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ORIGINAL ARTICLE

The Effect of Integrated Teaching with Case Based Learning (CBL) In the Biochemistry of Undergraduate Medical Curriculum

SURAPANENI K M *

ABSTRACT

Context: To compare the academic performance of the undergraduate medical students on the traditional curriculum with didactic lectures with that of the students who followed an innovative curriculum with case-based learning in biochemistry.

Methods: The study was conducted in Saveetha Medical College and Hospital, Saveetha University, Chennai, Tamil Nadu, India. The participants (n = 150) were 1st year MBBS students studying in the Saveetha Medical College, Saveetha University, during the academic year from 2008-2009. All the 150 students were divided into two groups as the control group and the study group. A total of 75 students on the traditional curriculum as the control group and 75 students on the innovative curriculum as a study group were studied.

Outcomes: The educational outcomes which were assessed were the marks in the written examination (i.e. based on the student's performance) on the traditional Curriculum with didactic lectures and those on the innovative curriculum with Case Based Learning (CBL). The students were asked to evaluate the relevance for the learning process of the use of Case Based Learning with regard to 13 items on a 5 point Likert scale.

Results: A total of 75 students on the traditional curriculum and 75 students on the innovative curriculum were studied. The performance of the students on the innovative curriculum with Case Based Learning was found to be significantly improved ($P < 0.001$) when compared to the performance of the students on the traditional curriculum, in terms of clinical knowledge. A 5 point Likert scale questionnaire containing 13 questions was administered to the students to know their perception on the usefulness of the CBL and this was completed by all the 150 students of 1st year MBBS. 98% of the students reported that in CBL sessions, a valuable exchange of ideas took place in group discussions. 97% of the students thought that by virtue of the CBL sessions, understanding of the subject / topic was better and all the students reported that it was helpful in terms of the future application of knowledge.

Conclusion: The introduction of the innovative curriculum with case based learning coincided with improved academic performance. The students opined that this innovative method to learn bio-chemistry trained them in self learning skills and improved their attitude towards the newer trends in medical education. The students perceived the CBL method to be a valuable learning tool in biochemistry which improved their reasoning skills and motivated them to learn.

Key Words: Integration, Case Based Learning, Biochemistry, Undergraduate Medical Curriculum, Medical Education.

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Introduction

Biochemistry is one of the basic medical science subjects which is introduced in the first year of the medical curriculum and is one of the foundation sciences for the medical curriculum. It needs to be taught and learned efficiently, so as to be placed in the context of a clinical case / problem and disease when the medical students graduate and practice in the community. In the traditional system of medical education and medical schools, biochemistry is introduced and taught in the first year of the medical course of four and a half years duration. It is taught along with anatomy and physiology, without any interdisciplinary interaction. In most of the medical colleges of India, it is mainly taught by means of didactic lectures, tutorials and practical classes. In this context, medical schools have been changing their educational programs and teaching strategies at national and international levels to ensure that the students had active responsibility for their learning process and that they were prepared for life-long, self directed learning [1]. The effort towards developing active learning was based on the concern expressed by experienced medical institutes and educators, that students memorized facts (“rote learning”) instead of understanding and applying the concepts (“meaningful learning”)[2]. Meaningful learning involves the acquisition of “useful” knowledge because i] it is stored in such a way that it can be accessed from different starting points, ii] it is well integrated with previous knowledge and iii] it is accompanied by the building of multiple representations [mental models] which are connected to other models for many other phenomena.[3]. Case based learning (CBL) is now an established method in undergraduate medical education throughout the world and aims to develop reasoning skills based on clinical case scenarios which allows the medical student to learn the basic medical science subjects in context of a medical problem [4]. Case-based learning (CBL) is a pedagogical method that uses case studies as active learning tools. A case study is composed of an engaging and/or controversial story, usually a dilemma that requires a basic understanding of scientific principles [5]. Qualitative studies of case-based learning methods suggest that students comprehend concepts, retain content longer and achieve

critical thinking and real-world problem solving skills [6]. However, student learning gains beyond qualitative, formative data have not been sufficiently investigated, especially in the biological sciences [7]. At Saveetha University’s Medical College Hospital, the approach used in teaching biochemistry was a lecture-based strategy, which was a teacher centered strategy, allowing very little active participation of the students and also, it didn’t fulfill the basic needs of the medical students. The purpose of this study was to investigate the correlation between the use of the Case Based Learning modules as a teaching – learning methodology in the first year undergraduate medical curriculum and to compare the academic performance of the undergraduate medical students on the traditional curriculum with didactic lectures, with that of the students who followed an innovative curriculum with case based learning in biochemistry.

