

# Concept Mapping Enhancing Learning in Health Professionals

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## ABSTRACT

Concept mapping is an educational tool that encourages meaningful learning. Teaching is challenging in undergraduate medical education, particularly because it is based upon imparting lectures and rewarding for recall of factual information during examinations. The purpose of the study is to introduce concept maps with clinical cases to improve learning of Biochemistry course content.

Participants were first year MBBS students (n=150) from Government Medical College Jammu, admitted during the academic year 2017-2018, attending the Biochemistry Department. They were randomly divided into two groups, the one (group 1) continuing with the traditional program (n=90), the other (group 2) with innovative program using concept mapping (n=60). The 60 students in the innovative group were further randomly divided into groups of six each, for a total of 10 small groups. In each of the three clinical-case unit tests, thereafter, the group 2 outperformed the group 1. Against the range of 12.54 to 14.48 for the group 2, the group 1 showed the score range of 8.66 to 10.02 only. Nearly all the students gave positive feedback and found the method interesting and worth all effort.

Thus, learning with understanding allows integration of new concepts with previously learned concepts and leads to retention of information in long-term memory in a usable manner and students may become more independent and responsible for their learning. This article introduces the concept of concept-maps in medical education as an effective instrument towards education and preparing a better physician and health professional.

**Key words:** Concept mapping, medical education, health professionals

**Key Message:** *Meaningful learning (learning with understanding) is much stronger and long lasting than routine learning (learning by memorization) because students address the conceptual meaning of the knowledge being learned, and link this new information with previous knowledge.*

## INTRODUCTION

Concept mapping is an active, creative visual and spatial learning activity in which concepts are organized according to their hierarchical relationships. Linking words are used to describe the relationships among the concepts. To create a concept map, students must understand the information that will appear in the map. Students must also relate and integrate the concepts that will be recorded in the map; as

a result students replace unidirectional linear organization with thinking- which proceeds in multiple directions. This improves retention of useful information for a long term, reduces retention of non-meaningful information and better the capacity of the student to transfer and utilize the knowledge acquired for future problem solving activities. Thus, concept mapping is a primary skill, once acquired by medical students, can be used to: organize and

integrate information, assess existing knowledge, gain insights into new and existing knowledge and relate basic science concepts to clinical presentation of the patient. Students can continue to use the concept mapping as they go through clinical clerkships and residency programs. As practicing physicians they can use the method to gain a meaningful understanding of new concepts and to integrate these new concepts with prior concepts retained in long term memory. <sup>[1]</sup> Three subjects namely: Anatomy, Biochemistry and Physiology are there in the first year MBBS since tradition. Biochemistry (clinical) must be taught and learned in the context of the disease or a medical problem in order to facilitate the transfer of this knowledge in terms of diagnosis and treatment of the patient once the student graduates and practices in the field. <sup>[2]</sup>

Department of Biochemistry GMC Jammu, with an aim to provide quality medical education by way of adopting and implementing active, novel and responsive learning strategies in the curriculum, conducted a study amongst the first year MBBS students to see the effect of integrated teaching with case based learning (CBL) in Biochemistry. It was evident from the results of this study that the CBL raised learning standards and effective gains as compared to the traditional curriculum. It was also observed that the students were able to formulate the learning objectives better and were able to gain further knowledge by virtue of case scenarios used in CBL strategy. Despite this, students were lacking in relating and analyzing the links between the basics of clinical biochemistry to medical problems; a shortcoming needed to be immediately addressed and we strongly felt the need for the introduction of another innovative tool in combination with the clinical cases to fill this gap. <sup>[2]</sup>

A few studies in physiology education have emphasized the use of concept mapping as an important tool to facilitate active, self directed, and deep learning. <sup>[3,4]</sup> Schmidt describes the

conceptual framework that promotes deep learning in a study about the foundations of PBL, <sup>[5]</sup> where he describes six principles of cognitive learning, one of which deals with “elaboration” of a content area. In concept mapping session with clinical cases, elaboration of the clinical cases promotes the understanding and better retention of a content area. During the past decade, the use of concept mapping in medical education provided a chance for the medical professionals to improve their meaningful and deep learning. <sup>[6,7]</sup>

However, the relevance and the use of concept mapping in medical biochemistry education were not studied and this is the rationale for developing this innovative curriculum. Specific objectives of this study are to: design and implement the innovative curriculum consisting of concept mapping with clinical cases, compare the knowledge of the undergraduate medical students in the traditional curriculum with that of students in innovative curriculum, and know the perceptions of the undergraduate medical students on the usefulness of the concept mapping with clinical cases in biochemistry.

