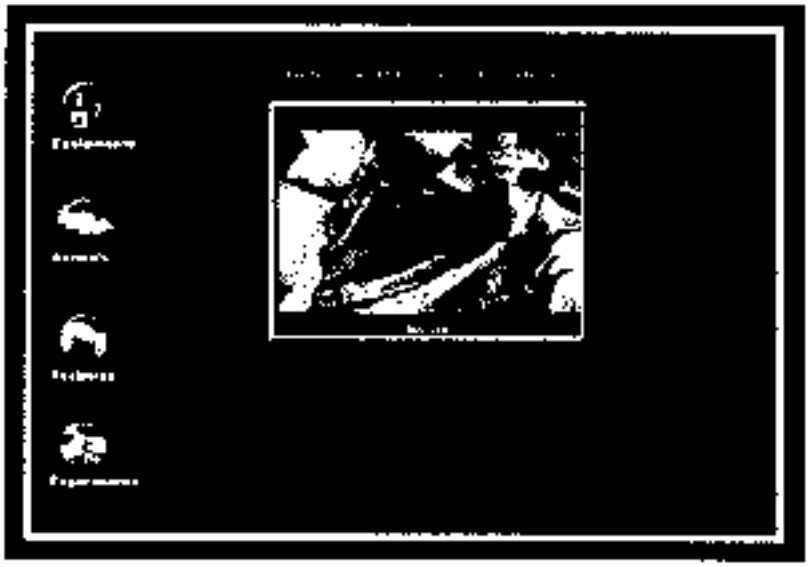


Figure 2

Figure 2: Graph showing recordings of blood pressure and heart rate of different drugs

Figure 3

Figure 3: An interface showing video demonstration showing isolation and recording of frog heart



Comparison Between Traditional Methods And CAL

One of the major problems of performing tissue based experiments is the variability in tissue responses. There are certain other limitations while carrying out the routine animal experiments. A few of them include lack of predictability of animals, cost of purchasing and maintaining these are major constraints in many institutions, and also large animals like dog and cat are difficult to handle during demonstrations in the laboratory etc.

Although traditional live animal experiments are invaluable, they do have shortcomings, and their cost effectiveness has been questioned. Apart from being time consuming, animal experiments can only test a limited number of drugs at a given period of time. Furthermore, animal experiments, in particular whole animal studies, are often labour intensive and costly...

Major Advantages Of CAL

1. [illegible]
2. Exercises difficult to be conducted in the laboratory can be demonstrated using CAL.
3. Many students can observe experiment at the same time
4. Experiments can be observed repeatedly without loss of animals with minimum errors.
5. Many experiments can be demonstrated in a short time
6. Drug effects can be visualized clearly
7. No experimental errors are seen as in laboratory exercises

Limitations Of CAL

Even though there are various advantages of CAL some arguments against this new method of learning are

1. No direct interaction with living tissue
2. Experiment is programmed with prefixed doses
3. Many a times variations in response as observed in living tissue cannot be observed
4. Requires expertise to handle problems related to computers.
5. Expensive method of teaching.
6. Experiments performed in laboratory are easier to remember and one may easily forget these methods.

2. [illegible] analysis of [illegible] experiment is lost.

The traditional practical classes should not be replaced with the computer simulation. It is therefore essential that the use of [illegible] considered and that a balance is struck in the variety of the [illegible]. This can [illegible] the advantage of students [illegible] equity.[illegible]

Conclusion

In conclusion, computer simulated experiments appear to be feasible and effective as a major part of practical lessons of pharmacology. Given the learning objectives of pharmacology practical lessons in medical students is to enhance students' understanding of the subject, computer simulations may serve as an alternative to the traditional live animal experiments.

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. 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] In the recent years, the undergraduate 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), use of audio-visual aids, clinical and community pharmacology studies.[2] The use of animals for teaching and learning of basic sciences has shown a downward trend over the last decade.[1,3,4] Laboratory based sessions are replaced by computer assisted learning which is now being used as an effective teaching and learning tool.[5,6] Increasing ethical concerns with the use of animals for undergraduate training and the development of information technology in the early 1900's contributed significantly to this trend.

