

## Evaluation of effectiveness of computer assisted learning in biochemistry for first year medical students

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**Abstract:** *Background:* Significance of computer assisted learning (CAL) programme is to complement existing undergraduate teaching methods is yet to be explored. *Aim:* This experimental pilot study was undertaken to assess the utility of CAL programme for first year medical students in learning medical biochemistry. *Materials & Method:* This prospective study included first year medical students divided into 3 groups comprised of 50 students each. CAL programme was conducted on 3 days in a month for 5 consecutive months. Each session consisted of pre-test, a review session and post-test. A single written test was conducted at the end of 5 months. Statistical comparisons were done between the mean scores of pre-tests & the post-tests as well between the total CAL scores & written test scores obtained. *Results:* The results of the study indicated as mean scores of post-tests were found to be higher than the mean scores of pre-tests and the differences were statistically significant ( $P < 0.001$ ). Mean score of total CAL test was higher than the mean score of written test and the difference was statistically significant ( $P < 0.001$ ). Majority of the study group felt that CAL programme had benefited them by enhancing memory coupled with rational thinking to learn medical biochemistry concepts. *Conclusion:* This study indicates CAL programme has benefited the students with diverse abilities in generating conceptual understanding enabling vivid expression of biochemical concepts. However, CAL programme needs to be conducted on a larger study group involving many medical colleges before arriving at any definitive conclusion.

**Keywords:** Computer assisted learning, undergraduate teaching, teaching learning methods, medical education.

### Introduction

Medical biochemistry is one of the preclinical subjects in first year MBBS course as per Medical Council of India curriculum for medical course. It is the fundamental link between basic medical sciences and clinical medicine and has evolved as an essence of diagnosis & treatment of various aspects of health & disease. Acquisition of this knowledge within a finite time period depends on the impact of teaching.

The general tendency of students is to memorize the topics, which are difficult to perceive & hardly understood. It is obvious that, in addition to the conventional teaching learning methods (like lectures, tutorials, demonstrations, seminars, text book methods, project methods, small group discussions, study tours, problem solving method, team teaching, inquiry approach, videotape, case studies etc.,) alternative teaching approaches are

needed to teach difficult concept in medical sciences [1]. Today, information & communication technologies can be effectively utilized as teaching learning tools in medical education. Among these technologies, the use of computers is the most popular and well known in educational settings. Computer assisted learning ranges from the simple basic text with images to highly complex web based interactive menu-driven method with built in systematic feedbacks that include online technologies (internet & World Wide Web), CD-ROMs, video laser disks, multimedia workstation, virtual reality and simulation testing. It is implemented either as an aid to or as a replacement for traditional formats in a variety of ways [2-3]. There are no documented CAL studies to complement existing undergraduate teaching & learning

methods in Medical Biochemistry in South India. Hence, this experimental pilot study was undertaken to assess the effectiveness of computer assisted learning on first year MBBS students in learning medical biochemistry.

### Material and Methods

This experimental pilot study was conducted by the department of biochemistry on first year medical students (males 47 & females 103, total of 150), aged between 18-20 years. Students were enrolled into the study voluntarily after obtaining ethical clearance from the institutional ethics committee and Informed consent was taken from all the students participated in this study. The students were divided into 3 groups as follows: Group A (50 students), Group B (50 students) and Group C (50 students) based on their serial order of roll numbers in the class. CAL Programme was conducted on 3 consecutive days in a month for 5 consecutive months followed by one written test at the end. During each study session, a topic in medical biochemistry which has been taught in the theory class was chosen for CAL Programme.

A description of study variables were as follows: Test conducted & feedback obtained from the study groups through self-assessment as independent variable, parameters which were held constant for the duration of the study format were: Pre-test session, length of review period, post-test session, digital library, content and its sequence, lighting and ventilation, these were considered as control variable. Uncontrolled variables in this study were age of students, intelligent quotient of students, miscellaneous (study habits / socio- economic factors affecting performance of the students etc).