## **MATERIALS AND METHODS**

All first year MBBS students (n=150) admitted during the academic year 2017-2018 attending the Biochemistry Department of GMC Jammu, were randomly divided into two groups: the ones who carried on in the traditional, lecture - based program (n=90), and the ones in the new innovative, clinical cases with concept mapping programme (n=60). Due permission was obtained from the institutional ethics committee before the start of the study. The 60 students in the innovative group were further randomly divided into groups of six each, for a total of 10 small groups. Three units for concept mapping with clinical cases were used for this study. The clinical cases were given to the students for discussion in the small groups, including the preparation of concept maps, all under the supervision of a faculty member. The following steps were adopted

for concept mapping, as described by Novak and Canas, with slight modifications: 1 Brainstorming stage, 2 Organizing stage, 3. Layout stage, 4. Linking stage, 5. Revising and finalizing stage, 6. Gallery walk. [1]

During this study, the same faculty member taught both groups of students, and the students of both groups were provided the same amount of teaching and learning time. Due care was taken so that both the groups had similar opportunity to clarify

understanding by asking for help from the faculty member. Student performance was assessed using the scores from the three post-module written tests on the clinical case units used. The test contained multiple choice questions (MCQs), structured essays questions (SEQs), and short answer questions (SAQs). On an average, each test contained eight questions, that is, five MCQs, one SEQ, and two SAQ; the maximum score for each test was 20.

**Box1: A Clinical Case Unit (Sample):**

A 50 year old man visits a physician with complaints of increased hunger, thirst, and increased urination. He also complains of tiredness, that he is easily fatigued, develops headache, blurring of vision and so on. He had noticed a recent weight loss. He confessed to a weakness for sweet foods. He ordered some investigations where fasting blood glucose 180mg/dl, random blood glucose 320mg/dl, ketone bodies in urine is negative. And he is suspected of having diabetes mellitus.

Specific learning objectives: By the end of the session, the student should be able to:

1. Explain the regulation of blood glucose.
2. Enumerate the risk factor for diabetes mellitus
3. List the normal range of blood glucose
4. Explain metabolism of glucose
5. Criteria to diagnose the diabetes mellitus in laboratory
6. Retrieve the names of the compounds or drugs that reduces the blood glucose levels
7. Explain the dietary control of glucose levels
8. List the biochemical markers to diagnose the diabetes mellitus
9. Classify diabetes mellitus

Areas to develop proficiency related to the objectives

- 1 Hyperglycemia and Hypoglycaemia
- 2 Glycosuria
- 3 Oral glucose tolerance test
- 4 Role of insulin in diabetes mellitus
- 5 Mechanism of action of insulin
- 6 Glucose transporters
- 7 Enlist the various hypo and hyperglycaemic hormones
- 8 Biochemical test used in the diagnosis of diabetes mellitus

**Self evaluation**

- 1 Define diabetes Mellitus
- 2 Classify diabetes mellitus
- 3 Enumerate the risk factors of diabetes mellitus
- 4 Write the normal values of fasting , random and post prandial blood glucose levels
- 5 Name the hypoglycaemic drugs
- 6 Role of insulin in diabetes mellitus
- 7 List the biochemical markers available for diagnosing the diabetes mellitus
- 8 Glycated hemoglobin in diabetes
- 9 Explain the role of Glycated hemoglobin and fructosamine in diabetes mellitus
- 10 Enlist the antibody tests in diagnosing diabetes
- 11 New future markers for diagnosing the disease.

Students' performances were assessed from the scores obtained from written sample tests conducted after the completion of the concept mapping module. A set of three sample tests, structured purposely and separately with maximum score of 20 each, was conducted on each student as a mix of questions containing multiple choice questions (MCQs), Structured essay questions (SEQs) and short answer questions (SAQs). Statistical analyses was done using Student t-tests (for windows), to compare the test-result outcome of both groups.

