

## CONCEPT MAPPING, AN INNOVATIVE EDUCATIONAL TOOL IN LEARNING BIOCHEMISTRY

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### ABSTRACT

**Background:** Several methods are adopted for teaching and learning Biochemistry like didactic lectures, which is commonly followed in Medical Colleges across India. Concept mapping, which represents the relationship between ideas, images or words, can be used in the teaching learning process of Biochemistry. This experimental study was aimed to compare the effectiveness of concept mapping with traditional lecture classes in Biochemistry. **Materials and Methods:** This study was conducted with the participation of 150 students of the 1<sup>st</sup> MBBS after obtaining ethical clearance and written consents. By unconditional selection they were grouped into control (C) and Test (T) of 75 each. A topic in Biochemistry was taught to both the groups by regular lecture classes. Then the concept mapping for the same topic was introduced to the test group alone, followed by a written examination with same question paper to both the groups. Papers were evaluated, scores were given and analysis was done. Then the control group was also introduced with the concept mapping and the feedback was obtained from all. **Results:** Comparison of the mean values of the scores of the control and test showed statistical significance (p-value <0.01). The individual scores of test group were also found to be better than the control group. Most of them (87%) were of the opinion that concept mapping helped them to understand and retain the knowledge in the subject. **Conclusion:** This study showed that concept mapping in Biochemistry is an effective teaching learning method than the regular didactic lecture alone.

**Keywords:** Biochemistry, Concept mapping, Feedback, Teaching learning method

### INTRODUCTION

As the medical profession is going through a changing phase, the teaching-learning methods used also need to be changed. Alternate teaching and learning strategies are required to retain the enormous amount of information to the medical students (1) as well as to keep them motivated throughout the course. Once they complete the course, they need to recollect, integrate, and apply what they have learned in the different phases of the course to serve the community. Biochemistry, one of the basic medical subjects, taught in the pre-clinical phase, has lots of clinical implications and help in the diagnostic process of the diseases. With the advent of molecular diagnostics, the significance of

the subject has even increased. Though there are many methods adopted for teaching and learning this subject, most of them may not be able to serve the purpose of the integration of biochemical aspects related to diseases, which ultimately leads to lack of motivation to learn and understand the subject. To overcome this identified lacunae some alternative teaching-learning methods like concept mapping can be adopted as a teaching-learning method.

Concepts maps (Cmap/CM) are pictures or graphic representations that allow learners to link, differentiate and relate concepts to one another. Joseph Novak and collaborators developed this tool

from David Ausubel's theory of meaningful learning(2). As per description, a concept map (Cmap) is 'a schematic device for representing a set of concept meanings embedded in a framework of propositions' to think and learn with concepts by linking new concepts to what we already know (3,4). This may help the students to connect the important concepts in a subject. In concept mapping, the student links together a series of concepts related to a particular topic (called concept-links and cross-links) producing a two-dimensional, hierarchically organized diagram representing their knowledge framework (3) and is an innovative approach that helps the learner to organize knowledge (5). Concept maps communicate knowledge, graphically instead of relying on lengthy textual explanations as we usually do in our traditional lectures. Concept maps are used in many areas of education at different levels with amenable representation of the concepts related to the subjects (6).

Circles or boxes are used while making concept maps to accommodate the key concepts. Relationships between concepts are indicated by connecting arrows linking two concepts. Cross links or arrows indicate how knowledge in one domain is related to knowledge in another domain (7). One can make concept maps by drawing it in paper using pen or pencil, or can use the available software. Once sensitized with the concept mapping, students can create their own pattern as per their imagination to integrate basic and clinical sciences for problem-solving (8,9,10). The tool has been successfully used to develop courses, curricula, and case for problem-based learning (PBL), problem-solving exercises (PSE), or case-based learning (CBL) (11). Through this the students must be able to relate and integrate the concepts used in the map (12). Though Cmap has been used as a successful learning strategy in several health-related fields, its use in basic medical sciences, especially in Biochemistry is still under the experimental phase. It can be one of the innovative teaching-learning techniques to connect the biochemical changes leading to various diseases and may help the students to understand and retain the knowledge in the subject. With this back ground, the present study was undertaken to evaluate the effectiveness of concept mapping as a teaching-learning method in Biochemistry for first MBBS students in a medical college at Kerala.

## **MATERIALS AND METHODS**

This experimental study was set in the Department of Biochemistry, Sree Gokulam Medical College and

Research Foundation, and the study was conducted for six months. All the 150 students of the first MBBS Batch were enrolled in the study. Prior to the study an introduction about the project activities to be followed were explained in detail to all the participants. The study was commenced only after obtaining approval from the Institutional ethics committee. Written informed consent was obtained from each of the participant prior to getting enrolled in the study. All the 150 students gave consent to take part in the study.

The students were grouped into 2 (Control and Test) with 75 in each group by unconditional selection. Through regular didactic lecture classes of 20 hours all the students were taught "Lipid Chemistry and Metabolism" in Biochemistry. Then the concept mapping for the same topic was prepared and introduced to the Test group alone with the help of knowledge structures as a set of concept meanings related to one another with the help of computer and by using LCD projector. This was then followed by a written test with same question paper to both the groups. Though 150 of them had given the consent to participate in the study, only 104 appeared in the evaluation process due to some logistic reasons (Control= 50 and Test= 54). Papers were evaluated by the faculty members with key and scores were given accordingly. The scores were used for the statistical analysis to find out the significance of the study. Then the control group was also introduced with the concept mapping in the same way as test group for the same topic so that they also get exposed to the technique. Finally feedback was also obtained from all the participants to know the effectiveness and the perception of this new technique in the teaching-learning process in Biochemistry.

