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Original Article

Physiology Section

Enhancing Knowledge Integration in Biochemistry among Undergraduate Medical Students through Active Learning Strategy

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ABSTRACT

Introduction: Medical education today, encourages modification of traditional didactic lectures with innovations to promote active learning strategies to enhance integration of knowledge and critical thinking skills among students. Learning independently is challenging in year 1 of the undergraduate medical curriculum. However, defining the learning goals clearly by the instructor to the students will make them appreciate it and mould them into successful learners with deep approach.

Aim: To enhance self-directed learning skills and to promote concept mapping ability to integrate the study of various metabolic functions and fundamental concepts in biochemistry.

Materials and Methods: First year MBBS Student volunteers (n=127) in their second semester having an experience of over 30 weeks of learning biochemistry in an integrated system-wise approach were involved in this study. They were exposed to a self-directed active learning strategy for a period of 10 weeks, for linking important biochemical terms from the current learning objectives to various concepts and topics learnt earlier in the year. Student's perspective regarding the above activity was documented by obtaining their responses in a closed ended questionnaire using Likert scale and was expressed as percentage.

Results: Majority of the students (n=100, 79%) opined that it was a unique way of learning biochemistry and that they (n=111, 87%) were required to read up previous portions. Many students (n=100, 79%) felt that it made them more than mere rote learners and were able to integrate biochemistry topics more efficiently (n=109, 86%). Many students also felt that it helped them to improve their test scores (n=79, 62%).

Conclusion: Active participation in the current study has made them learn the concept building skills in biochemistry and has proved to be an effective exercise of revisit to topics learnt throughout the year. Innovative curriculum delivery strategies should be designed to teach preclinical subjects in a medical school so that they shall infuse integrated learning approach in students. Concept building activities in a lecture set up shall generate curiosity in the process of learning and transform students into deep approach learners.

Keywords: Lecture, Metabolic syndrome, Uric acid

INTRODUCTION

Less reliance on dogmatic adherence to any one teaching approach and more calling for eclectic and flexible approach to learning has become the need for medical education today. Effective lectures enhance enthusiasm and motivation for learning. However, teaching should aim at training students to be independent acquirers of knowledge in the vast field of medicine. The ability to integrate multiple knowledge modalities is profound for clinical decision making among medical graduates. Medical students are expected to possess Self-Directed Learning (SDL) skills to pursue lifelong learning [1]. SDL is widely being used in medical as well as other healthcare professional course settings [2]. SDL is found to be an effective tool for learning among medical undergraduates to enhance their capacity to become independent and responsible learners. It has proved to be an effective method to help students to explore newer arenas of knowledge and update their course content ideally [3-6]. Certain reports on the contrary indicate that, introduction of SDL into undergraduate curriculum has not always been successful [7]. As a result of these efforts to introduce new curricular formats, there exist hybrids of traditional and self-directed learning methods today [8]. Considering the benefits of SDL, it has become a necessity for first year MBBS curricula to inculcate and introduce preliminary steps to boost the confidence in students to become effective self-directed learners. Currently medical education aims to make student self directed learners, but there is also a great need to boost the integration skills in medical students. Hence the present study was designed to encourage the primary process of SDL in a lecture set-up and to promote the skill of integration of knowledge in first year MBBS students. The phenomenon of linking concepts in biochemistry using important biochemical terms was used to enhance the deep learning approach and to transform students to become independent holistic learners.

MATERIALS AND METHODS

This cross-sectional study was conducted on a group of first year MBBS students (n=127) studying in second semester for a period of 10 weeks in the year 2009. The students had undergone a preclinical training for a period of 30 weeks before participating in this study. The undergraduate MBBS course in the college is a unique five year academic programme of ten semesters taught in twin campuses in India and Malaysia. The first five semesters of pre, paraclinical subjects and an introductory clinical exposure are conducted in the Indian Campus followed by the next five semesters of clinical training in the Melaka Campus at Malaysia. Biochemistry is taught with a temporal integration with Physiology and Anatomy topics in a system wise approach in semesters one and two. Each of these semesters is further divided into two blocks each. The systems taught in each block are as listed below:

- Block 1 (Semester 1): Basic concepts, Blood and Respiratory System;
- Block 2 (Semester 1): Cardiovascular System, Nutrition, Gastrointestinal and Hepatobiliary System;
- Block 3 (Semester 2): Endocrine, Reproduction, Muscle, Bones, Kidney and Electrolytes;
- Block 4 (Semester 2): Central Nervous System, Special senses and Molecular biology;

Instructional methods include didactic lectures, SDL, Problem Based Learning (PBL), Case Based Learning (CBL) sessions, practical exercises, demonstrations, specific skills training and various other small group learning activities.