In addition to it, the students in the innovative program (group 2) were asked to provide a feedback on a 12-item, 5-point Likert Scale questionnaire regarding their perception of the usefulness of the concept mapping approach in combination with the clinical cases, which was prepared and based upon the one documented by Pinto and Zeitz. [1]

The questionnaire assessed the following 12 items of the participants:

1. Deep understanding of the subject matter
2. Relevance of the cases
3. Opportunities for discussion
4. Use of critical thinking
5. Usefulness of concept mapping
6. Relevance for future practice
7. Promotion of self-assessment
8. Promotion of active learning
9. Motivation to learn
10. Meaningfulness of learning
11. Role of the teacher
12. A general question

## RESULT

The outcome of the tests and the feedback from the students in the innovative curriculum were significantly in favour of the mapping the subject concepts for all type of medical teaching. In each of the three clinical case unit tests, the group 2 outperformed the group 1 and their score range reflected the same, i.e. against the range of 12.54 to 14.48 for the group 2, the

group 1 showed the score range of 8.66 to 10.02 only. (Table 1)

Nearly all the students gave positive feedback and found the method interesting and worth all effort. On an average the feedback reflected that the students got an in-depth understanding due to integration of information, clear and enormous opportunities for discussion, induced critical thinking and analysis by linking of basic concepts in biochemistry with the clinical problems, sufficient motivation and fun to inhibit learning and definite value addition in teaching process. The results outcomes and feedback further demonstrated that the teacher or faculty's role as facilitator is the key factor for the proper conducting of these concept-mapping sessions in small groups.

**Table 1: The mean  $\pm$  SD values of the test scores to assess the academic performance in group 1 (controls: n= 75) and group 2 (study subjects: n= 75)**

Test no	Group 1: Traditional Method	Group 2: Innovative Method
1	8.66 $\pm$ 2.21	12.54 $\pm$ 3.40
2	10.02 $\pm$ 1.43	14.48 $\pm$ 2.06
3	8.83 $\pm$ 1.97	13.28 $\pm$ 2.91

## DISCUSSION

It can be assumed that the enthusiasm of the faculty or teacher involved during the test lectures were also in favour of the new innovative teaching mechanism of 'concept –mapping' and that a good amount of novel and creative inputs may have been put into the lectures involved with concept mapping as compared to the traditional form of lectures on the same subject matter, and that there was no separate data-analysis to analyse the enhanced influence they had on the students while teaching, but still the outcome is clear marker on the matter. The results of the study clearly show that the students undergone the novel process of learning through concept mapping invariably outperform the ones studying the traditional way. Thus, such maps facilitate learning a subject because the students use logic to reach their own conclusions. [8] Students may become more independent and responsible for their learning, developing

self-confidence, and attaining a more significant and personalized learning; similarly demonstrated by Wikies et al. [9] Nearly all the students found the method interesting, highlighting the benefits obtained with the application of concept maps are many and worth all effort. Difficult concepts are approached in steps, improving learning and making them easier to understand, as stated by Azevedo et al [10] The information on the map can be shown in a long way or in a short way, with no loss of information, complexity or significance. Concept maps can also be a great studying tool when reviewing ideas, as they facilitate the organization of information for the student by West et al [11] and they can themselves use concept maps to integrate, reconcile and differentiate concepts, as stated by Costa et al. [12] Students' previous knowledge becomes essential to the acquisition of new concepts and theories, as explained by Lieuby et al. [13] Such maps and visual form of demonstrations helps students who have a visual memory and who "learn by seeing". [14] Equally important, the maps help the students to have inter- and multidisciplinary learning. [15] Oftentimes otherwise excellent students have difficulties associating concepts from different disciplines; they may see things more clearly with concept maps. [13] As the study process becomes more autonomous, students with greater difficulties have more chances of obtaining help from the teachers, similarly displayed by Wikies et al. [9]

## CONCLUSION

Learning is a complex cognitive process that occurs in individuals of all ages. Learning with understanding allows integration of new concepts with previously learned concepts and leads to retention of information in long-term memory in a usable manner. It is important to use varied tools to enhance the construction of knowledge. Considering medical education specifically, use of an isolated methods, whether traditional or expositive classes or problem-based learning, is underlined with

limitations. Supported by this premise, the use of the concept map can represent a latest and constructive strategy for the ever expanding knowledge base in medical education. Concept mapping is a strategy that can help medical students, residents and experienced physicians with their efforts towards meaningful learning.

Taking these aspects into account, pedagogical changes have been proposed – which begin to configure a new paradigm in the medical teaching – aiming to transform the student into a critical, reflexive individual who is able in his practice to fully learn how to learn. Supported by this point of view, this article broaches the concept of *concept maps* (CM), aiming to open the discussion of this tool as an instrument to be applied effectively to contribute to the realization of forming an effective physician.

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