

Original article:

“Concept mapping – an innovative approach to learning”

Preetha Paul¹, Rajarajan Easuraj², Sasikumar Arumugam³, Jamunarani Srirangaramasamy⁴

Abstract:

Background: For a medical student to blossom into a competent doctor with critical thinking and decision-making skills, appropriate learning techniques that will enhance his learning and develop higher-order thinking skills are needed. Concept mapping is a learning technique that creates a mind map. It serves to represent information in a structured format with appropriate linkage and sequencing. **Objective:** This article describes a concept mapping workshop that was organized in our institution, our pre- and post-test results and the feedback we received. **Materials and methods:** An innovative workshop on “Learning by concept mapping” was organized for first year MBBS students. Twelve facilitators and 150 students participated. The workshop began with an introductory talk on concept mapping. Then, a demonstration on how to create concept maps was given. This was followed by a hands – on session where the students created their own concept maps under the guidance of facilitators. Pre- and post-tests were administered and feedback on the workshop was taken. **Results and Discussion:** Statistical analysis showed significant improvement between pre- and post-test scores. Participants appreciated the workshop and felt that concept mapping was an innovative way of learning and could help in assimilating complicated subject matter. **Conclusion:** Concept mapping, as a learning technique, can lead to a meaningful learning experience. Such innovative approaches to learning are welcomed by students.

Keywords: Concept maps; learning; workshop

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Introduction:

Modern medicine is growing at a phenomenal pace and the explosion of information with each new day is mind-boggling. While medical education has always been a heavy academic burden for any budding doctor, recent times have seen this load increase manyfold. Today, the volume of information that is expected to be read, retained and recollected by the learner is extremely large. As teachers in medical colleges, we need to be able to help learners with this load and thus facilitate the learning process.

Nowadays, due to the initiatives taken by the Medical

Council of India, medical teachers are well-trained in medical education technologies and learner-centric teaching methods. Many dedicated teachers have internalized these concepts and put time and effort into practising them. Thus, teaching methods and techniques have improved and this is all for the good.

If, at the same time, learners could be guided with learning strategies and tools that could make the learning process simpler and more meaningful, they will derive maximum benefit from their medical education. Their learning will then become more efficient and will serve to effectively develop their

1. Preetha Paul, Professor, Department of Physiology, Tagore Medical College and Hospital, The Tamil Nadu Dr MGR Medical University, Rathinamangalam, Chennai – 600 127, Tamil Nadu, India
2. Rajarajan Easuraj, Compulsory Rotatory Resident Intern (CRRI), Tagore Medical College and Hospital, Rathinamangalam, Chennai – 600 127
3. Sasikumar Arumugam, Assistant Professor, Department of Physiology, Tagore Medical College and Hospital, Rathinamangalam, Chennai – 600 127
4. Jamunarani Srirangaramasamy, Associate Professor, Department of Pathology, Tagore Medical College and Hospital, Rathinamangalam, Chennai – 600 127

Correspondence to: Preetha Paul, Professor, Department of Physiology, Tagore Medical College and Hospital, The Tamil Nadu Dr MGR Medical University, Rathinamangalam, Chennai – 600 127, Tamil Nadu, India. Email: drpreethapaul@yahoo.co.in

higher order thinking skills, rather than just being a knowledge-gathering exercise. This will translate ultimately into the creation of more-than-competent medical graduates, with the requisite knowledge, critical-thinking skills and attitudes.

Concept mapping is an innovative learning technique that creates a mind map. It serves to represent information in a structured format with appropriate linkage and sequencing and thus brings about meaningful learning. In this article, we have described a concept mapping workshop that was organized in our institution for first year MBBS students, our pre- and post-test evaluation results and the feedback we received.

Objective:

Through a workshop, we introduced our students to a new technique of learning called concept mapping and sought to analyze, using the pre- and post-test scores, its effectiveness in helping them with the learning process. We also recorded their feedback regarding the workshop and the technique.

Materials and Methods:

The Department of Physiology, Tagore Medical College, Chennai, India, organized an innovative workshop on “Learning by concept mapping” for first year MBBS students. One hundred and fifty students participated in this half-day program that was held in May 2017. The learners were divided into twelve batches of 12 to 13 students each. There were a total of 12 facilitators as well, one for each batch, six of them from the department of Physiology and six from the departments of Pathology and Community Medicine. All twelve facilitators were trained in concept mapping by an expert in the field of medical education, who was also the chief resource person for the workshop.

The workshop began in the lecture hall with an enthusiastic presentation by the first speaker, a fourth year MBBS student, who spoke about how she came to learn about concept mapping, how she tried it out, the challenges she faced initially and the way it enhanced her learning.

This was followed by a demonstration on “The making of a concept map” by the first author, who chose a topic the I MBBS students were familiar with (neurophysiology of aphasia), explained how that topic should be approached, and demonstrated, step-by-step, using a Powerpoint presentation, how a concept map of that topic could be developed.

Following this, the students took a pre-test on diabetes

mellitus, which was the topic that was chosen for the workshop. The pre-test carried multiple choice questions and ultra-short answer questions for a maximum score of 12, based on five pages of text on diabetes mellitus from Guyton and Hall’s “Textbook of Medical Physiology” (twelfth edition). This was material the students were expected to have read already.

The pre-test sheets were collected and then, the whole group moved into a spacious reading hall with several large tables, so that each group could seat themselves around a table with a facilitator. They were now asked to read those five pages of text on diabetes mellitus and make a concept map of it.