Computer assisted learning consists of a range of computer based packages, which focuses on providing interactive instruction in a specific subject area. CAL in pharmacology includes collection of animal experiments on course software package which helps in understanding concepts and techniques in pharmacology.[7] CAL has now become an integral component of the pharmacology curriculum in the medical schools. A number of studies from various medical schools have documented the effectiveness of CAL in terms of knowledge acquisition and meeting learning objectives.[1,8–11] CAL in medical education has been increasingly adopted by several medical schools across the world (India,[1,2,7,12–14]), United Kingdom[3,8,9,11,15–17] Canada,[18,19] United States,[20–22] Australia,[23–25] Germany,[26] Balkan countries,[27] Malaysia[28] and Korea.[29] CAL in medical education has been implemented by

95% of medical schools in the United States and 100% across medical schools in Canada and United Kingdom.

This trend review on CAL in undergraduate pharmacology curriculum considers nature of the trend, factors leading to this trend, advantages, limitations of CAL and pitfalls in implementation of this trend in the medical curriculum.

Search strategy

To find evidence of examples of CAL in undergraduate medical pharmacology, a search was carried out using PubMed (Medline), ProQuest, Cochrane Library, Medscape and Google Scholar search engines from January 1990 to December 2009, since 1990's reflected the beginning of wide spread interest in CAL in pharmacology teaching. The search terms included "Computer assisted learning and pharmacology", "Computer based learning and pharmacology learning", "CAL and undergraduate pharmacology", "CAL and pharmacology teaching", Computer assisted instruction and pharmacology, Computer simulations in pharmacology learning and "Computer based alternatives and pharmacology". The types of articles included in this review are original research, review papers and editorials from various medical schools across the globe. Both abstracts and full text articles were identified and reviewed. All the articles focusing on the factors leading to the trend, advantages, disadvantages and hindrances to implementation

were included. Articles published in English language and English abstracts of articles published in other languages were included. A total 23 studies were included, 15 of them were research articles, six were letters to editor and editorials, and two were review articles. The details from 8 articles are given in Table 1

Table 1

Summary of findings from studies on knowledge assessment and students' opinion of computer assisted learning in medical undergraduate teaching

Parameters	Govindaraja *et al.*[28] (Malaysia)	Kuruvilla A *et al.*[1] (India)	Brain S *et al.*[32] (United Kingdom)	Compara Sewell RI *et al.*[33] (United Kingdon
Number of students	127	141	78	99
Knowledge assessment in CAL (mean (%))		(65+76)		
Pretest	64.36±18.04%		58.0±14.4	
Post test	75.41±17.09%		83.8±10.4	
	(Higher post test scores $P<0.05$)		(Higher post test scores $P<0.01$)	
Outcome				
Good	83.3%	99%	Yes	Yes
Acheives learning objectives	70%	NM	Yes	NM
Improves understanding	75%	NM	Yes	Yes
Enjoyable/interesting	75%	100%	NM	NM
Recommend CAI use	70%	96%	Yes	Yes
Advantages				
Repealed observation without animal loss	90%	9%	NM	Yes
Many students can observe at same time	>80%	13%	NM	NM
Less time consuming	NM	100%	NM	NM
Many experiments performed	NM	100%	NM	NM
Difficult experiments demonstrated	>80%	24%	NM	NM
Avoid use of animals	>50%	51%	NM	NM
Learning at their own pace	NM	NM	Yes	Yes
Better visualization of drug effects	70%	46%	NM	NM
Accurate results	60%	3%	NM	Yes
Easy to use	NM	NM	Yes	NM
Better teacher student	NM	NM	NM	NM

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Factors leading to this trend

Although laboratory practical classes are invaluable, eventually they are only a vehicle for effective teaching and learning of laboratory and animal handling skills.