Statistical analysis was done by using SPSS version 20. Independent t-test was used to compare the mean scores of the control and the test groups. A p-value <0.01 was taken as statistically significant (13).

## **RESULTS**

Figure 1 represents the scores of the students in the post-test. As part of evaluation, a score of > 20 is considered as a good score and is taken for evaluation. In the test group (n=54) 33 of the students scored > 20 (61.1%) as shown in the figure while in the control group it was only 22 (44%). However those scored < 20 in control group were 56% and in the test group it was only 38.88%

Among the control, 26% scored between 20-25, 10% scored 25-30, 4% scored 30-35, 2% scored 35-40 and 2% scored > 40. While in the test, 11.1% scored 20-25, 16.7% scored 25-30, 11.1% scored 30-35, 14.8% scored 35-40 and 7.4% scored > 40. The mean scores of the two groups are given in table 1. Independent t-test is used to compare the mean scores of the two groups by using the SPSS version 20. The t-value is found to be 2.981 and degree of freedom is 102 and the p-value for the same is 0.004. Since the p-value is < 0.01 the test is significant at 1% level and the intervention is found to be effective.

Figure 2 represents the feedback obtained from the students about the concept mapping in facilitating their learning process. Among the students 87% are of the opinion that the technique has helped them to understand the subject better, as compared to traditional didactic lecture alone. Eleven percentage of the students responded that they don't know whether the technique has helped to understand the subject better. Remaining 2% didn't respond to the feedback session at all.

## DISCUSSION

Concept maps have been successfully used in education for over 25 years and a growing body of literature indicates that their use in medical education is increasing (14) as we are seeking alternate methods to impart knowledge to students for better retention. The results of the present study clearly indicate that the concept mapping has enhanced the learning process and has helped the students to arrange their knowledge in a more organized way. The test group, which was exposed to the concept mapping got statistically significant scores in the post-test as compared to the control group which was not exposed to the technique. This clearly shows the successful implementation of the concept mapping in Biochemistry. The individual scores of the test group were also found to be better than the scores of the control group. The present study is supported by a number of previous experiments done by others in various other subjects and aspects of medical education. Student's attitude towards C maps as an additional tool for learning was already described and for large classes, the C maps enabled better perception as an alternate method (15). Further studies show that C maps are better resources for curriculum development to organize curriculum databases in medical schools, specifically to support the development of PBL curricula (16, 17). There are reports that concept maps are highly useful in the discussion part of PBL,

in which the experimental group had significantly higher proposition and hierarchy scores for their concept maps compared to the control group (18), further supporting the results of this study.

The questionnaire designed to evaluate perception of the students at the end of the project showed that students found constructing and explaining concept maps to be helpful in understanding lipid chemistry and metabolism as compared to the lecture class alone. Majority of the students agreed that concept map has assisted and enhanced thinking and learning of lipid metabolism in relation to atherosclerosis and lipid storage disorders. Further they are of the opinion that other topics in biochemistry can also be dealt with the same way using concept maps. This will help them to understand the subject and correlate with the metabolic alteration in disease progression. Most of them have specified that even the same technique can be used to learn other preclinical subjects also. Concept mapping can be used as mode for communication between students and teachers, which is useful for the teacher to understand the construction ability of a student to connect the concepts and is an advantage of Cmaps(19). From the student's perspective, it was found that creating Cmaps was an effective technique to learn the subject and for the teachers it was a better avenue to understand the drawback of the students, so that through feedback they could correct them and clarify the content and performance of each student (20). Hence could foster the development of shared meaning between the instructor and the student (3).

The results of the present study shows that concept maps enhanced the learning activity in Biochemistry of first MBBS students and has developed clear concepts in them to effectively link the various aspects of the biochemical alterations and its implications leading to various diseases and in getting a comprehensive and accurate overview of the entire topic. Further the concepts have helped them to improve their scores in the examination too. Hence it is suggested that concept mapping is an effective teaching-learning tool in Biochemistry and can be very effectively implemented in the undergraduate learning process.

## CONCLUSIONS

It can be concluded from the present study that concept mapping is an effective teaching-learning method in Biochemistry than the regular lecture classes alone for first MBBS students in a Medical College. It is found that the Cmap has helped the

students to think critically and extract the answers based on the previous concepts and also helped them to retain the knowledge gained.

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## TABLE AND LEGEND

**Table 1: Mean scores of control and test groups**

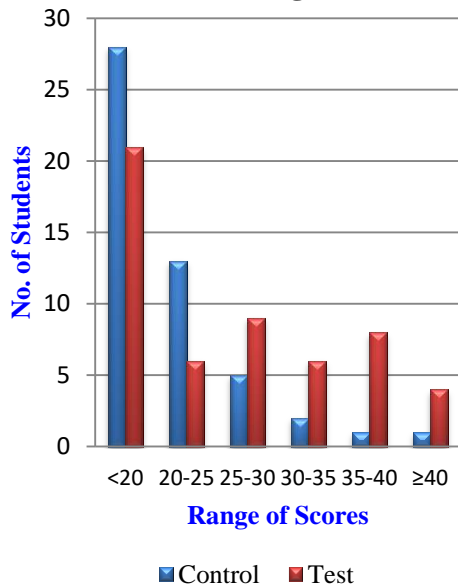
Groups	Number	Mean Score	Standard Deviation (SD)
Control	50	17.02	8.677
Test	54	23.02	11.521

\*Values are mean + SD; t value = 2.981, degree of freedom = 102, p-value = 0.004

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## FIGURES AND LEGENDS

**Figure 1: Distribution of students according to the scores**



**Figure 2: Student's Feedback on Concept map**