*Conduct of the study:* Topic of CAL programme was announced 15 days prior to conduct of the study. The study group was stratified into three groups, each comprised of 50 students & CAL programme conducted on 3 consecutive days in a month for 5 months. Each student in a group was assigned one computer in digital library & the study pattern was explained to the students. A secure, customized web page with password protection was created for the CAL Programme. The CAL programme conducted under the supervision of the faculty of Department of Biochemistry included a pre-test, followed by review session (for about 15 minutes) facilitated

by relevant power point presentation and e-textbooks pertaining to the topic and later a post-test on the same topic studied. Pre-test & post-test, each included 30 objective type questions (Multiple choice questions) and one mark was awarded for each correct answer. Identical pretests and post-tests were used in the study but in a different order.

Purpose of providing power point presentation & e-textbooks pertaining to the topic was to describe the key topic of medical biochemistry chosen for CAL program, encouraged to think critically, organize & understand the topic in a sequential manner with a coherent thinking, evaluate & summarize to arrive at a sequential conclusion of the topic. Also prepared the students for the post-test.

*Duration of activity:* Pre-test session was conducted for 10 minutes for 30 multiple choice questions. Review session was conducted for 30 minutes. Post-test session was conducted for 8 minutes for 30 similar MCQs in different order. Our study duration & pattern was based on few modifications of patterns adopted by various researchers. A participant feedback was obtained after completion of the teaching learning method. Data were exported from the Google forms to Microsoft excel spreadsheet. Spreadsheet with predesigned formula to calculate the correct answer obtained from the submission data automatically. Immediately after the session, results were got on real time. The results obtained were tabulated for students display. At the end, a written test covering all the topics of CAL Programmes was conducted.

*Statistical Analysis:* The Student 't' test & ANOVA tests were employed to compare the mean marks of study group during the pre-tests, post-tests & the written tests. The data was analyzed by using online statistical tools. P values which were <0.05 were considered to be statistically significant.

### Results

A total of 150 students belonging to first year MBBS were included in the study. In the present study, the mean post-test marks obtained were significantly higher ( $p < 0.001$ )

than the pre-test scores in all the five tests conducted [Table 1]. However the mean difference between pre-test and post test results ranged from 0.83 to 4.95 marks [Table 2]. The highest difference was seen in the first test and lowest in fourth test. It can also be noticed that incidentally this difference can be correlated with better performance in both pre and post-test in first test, (Mean: 14.23-19.22) as compared to fourth test (13.54-14.97) where the performance was poorest among the five. In all the five tests 25% of the students showed no improvement in marks as compared to another 25% showing improvement in marks from more than 3 to 9 [Table 2].

**Table-1: Comparison of score between Pre-test and Post-test by MCQ method**

Test		Mean	Std Dev	't' value	P value
First	Pre	14.23	6.99	11.06	<0.001
	post	19.22	6.40		
Second	Pre	14.11	4.88	5.75	<0.001
	post	15.27	4.89		
Third	Pre	13.54	4.76	14.91	<0.001
	post	14.97	5.08		
Fourth	Pre	11.39	5.00	3.92	<0.001
	post	12.23	4.66		
Fifth	Pre	12.67	4.86	6.18	<0.001
	post	14.1	5.40		
Over all	Pre	69.65	19.92	14.91	<0.001
	post	75.8	21.39		

P value <0.05 is statistically significant

**Table-2: Mean and Quartile difference in scores between Pre-test and Post-test MCQs**

Test	Mean	25%	50%	75%
First	4.95	00	4	9
Second	1.15	00	1	3
Third	1.42	00	2	3
Fourth	0.83	-1	1	3
Fifth	1.41	00	1	3

The marks obtained in Post-test by MCQs were compared with corresponding written test scores. The scores obtained in MCQs were higher as compared to written test in first four tests and it was significant in three of them. However the written test scores were significantly higher in

written test in fifth evaluation as compared to MCQs [Table 3]. However when the overall tests mean were compared the CAL test marks were significantly higher than the written test [Table 4].