Concerns were raised with regard to use of animals for undergraduate training as compared to that for research. The practical sessions in pharmacology training involving animal experiments were perceived to be unnecessary by medical students educationists as the learning objectives of these practical sessions primarily focus on observational, analytical and interpretative skills, which are components of the cognitive domain and not psychomotor domain.[11,30]

Furthermore, the use of animals has reduced due to ethical concerns, practical problems associated with the animal experiments such as availability of animals, cost of purchasing animals and maintaining animal houses. Animal experiments are often time consuming and associated with practical difficulties. It is often difficult to demonstrate minute details to large numbers of students and only limited number of drugs can be tested at a given period of time.[1,7,16,17,31]

One of the major problems with animal experiments is the biological variability in the response and non reproducibility. This aspect can affect student learning and have an adverse impact on their motivation. Several published reports from the

medical schools have documented that CAL can be an effective replacement for these practical sessions to overcome these limitations.[1,4,12–17,26,27,31,32]

With widespread use of computers among medical students and the abundance of computer based resources available for supporting teaching and learning in the medical sciences, there was a perceived need that medical graduates need to be both familiar with and have competency in information technology and computing skills.[34] CAL can also help to achieve a greater theoretical understanding of the experiments as simulations mimic the actual experimental set up in the laboratory.[1,35]

Nature of the trend

Until the 1990's laboratory based practical classes had been the central feature of pharmacology teaching. The use of animals for educational purpose declined since then when many academicians suggested that the need for using animals for education and training is small as compared to that with research.[11] Around the same period, the use of computers and e-learning were increasingly incorporated in the medical schools and subsequently and increasing trend of CAL in pharmacology teaching. Large number of high quality computer simulations of animal experiments in pharmacology were developed by many medical schools and also made available for teaching and learning.[33]

CAL in pharmacology consists of various softwares with demonstrations of animal experiments. These softwares mimicked the actual experimental set up in laboratory and include illustration of methods of anesthesia, dissection and mounting of tissues. Computer simulations and interactive interface in pharmacokinetics and pharmacodynamics and clinical pharmacology of various drug classes help in reinforcing the theoretical knowledge of different drugs acting on various organ systems in the body. CAL software has also been developed to promote rational and evidence based medication utilization among the medical students.[5,30,34] The majority of the CAL software includes self-assessment tools such as multiple choice questions.

Advantages of computer assisted learning

CAL has a number of perceived advantages to both students and teachers. Modern computers with multimedia capabilities and presentational benefits can provide an interactive and personalized learning experience and thus promote active and self-directed learning[6,2]; it offers the students the advantage to learn at their convenience and pace of learning; it can save faculty time as well as resources.[32]

The most important advantage of CAL is that they meet the majority of the learning objectives. There is supporting evidence from many medical schools that CAL is the best suitable alternative to practical laboratory classes and successfully

meets the learning objectives of the sessions.[8,9,25,28,30,32] The learning objectives addressed by CAL include the cognitive domain (understanding the pharmacological effects) as well as skill components such as handling the data and communication skills. CAL increases the understanding of the theoretical concepts when it is applied in the setting of simulated experiments.[33] CAL can also supplement lectures and enable students to learn better in their self-study; it can extend the learning experience into fields which are too costly or time consuming and also staff expertise may not be available.[34]

The drug effects can be clearly visualized in simulations; time consuming and difficult experiments can be demonstrated very conveniently with the help of CAL. Biological variations observed in the animal experiments may lead to discouragement among students and also waste faculty and student time, while animal simulations in the CAL session provides results that are reproducible. These experiments can be observed repeatedly without the loss of animals as well as experimental errors.[1,7] The students can observe the effects of drugs at varying dose ranges which would be time consuming when performed on animals. Large number of students can perform the experiment at the same time at their respective stations and their individual computers, whereas the animal experiments are usually conducted among groups of students and depending on the availability of animals the group size varies. Reduction in expenses involved with use of

animal experiments is a definitive advantage.[1,3] Studies have documented that computer simulations of animal experiments are more cost effective than establishing and maintaining animal houses.[7–9] Leathard HL *et al.* study reported the total cost of carrying out sessions on the GI motility with CAL was around £320 and £860 with tutor demonstration of animal experiments.[9]