Materials and Methods

The study was conducted in Saveetha Medical College and Hospital, Saveetha University, Chennai, Tamilnadu, INDIA. The participants (n = 150) were Ist year MBBS students who were enrolled in Saveetha Medical College, Saveetha University, during the academic year from 2008-09. All the 150 students were divided into two groups as the control group and the study group. A total of 75 students on the traditional curriculum as the control group and 75 students on the innovative curriculum as the study group were studied. All the students were in the range of 19 – 25 years of age. The educational outcomes which were assessed were the marks in the written examination (i.e. based on the student’s performance) on the traditional Curriculum with didactic lectures and those on the innovative curriculum with Case Based Learning (CBL). The intervention group was given a clinical problem in which the symptoms of a particular disorder of a system were made very clear and a set of questions was given following the problem. Case-based modules were prepared in consultation with clinicians, based on the common medical problems that the students would come across after their graduation. The cases were brief and were correctly formulated and framed [8], in which the specific learning objectives and the

areas in which the students had to get proficiency to achieve the specific learning objectives were described clearly and the questions were discussed properly and systematically. Efforts were taken to make sure that each and every member of the group had a chance to participate in the discussion. One such example of case- based module which was prepared for the study is attached in [Table/Fig 1]. A total of five such case-based modules were used in the study to teach biochemistry to the intervention group. To diminish the intervention effects between the two groups, the comparison group completed a post–discussion evaluation exercise by using CBL modules.

The controls and the study subjects were divided into two groups.

- Group 1 (Controls): Seventy – Five medical students of Ist year MBBS on the Traditional Curriculum.
- Group 2 (Study Subjects): Seventy – Five medical students of Ist year MBBS on the Innovative Curriculum by using Case based modules.

(Table/Fig 1)

**APPENDIX - A
CASE BASED MODULES**

Case Scenario:

A 35 year old woman working on daily wages comes to the out patient’s department of Saveetha Medical College Hospital with the complaints of breathlessness, headache, extreme tiredness, exhaustion and loss of appetite. On examination, she was found to be pale and her haemoglobin value was < 8 gm/dl. Serum Iron level, MCV,, MCHC were found to be low with high TIBC. A diagnosis of anaemia was made.

Specific Learning Objectives

1. Enumerate the Functions of Iron
2. Describe the mechanism of absorption of Iron
3. Enumerate the factors influencing Iron Absorption
4. Explain the transport of Iron in blood.
5. Mention the normal values of the Serum Iron Content & interpret the abnormal values.
6. Discuss the manifestations of deficiency of Iron.
7. Define Hemochromatosis.

Areas to develop proficiency related to the objectives

1. Sources & Recommended Daily Allowance of Iron.
2. Distribution of Iron in the body.
3. Mechanism of iron absorption.
4. Factors which influence the Iron absorption
5. Functions of Iron
6. Transport of iron in Blood.
7. Excretion of iron.
8. Interpretation of Serum Iron Content.
9. Manifestations of iron Deficiency..
10. Hemochromatosis.
11. Biochemical role of Vitamin B12 & Folic Acid.

We administered the same attitude survey to all the students who had used the Innovative Curriculum during the academic year from 2008 -09. The survey [Table/Fig 2] asked thirteen questions and allowed a free response to one question. A 5 point Likert scale questionnaire containing 13 questions was administered to the students to know their perception on the usefulness of the Case based learning and it was completed by all the 150 students of Ist year MBBS. Multiple Bar Diagrams of the student responses are shown in [Table/Fig 3] and [Table/Fig 4] .