Students were exposed to an innovative active learning strategy in the biochemistry classes in their 4th block of year I MBBS for a period of 10 weeks. It was a hybrid lecture which included partly didactic lecture along with a scope for SDL component and active involvement of students. Certain important biochemical terms from the current lecture, that could be linked with previously learnt topics were identified by the teacher. The students were requested to highlight these key biochemical terms in their notes using asterisk, and then asked to go back after class, read up textbooks and previous notes to make maximum number of links.

Example for Linking Concept Terms

Few examples of key biochemical terms (current lecture topic: purine metabolism) which were linked with topics learnt previously are given below.

Ribonucleotides and Deoxyribonucleotides

Students linked these words with nucleic acid chemistry topic that they had studied in Block 1 under basic concepts and with high energy nucleoside triphosphates in various metabolic pathways which they had studied in Blocks 1, 2 and 3.

Ribose 5-phosphate

Students linked this with HMP shunt pathway learnt in Block 1 under blood topic. It was also linked with Von-Gierke's disease learnt in relation to glycogen metabolism in Block 3 under muscle metabolism.

Aspartate, Glycine and Folate Derivative (Sources of Purine Ring Atoms)

Aspartate was linked with amino acid and protein chemistry, with TCA cycle and anaplerotic reactions, malate aspartate shuttle system topics learnt in block 1. It was also linked with protein digestion and gluconeogenesis topics studied in Block 2.

Glycine was linked with amino acid and protein chemistry and with glutathione metabolism in RBC metabolism in block 1. It was linked to bile salts, gluconeogenesis and proteolytic enzyme specificity in block 2. In block 3 it was linked to creatine metabolism and collagen synthesis.

Coenzyme forms of tetrahydrofolate were linked to folic acid metabolism learnt in Block 1 in the context of erythropoiesis. In Block 2, it was linked with nutrition under vitamins chapter.

Methotrexate and Sulphonamides

These words were linked with antimetabolites or competitive inhibitors they had learnt under enzyme chapter in Block 1. Mycophenolic acid was linked with uncompetitive inhibition they learnt in enzyme chapter.

Adenylate Kinase

It was linked with energy metabolism of muscle chapter in block 3.

Xanthine Oxidase and Allopurinol

In block 1, they linked these to competitive and suicide inhibition mechanism they learnt under enzyme chapter. In Block 3 they linked it with type I glycogen storage disorder studied under glycogen metabolism.

The selection of students was based on their roll numbers and care was taken to include all students and avoid repetition of opportunities. The selected students were asked to present the integrated information in the subsequent lecture class.

Individual student consent was taken for their active participation in this learning strategy. Institutional permission was sought for conducting this study as per the ethical permission rules at the time of the study. Students were exposed to about 14 lectures with this strategy. Students were asked to respond to a simple structured questionnaire at the end of the block regarding their opinion on the effective practice of this active learning strategy. The questionnaire was validated by experienced senior colleagues in the department. A ten-item questionnaire with closed ended questions was prepared. The level of agreement or disagreement was collected on a Likert scale. Data was reduced to the nominal level by combining all agree and disagree responses. The questionnaire was designed to test opinions in three domains namely: to know their acceptance for this modified lecture in learning Biochemistry; to know, if and how students altered their study habits and to know the benefits of linking lectures as a step to promote self-directed learning.

RESULTS

The Domain one section of the questionnaire gives a feedback of students regarding their acceptance towards this innovative learning strategy. The overwhelming acceptance for the current strategy is presented below as percentage [Table/Fig-1]. Majority of the students expressed their penchant for this unique way of teaching and learning in biochemistry. It has also made them rate it as an effective means of teaching and that they have expressed their consent to introduce more of such innovative learning strategies.