Dewhurst DG *et al.* study results revealed that the cost of conventional teaching method with animal experiments ($540) was five times greater than that of CAL ($2598).[8]

CAL is an innovative teaching method and primarily focuses on increasing the understanding of the subject rather than psychomotor skill acquisition. The assessment methods for CAL sessions are those used for assessment of the cognitive domain, unlike the conventional methods where in the evaluation is based more on animal handling skill and to lesser extent the knowledge. The advantage of these assessments is that the higher levels of cognitive domain such as application and analysis can also be tested. Communication skills can also be assessed with the use of interactive multimedia softwares.[9]

Disadvantages of CAL

Despite all the benefits of CAL, there are few associated disadvantages. In a virtual laboratory environment, there are certain skills that cannot be adequately taught,

which pharmacology teachers consider essential in pharmacology training. These include making up of drug solutions in varying concentrations, setting up and use of experimental equipments, administration of test drugs and monitoring of the physiological signs.[7,11,31]

CAL limits the direct interaction with the living tissue and observation of variations in responses in living tissue. The practical knowledge and experience of a real experiment is lost. Despite all the benefits that CAL may bring, it is often easily forgotten in comparison to traditional animal experiments.[1] The virtual experiments and simulations have prefixed doses which hinder students to observe biological response at desired doses. CAL is expensive in the initial stages of implementation in the curriculum. Dependence on computers and technical problems arising during class are other disadvantages with CAL. Technical snags are commonly encountered during CAL learning session which can be precluded with good technical support.[28] Development of CAL software is labor intensive, requiring appropriate hardware, backup and frequent upgrading. Many teachers have little expertise in developing software and require the support of information technology staff.[35]

Pitfalls in implementation

Any change in the existing system is encountered with resistance and challenges at multiple stages. These include difficulties at the academic, administrative, financial and logistics level. Appropriate software programs need to be developed based on the learning objectives and the programs should be modified to meet the local educational needs. Faculty resistance to change the traditional animal experiments to CAL is another stumbling block. Many teachers consider CAL inferior and introduction of technology based learning methods a retrograde step.[11] Also, many of them are less inclined to use electronic resources due to lack of computer literacy.[35] Many teachers are unwilling to use software packages, particularly those which are developed by other universities.[32] Persuading teachers and convincing them to use CAL is critical and requires strategies to raise awareness in this direction. Faculty should support the integration of CAL into pharmacology teaching and devise suitable steps to overcome faculty resistance.[11]

Faculties often lack time to develop the skills to integrate this new method of teaching into the modules and learning strategies.[16] Teachers should be informed regarding the availability of CAL softwares and also its integration into the mainstream teaching.[34]

Many of the existing CAL software was developed in the early 1990s: rapid changes in the technologies that were used have rendered it difficult to use and in many instances the software has become obsolete despite the content being still

valid.[36] Initiatives should be taken to develop software at the institutional level based on the local needs and also enable faculty to modify content, educational approach and avoid technological redundancy. In addition, a dedicated information technology staff is necessary to provide practical advice and maintenance of the software and hardware.[34]

It is insufficient to just develop computer based learning material available to students. Like a laboratory class, it must be fully integrated into the modules to obtain the desired benefits.[36] Students should be guided on how to learn from computer-based learning materials as well as to incorporate this learning tool in their learning strategy.[34]