**Table-3: Comparison of score between Post-test by MCQ method and Post-test by written test**

Test		Mean	Std Dev	't' value	P value
First	MCQ	19.22	6.40	6.58	<0.001
	Written	12.69	7.22		
Second	MCQ	15.27	4.89	0.799	0.426
	Written	14.61	6.01		
Third	MCQ	14.97	5.08	3.01	<0.001
	Written	14.90	6.78		
Fourth	MCQ	12.23	4.66	5.90	<0.001
	Written	8.69	4.82		
Fifth	MCQ	14.1	5.40	10.95	<0.001
	Written	20.69	4.33		

P value <0.05 is statistically significant

**Table-4: Comparison Between scores obtained Post-Test between MCQ and Written test**

Test	Mean	Std Dev	't' value	'P' value
Total CAL test	15.18	4.28	8.43	<0.001

P value <0.05 is statistically significant

**Discussion**

A total of 150 first year MBBS students were involved in this study. In this study, mean scores obtained in all the post-tests were found to be higher than the mean scores obtained in all the pre-tests and the differences were statistically significant (p<0.001) [TABLE 1]. Mean score of total CAL test was higher than the mean score of written test conducted at the end of CAL programme and the difference was statistically significant (P<0.001) [TABLE 2]. Majority of the students showed improvement in scores following CAL. Hence this study shows that CAL complements conventional teaching method in undergraduate medical education. The incorporation of CAL program as a multidisciplinary, team based approach into undergraduates' medical education offer distinct administrative advantages for the

teaching staff and deliver learning material to all the students, adding consistency to a highly diverse educational experience. The results of this study is concordant with Yip HK et al., study conducted on computer-based teaching methods in clinical dentistry [4].

Out of 150 marks, 75% of the students improved their score by more than 4 marks, 50% of the students by more than 10 and 25% of them by more than 10 and 25% of them by more than 16 marks and 5% of the students performed poorer than the pre test. Studies have reported the use of CAL as a remedial tool for those performing poorly in conventional evaluation and show improvement of scores following CAL instruction suggesting a high information assimilation rate among medical students [5]. Studies to explore the outcome of replacing lectures completely with a CAL program have led to controversial data. Some evidence suggests that although the gain in knowledge is similar following computer or traditional instruction, the time required to achieve these similar results is less when the student uses the computer aided instruction [6].

Computer technologies can provide a “rich environment for active learning” in which the learner actively builds rather than passively consumes knowledge which engages students in a continuous collaborative process of building and reshaping understanding [7]. The significant improvement in post-test scores in all tests as compared to pre-tests and significantly higher score in total CAL test than the conventional written test suggest that CAL program has benefited students with diverse abilities and learning preference in generating conceptual understanding of the complex biochemical & molecular topics, encouraging student centered , self learning, enhancing memory coupled with rational thinking & enabling vivid expression of biochemical concepts correlates with the studies conducted by John Li & Se AB et al.[8-9].

Based on the feedback obtained by medical students we could summarize that computer aided learning (CAL) offers distinct advantages over conventional teaching methodology, such as: Computer assisted learning is a novel and fun way to learn, accessible anywhere easily (through internet), focused self learning, convenient, user friendly; unique, highly retainable, effective

utilization of time, eco-friendly (paperless) etc. is in accordance with the study conducted by Zimita C & McAlpain L, multimedia in Biochemistry and molecular biology education[10]. In addition to the text, tables, images, videos and animations can be integrated into dynamic packages in CAL.. The system is very flexible allowing a lecturer to update and upload data in the package and to monitor an individual student activity [11]. CAL has the potential to offer more advanced, interactive, multimedia learning experiences than it is currently reasonable to expect from the Web.

Developing computer assisted learning application is a lengthy, labour intensive, time consuming and skilled process. Limitations of CAL programme are: Inadequate planning, poor integration with other forms of learning, and cultural resistance from staff. It requires expertise in content, in pedagogy, and in technical aspects of design and delivery. Students who rely heavily on computer work may spend most of their first term getting to grips with the technology [12]. Rather, CAL can be used by academics if they are well supported by the management and available as easily customized, upgradable and integrated with traditional teaching material [13-14].

### Conclusion

Our study shows that CAL complements conventional teaching and learning method in Biochemistry. The incorporation of CAL program as a multidisciplinary, team based approach into undergraduate medical education offers distinct administrative advantages for the teaching staff and deliver learning material to all students, adding consistency to a highly diverse educational experience.

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