(Table/Fig 2)

**APPENDIX B
SAVEETHA UNIVERSITY
SAVEETHA MEDICAL COLLEGE & HOSPITAL,
Saveetha Nagar, Thandalam, Chennai – 602 105.
DEPARTMENT OF BIOCHEMISTRY
STUDENT QUESTIONNAIRE – EVALUATION OF CASE BASED LEARNING
(CBL) APPROACH**

Please respond to these questions regarding the Case Based Learning. For each one of the following objectives, could you give your opinion from your learning experience using Case Based Learning Approach to study and learn clinical biochemistry?

1. In understanding a particular topic, didactic lectures were Very Useful

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

2. In understanding the a particular topic, CBL sessions were Very Useful

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

3. The clinical cases given in the biochemistry tutorial classes were interesting to me

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

4. In CBL sessions, a valuable exchange of ideas took place in group discussions

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

5. The CBL module was very much helpful in terms of development of critical thinking

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

6. By virtue of the CBL sessions understanding of the subject was / topic was better

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

7. The CBL module was useful in terms of future application of knowledge

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

8. The CBL module was helpful in terms of self assessment of your learning gaps

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

9. The CBL approach is very much helpful in facilitating the active learning

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

10. Was it more motivating when we used the CBL approach in teaching biochemistry

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

11. Promoted meaningful learning instead of traditional class room teaching

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

12. Promotes active independent learning, student reasoning and communication skills

Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

13. Role of teacher was essential in CBL sessions

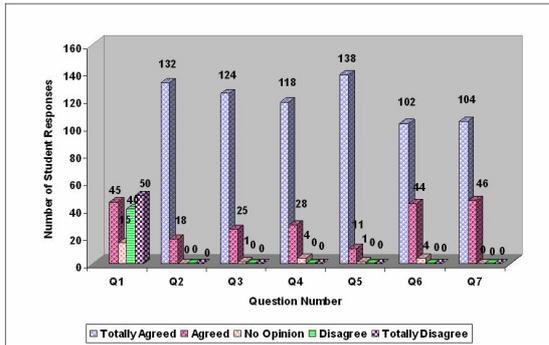
Totally Agreed	Agreed	No Opinion	Disagree	Totally Disagree

14. Do you wish to make any additional comments

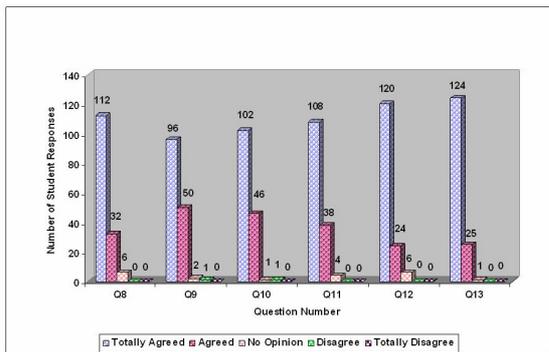
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THANK YOU SO MUCH

Attitude Survey of the Students



(Table/Fig 3) Results of attitude survey on Case - Based Learning for questions 1 – 7.



(Table/Fig 4) Results of attitude survey on Case based learning for questions 8 – 13.

Statistical Analysis

Statistical analysis between group 1 (controls) and group 2 (study subjects) was performed by the Student’s t-test by using the SPSS package, version 15, for Windows. The data expressed as mean ± SD. p < 0.05 was considered as significant.

Results

The mean ± SD of the Evaluation Tests 1, 2, 3, 4 and 5 are indicated in the [Table/Fig 5] and [Table/Fig 6]. There was a statistically significant increase in the test scores of the academic performance in the study subjects as compared to the controls.

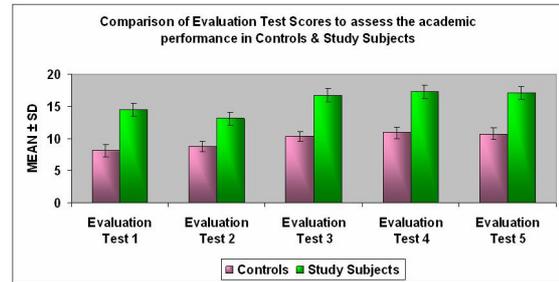
The results of the Questionnaire are shown in [Table/Fig 3] and [Table/Fig 4].