CONCLUSION

In conclusion, computer assisted learning is a feasible and very effective teaching and learning method in pharmacology with huge potential to change the way of learning as it meets the majority of the learning objectives. In the medical curriculum, where teaching and learning is delivered and facilitated in a rapidly changing environment, computer based learning methods have the qualitative and quantitative potential to raise teaching standards to new levels of sophistication. However, there is a need to invoke awareness among the teachers of the advantages of this method of teaching

1. Kuruvilla A, Ramalingam S, Bose AC, Shastri GV, Bhuvaneswari K, Amudha G. Use of computer assisted learning as an adjuvant to practical Pharmacology teaching: Advantages and limitations. *Indian J Pharmacol.* 2001;33:272–5. [Google Scholar]

2. Sharma R, Verma U, Kapoor B, Chopra VS. Novel teaching approaches in Pharmacology. *JK Science.* 2004;6:172–3. [Google Scholar]

3. Greenhalgh T. Computer assisted learning in undergraduate medical education. *BMJ.* 2001;322:40–4. [PMC free article] [PubMed] [Google Scholar]

4. Hansen LA, Boss GR. Use of live animals in the curricula of U.S. medical schools: Survey results from 2001. *Acad Med.* 2002;77:1147–9. [PubMed] [Google Scholar]

5. Wiecha JM. Collaborative online learning (COL): A new distance education methods. *Essential Drug Monitor.* 2003;33:36. [Google Scholar]

6. Moss S. Computer technology in education. *Pharm J.* 1993;251:491. [Google Scholar]

7. Baby LT, Kavalakkat JC, Abraham S, Sathianarayanan S. CAL: A modern tool for Pharmacology. *Internet J of Medical Simulation.* 2009,2:2. [Google Scholar]

8. Dewhurst DG, Hardcastle J, Hardcastle PT, Stuart E. Comparison of a computer simulation program and a traditional laboratory practical class for teaching the principles of intestinal absorption. *Am J Physiol.* 1994;267:S95–104. [PubMed] [Google Scholar]

9. Leathard HL, Dewhurst DG. Comparison of cost effectiveness of a computer assisted learning program with tutored demonstration to teach intestinal motility to medical students. *ALT-J.* 1995;3:118–25. [Google Scholar]

10. McAteer E, Neil D, Barr N, Brown M, Draper S, Henderson F. Simulation software in a life sciences practical laboratory. *Computers and Education.* 1996;26:101–12. [Google Scholar]

11. Dewhurst D. Is it possible to meet the learning objectives of undergraduate pharmacology classes with non-animal models? *AATEX.* 2008;14:207–12. [Google Scholar]

12. Bhavsar VH, Vajpeyee SK, Joshi NJ, Mistry SD, Kantharia ND, Sharma AK. Training during practical pharmacology sessions for undergraduate medical students: An experience with a modified teaching programme. *Indian J Pharmacol.* 1999;31:176–86. [Google Scholar]

13. Desai M. Changing face of pharmacology practicals for medical undergraduates. *Indian J Pharmacol.* 2009;41:151–2. [PMC free article] [PubMed] [Google Scholar]

14. Budyal DK, Modgill V, Kaur J. Computer simulation models are implementable as replacements for animal experiments. *Altern Lab Anim.* 2009;37:191–5. [PubMed] [Google Scholar]

15. Stevens R, Lewis D, Sewell R. Initial experiences of creating multimedia computer simulations to replace pharmacology practicals. *Br J Educ Technol.* 1995;26:122–30. [Google Scholar]

16. Markham T, Jones SJ, Hughes I, Sutcliffe M. Survey of methods of teaching and learning in undergraduate pharmacology within the UK higher education. *Trends Pharmacol Sci.* 1998;19:257–62. [PubMed] [Google Scholar]

17. Hughes I. Changes in the technological methods of teaching and learning in undergraduate pharmacology in UK Higher Education. *BEE-j.* 2003;1:1. [Google Scholar]

18. Rangachari PK. Quality education for undergraduates in pharmacology: A Canadian experiment. *Trends Pharmacol Sci.* 1994;15:211–4. [PubMed] [Google Scholar]