Student responses (n=127)	Agree n(%)	Uncertain n(%)	Disagree n(%)
Lectures were interesting with this activity	101 (80%)	22 (17%)	4 (3%)
It is a unique way of teaching Biochemistry	100 (79%)	23 (18%)	4 (3%)
It should be practiced for every lecture	88 (69%)	18 (15%)	21 (16%)
It is one of the efficient ways of teaching	100 (79%)	16 (13%)	11 (8%)

[Table/Fig-1]: Student responses to Domain One (To know their acceptance for this modified lecture in learning Biochemistry, n=127 first year MBBS students) expressed as percentage.

Any teaching learning exercise should have a significant bearing on the academic performance of students and by any means should not be thrust on students compulsorily and prove to be a hindrance and waste of their valuable learning time. We are glad that our students did benefit out of this activity and that has been clearly stated as responses to the questions in domain two and three of this questionnaire as given in [Table/Fig-2,3]. The questions in domains two and three of the current study tested the impact bearing of this strategy on study habits and influence on promoting them as independent learners [Table/Fig-2,3].

Student responses	Agree n (%)	Uncertain n (%)	Disagree n (%)
It encouraged to read textbooks very often	90 (71%)	30 (24%)	7 (5%)
It inspired to read the previous block portions	111 (87%)	12 (9%)	4 (4%)
It reassured to read more often and improve test scores	79 (62%)	44 (35%)	4 (3%)

[Table/Fig-2]: Student responses to Domain Two (To know, if and how students altered their study habits, n=127 first year MBBS students) expressed as percentage

Student Responses	Agree n (%)	Uncertain n (%)	Disagree n (%)
It trained to integrate various topics in Biochemistry	109 (86%)	16 (13%)	2 (1%)
It prepared to become a deep learner	100 (79%)	13 (10%)	14 (11%)
It never confused	99 (78%)	11 (9%)	17 (13%)

[Table/Fig-3]: Student responses to Domain three (To know the benefits of linking lectures as a step to promote self-directed learning, n=127 first year MBBS students) expressed as percentage.

DISCUSSION

Modifying the didactic lecture into innovative ones may come a long way in promoting students to be self-directed learners. It is well known that active learning and integration of knowledge are corner stone's of knowledge retention [9]. In a predominantly lecture driven curriculum, it is important to provide avenues for active learning [10]. Dynamic changes are to be implemented in medical education today to keep up the pace with rapid and innovative changes in information and methodology of curriculum delivery. The current study is an attempt to be innovative to help students to integrate their preclinical knowledge and to pave way to make them self-dependent learners. It is a well-established fact now in medical education that lectures promotes a concept of sage on stage where the teacher dominates the learning process. However, today the teaching aims to portray the teacher as a guide by the side, thus providing importance to students to promote an active learning process. The advantages of active learning strategies definitely outweigh the traditional didactic lectures. Current changes in medical education research encourage innovative teaching practices to increase student participation in the process of effective learning [11]. The current study revealed an eager acceptance for active learning strategy. Students settle down easily for a surface learning approach if a well prepared and content rich lecture is delivered regularly. However, if active learning strategies are introduced compulsorily, they accept the challenge and involve enthusiastically in the process of learning. It gives them an opportunity for independent research about the subject as well as to present small topics in front of their peers and teachers. Such activities empower students to be independent learners and help them to advance their thinking skills. It assists in the clinical decision making skills for a future doctor. The current active learning strategy has substantiated to be beneficial to both the faculty and the students. Hosting such innovative strategies could be challenging for the faculty due to time constraints and to verify and validate the concept linkers presented by students. However, if teachers accept this with an open mind to blend and change the traditional didactic lectures, it can prove to be very rewarding to the students. The researching and concept building skills will be enhanced through such activity and shall prove advantageous to students to prepare well for exams.

CONCLUSION

The current teaching strategy was an easy implementable method for the teacher in a class room set up and gave an ideal opportunity for students to advance their knowledge integration, communication and presentation skills. This innovative teaching method was done as an experimental study. However, correlation of this strategy with academic performance of students undergoing this strategy remains unexplored currently.

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