Evaluation Tests to assess Academic Performance	Group1 (Controls) (mean ± SD) n=75	Group2 (Study Subjects) (mean ± SD) n=75
Evaluation Test 1	8.1 ± 0.98	14.47 ± 0.79*
Evaluation Test 2	8.73 ± 0.78	13.07 ± 0.99*
Evaluation Test 3	10.36 ± 0.73	16.72 ± 1.07*
Evaluation Test 4	10.87 ± 0.89	17.25 ± 1.04*
Evaluation Test 5	10.69 ± 0.91	17.07 ± 1.00*

* P < 0.001 compared to controls

(Table/Fig 5)The mean ±SD values of the Evaluation test scores to assess the academic

performance in Group 1 (Controls) and Group 2 (Study Subjects).



(Table/Fig 6)The mean ± SD values of the Evaluation test scores to assess the academic performance in Group 1 (Controls) and Group 2 (Study Subjects)

Results of the Attitude Survey

Results of the Questionnaire were showed in [Table/Fig 3] and [Table/Fig 4].

No one thought that the innovative curriculum using Case Based Learning was of no use. All the students felt that in understanding the particular topic, CBL sessions were very useful. 99% opined that the clinical cases given in the biochemistry tutorial classes were interesting to them. 97% of the students thought that by the virtue of the CBL sessions, understanding of the subject / topic was better and all the students reported that it was helpful in terms of the future application of knowledge. Most of the students agreed that in the CBL sessions, a valuable exchange of ideas took place in group discussions (97%) and the CBL module was very helpful in terms of the development of critical thinking (99%). The students perceived that the CBL module was useful in terms of the future application of knowledge. It was helpful in terms of the self assessment of their learning gaps and it was also very helpful in facilitating active learning. The students opined that the innovative curriculum by using case-based modules promoted meaningful learning instead of traditional class room teaching. 97 % students expressed that it was a good tool to promote active independent learning, student reasoning and communication skills. On interaction with the students, it was found that all students opined that they all enjoyed the CBL sessions and that they had been motivated to learn biochemistry in an easier way. Finally, 99% of the students felt that the role of the teacher was essential in the CBL sessions.

Discussion

Based on the evaluation test results of our study, it was clear that the case based learning methodology had improved the learning environment of the students, as evidenced by the significantly improved evaluation test scores in the study subjects with CBL as the innovative teaching learning methodology, as compared to the controls, in learning clinical biochemistry. Our results were supported by various other studies which reported that CBL provides opportunities for developing and practicing contextual thinking and clinical collaboration skills [9]. Medical education research describes how students learn biological concepts optimally and it also evaluates whether the most effective learning environments achieve the specific learning objectives [6].

The data of our study also revealed the fact that case based learning had improved learning gains as compared to the controls with traditional didactic lectures as the learning methodology. Similar results have been reported by various other studies also [10]. This innovative curriculum with a case based learning strategy also promoted active learning. This concept was also supported by the results of the other studies [11]. This innovative curriculum also promoted active participation by the students in learning biochemistry in the context of clinical cases/diseases and in the development of case analyzing and it also improved diagnostic skills rather than mugging up and memorization, which was the ultimate goal of learning biochemistry in the undergraduate curriculum. To make the students understand a particular area of knowledge, the best way was to involve them. The present study used a case based learning to promote inquiry-driven learning in first-year medical undergraduates. So, this innovative teaching learning methodology involving case based learning served the above purpose in giving the students a case and allowing them to handle it analytically.

Conclusion

These results suggest that the use of the CBL methodology in teaching biochemistry to Ist year MBBS students resulted in an

improvement in their academic performance, which was evident by the results of their Evaluation tests. Also, it resulted in greater generation of ideas and motivated them towards the meaningful learning of biochemistry. The use of the CBL methodology helped them to gain and improve their knowledge, and it also helped them in the easy understanding of the complex concepts in biochemistry like metabolic pathways and clinical biochemistry.

Acknowledgements

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