19. Rangachari PK. The teaching of pharmacology. Needs, challenges and response for the future. *Trends Pharmacol Sci.* 1994;15:399–402. [PubMed] [Google Scholar]

20. Ward JP, Gordon J, Field MJ, Lehmann HP. Communication and information technology in medical education. *Lancet.* 2001;357:792–6. [PubMed] [Google Scholar]

21. Liras A. Computer assisted instruction and scientific method in medical schools. *Acad Med.* 1990;65:687. [PubMed] [Google Scholar]

22. Moore L, Waechter D, Aronow L. Assessing the effectiveness of computer assisted instruction in a pharmacology course. *Acad Med.* 1991;66:194–6. [PubMed] [Google Scholar]

23. Bell C. Education in pharmacology. Comments from the Australian Physiological and Pharmacological Society. *Trends Pharmacol Sci.* 1994;15:176. [PubMed] [Google Scholar]

24. South M, Nolan T. Computer-assisted instruction in Australian medical schools. *Med J Aust.* 1993;159:175–6. [PubMed] [Google Scholar]

25. Wang L. Computer-simulated pharmacology experiments for undergraduate pharmacy students: Experience from an Australian university. *Indian J Pharmacol.* 2001;33:280–2. [Google Scholar]

26. Haberman E. Education in pharmacology: Comments from E. Habermann, University of Geissen, Germany. *Ibid.* 1994;15:175–6. [PubMed] [Google Scholar]

27. Kojic ZZ, Dewhurst DG. The impact of introducing computer-based alternatives to the use of animals in the teaching of physiology and pharmacology at Balkan universities-a pilot study. *Altern Lab Anim.* 2009;37:547–56. [PubMed] [Google Scholar]

28. Govindaraja C, Jaiprakash H, Annamalai C, Vedhavathy SS. Computer assisted learning: Perceptions and knowledge skills of undergraduate medical students in a Malaysian medical school. *Natl J Physiol Pharm Pharmacol.* 2011;1:63–7. [Google Scholar]

29. Kim KJ, Kee C. Reform of medical education in Korea. *Med Teach.* 2010;32:113–7. [PubMed] [Google Scholar]

30. Hughes IE. Do computer simulations of laboratory practicals meet learning needs? *Trends Pharmacol Sci.* 2001;22:71–4. [PubMed] [Google Scholar]

31. Dewhurst D. Computer-based alternatives to using animals in teaching physiology and pharmacology to undergraduate student. *Altern Lab Anim.* 2004;32:517–20. [PubMed] [Google Scholar]

32. Brain S, Dewhurst D, Williams A. Evaluation of a computer-based learning program to support student learning in pharmacology. *ALT-J.* 1999;7:37–45. [Google Scholar]

33. Sewell RD, Stevens RG, Lewis DJ. Pharmacology experimental benefits from the use of computer assisted learning. *Am J Pharm Educ.* 1996;60:303–7. [Google Scholar]

34. Hughes IE. Computer-based learning-an aid to successful teaching of pharmacology? *Naunyn Schmiedebergs Arch Pharmacol.* 2002;366:77–82. [PubMed] [Google Scholar]

35. Haq I, Daere J. Computer-assisted learning in undergraduate and postgraduate rheumatology education. *Rheumatology (Oxford)* 2003;42:367–70. [PubMed] [Google Scholar]

36. Dewhurst D. Computer-based alternatives in higher education--past, present and future. *ALTEX.* 2006;23:197–201. [PubMed] [Google Scholar]

ANNEXURE - II

VALUE ADDED COURSE

Applications of Computer in CAL

List of Students Enrolled Sep 2017 – Jan 2018

Sl. No	Name of the Student	Register No	Signature
1	PRIYANKA BANDOPADHYAY	U17MB351	
2	PRIYANKA KUMARI	U17MB352	
3	PRIYANKA SINGH	U17MB353	
4	RAAGAVI S	U17MB354	
5	RAHUL RAI	U17MB355	
6	RICHI SWARN	U17MB356	
7	RINI DAS	U17MB357	
8	RISHABH SUMAN	U17MB358	
9	RISHIKA	U17MB359	
10	RISHIRAJ KAR	U17MB360	
11	RIYA M.A	U17MB361	
12	ROFIQUL ISLAM	U17MB362	
13	ROHAN DAS	U17MB363	
14	SAKSHI SHARMA	U17MB364	
15	SAMYUKTHA	U17MB365	
16	SANORITA	U17MB366	
17	SANTOSHKUMAR NK	U17MB367	
18	SAPTARSHI CHATTOPADHYAY	U17MB368	
19	SATHIYA JAINAUD T.S	U17MB369	
20	SHABAN OS	U17MB370	

PROFESSOR & HEAD
DEPARTMENT OF BIOTECHNOLOGY
Sri Lal Bahadur Shastri University
PONDICHERRY - 605 502

SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES

Osudu, Agaram Village, Koodapakkam post, Puducherry – 605502

Annexure -III

1. The combination of operating system and processor in a compute is referred as computers.

(A) Minimum requirements (B) Specifications

(C) Platform (D) Firmware.

2. Which was the computer conceived by babbage

(A) Donald Knuth

(B) Arithmetic machine

(C) Analytical engine

(D) All of the above

3. Name the application used for creating presentations

(A) MS Access (B) MS Word (C) MS Excel (D) MS PowerPoint

4. Modem is a

(A) Word processing software

(B) Application software

(C) Hardware

(D) Live ware

5. Which of the following can be considered as portable computer?

(A) Desktop (B) PDA (C) Mainframe computer (D) Mini computer

7. Where is the DVD disk put in a computer?

(A) Floppy drive

(B) CD-ROM

(C) Hard disk drive

(D) DVD drive

8. CPU is the ____ of computer.

(A) Brain

(B) Eye

(C) Ear

(D) All above these

9. A desktop computer is also known as

(A) Laptop

(B) Mainframe

(C) Palmtop

(D) PC

10. Numeric pad is in the

(A) Keyboard

(B) Monitor

(C) Speaker

(D) Mouse

September 2017

February 2018

Dr.Somasundaram

Student Feedback Form

Course Name: Applications of computer in CAL

Subject Code: PH 05

Name of Student: [illegible] Roll No.: [illegible]

We are constantly looking to improve our classes and deliver the best training to you. Your evaluations, comments and suggestions will help us to improve our performance

Sl. NO	Particulars	1	2	3	4	5
1	Objective of the course is clear					
2	Course contents met with your expectations					
3	Lecture sequence was well planned					✓
4	Lectures were clear and easy to understand				✓	
5	Teaching aids were effective					
6	Instructors encourage interaction and were helpful					✓
7	The level of the course					✓
8	Overall rating of the course	1	2	3	4	5

Rating, 5 – Outstanding; 4 - Excellent; 3 – Good, 2– Satisfactory; 1 - Not-Satisfactory

Suggestions if any:

From

Date: 11.01.2018

Dr.G Somasundaram
Professor and Head.
Department of Pharmacology
Sri Lakshmi Narayana Institute of Medical sciences
Pondicherry

To
The Dean.
Sri Lakshmi Narayana Institute of Medical sciences
Pondicherry.

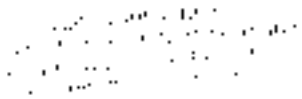
Sub: Completion of value-added course: Applications of Computer in CAL

Dear Sir,

With reference to the subject mentioned above, the department has conducted thevalue-added course titled: **Applications of Computer in CAL** on **Sep2017– Jan 2018**. We solicit your kind action to send certificates for the participants.that is attached with this letter. Also, I am attaching the photographs captured during the conduct of the course.

Kind Regards

Dr.G.Somasundaram



Encl: Certificates

Photographs