This hands-on session lasted about two hours with the first half hour for the reading and the next one and a half hours for the mapping. When the students were done, the chief resource person delivered a very informative talk on concept mapping and suggested various ways in which it could be taken to the next level so as to be useful for insightful learning. He critiqued some of the concept maps that had been prepared, highlighting and appreciating their plus points and suggesting ways of improvement and further expansion. The workshop ended with the post-test being administered. The post-test was identical to the pre-test and served to assess whether learning had taken place during the session.

Feedback on the program was taken from the students. The feedback form included statements on the clarity and usefulness of the various sessions, the conduct of the workshop and student confidence in their concept mapping abilities at the end of the workshop. The students indicated their level of agreement with the statements on the feedback form on a 5-point Likert scale - Strongly agree/Agree/Neither agree nor disagree/Disagree/Strongly disagree.

Data collected included the pre- and post-test scores and the Likert ratings from the feedback forms. All data were entered in Microsoft Excel. Mean and standard deviation of the pre- and post-test scores was computed using the same. Statistical analysis of the difference between these two sets of scores was done using the student ‘t’ test. Student feedback was analyzed and presented as frequency and percentage.

Results:

The workshop was attended by all 150 students of first year MBBS. All of them took the pre-test and post-test and filled up the feedback forms as well. The response rate was 100%.

The pre- and post-tests administered carried a maximum score of 12. The scores obtained by the 150 learners are shown in Table 1.

Table 1: Pre- and Post-test Scores

Scores obtained by students		
Score obtained (Max score = 12)	No. of students	
	Pre-test	Post-test
2	1	0
3	2	0
4	2	0
5	10	0
6	10	0
7	15	2
8	19	1
9	25	6
10	30	19
11	24	30
12	12	92
	Total = 150	Total = 150

Pre-test scores ranged from 2 to 12. Twenty five of the 150 students had scored 6 marks or less. Eighty nine had obtained scores ranging from 7 to 10, while

12 had obtained a full score. The mean pre-test score was 8.77 ± 2.21 .

Of the post-test scores, the lowest value was found to be 7. Twenty eight students had scores ranging from 7 to 10. A whopping 122 students had scores >10, of whom 92 had scored a perfect 12. The mean post-test score was 11.33 ± 1.03 .

Statistical analysis using the student ‘t’ test revealed that the difference between the pre- and post-test scores (Table 2) was highly significant with a p value of less than 0.0001.

Table 2: Analysis of pre- and post-test scores

	Arithmetic Mean	Standard Deviation	Standard error of mean	P value
Pre-test score	8.77	2.21	0.18	< 0.0001*
Post-test score	11.33	1.03	0.08	

*highly significant

Table 3 gives the student feedback on the workshop. Regarding the introductory talk on concept mapping and its uses/ advantages, 97% of the students felt the objectives of concept mapping were clearly defined and 91% felt it was organized and easy to understand. As for the concept mapping demonstration, 94% said it was useful and 90% felt it made construction of the concept map easier.

Table 3: Students’ feedback on concept mapping

Session	Questions	Feedback From Students				
		Strongly agree Freq (%)	Agree Freq (%)	Neither agree nor disagree Freq (%)	Disagree Freq (%)	Strongly disagree Freq (%)
Presentation on the use/ advantages of concept mapping	The objectives of concept mapping were clearly defined	67 (44.67)	78 (52)	5 (3.33)	0 (0)	0 (0)
	The presentation was organized and easy to follow	52 (34.67)	85 (56.67)	13 (8.67)	0 (0)	0 (0)
Concept mapping demonstration	The demonstration session was useful	82 (54.67)	59 (39.33)	9 (6)	0 (0)	0 (0)
	The demonstration session made construction of the concept map easier	76 (50.67)	59 (39.33)	14 (9.33)	1 (0.67)	0 (0)

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Hands-on making of a concept map (guided by facilitators)	The facilitator was knowledgeable about concept mapping	47 (31.33)	88 (58.67)	13 (8.67)	2 (1.33)	0 (0)
	The facilitator helped me in constructing the concept map	48 (32)	80 (53.33)	18 (12)	4 (2.67)	0 (0)
	Individual participation and interaction was encouraged	67 (44.67)	75 (50)	26 (17.33)	2 (1.33)	0 (0)
Overall feedback about the workshop	Concept mapping helped me understand the subject matter	65 (43.33)	75 (50)	9 (6)	0 (0)	1 (0.67)
	I will be able to construct concept maps in other subjects as well	55 (36.67)	66 (44)	28 (18.67)	1 (0.67)	0 (0)
	Concept mapping will help to revise topics for examination in a short time	73 (48.67)	60 (40)	13 (8.67)	4 (2.67)	0 (0)
	Similar sessions may be conducted in future	73 (48.67)	65 (43.33)	12 (8)	0 (0)	0 (0)
	The time given for constructing the concept map was adequate	30 (20)	57 (38)	39 (26)	20 (13.33)	4 (2.67)
	The training room and the facilities were adequate and comfortable	57 (38)	62 (41.33)	26 (17.33)	3 (2)	2 (1.33)

The hands-on session had 95% stating that participation and interaction was encouraged, 90% felt the facilitator was knowledgeable about concept mapping and 85% said the facilitator helped in constructing the concept map. Ninety three percent felt that concept mapping helped with the understanding of the subject matter while 6% were not sure. Regarding the statement on concept mapping helping in revising topics for examination in a short time 89% said it would, while 9% were not sure. However 2% said it would not.

The time given for constructing the concept map was considered adequate by 58% of participants.

However, 16% stated that it was inadequate, while 26% were not sure. The training room and the facilities were adequate and comfortable for 79%, while 3% felt it was not and 17% said they were not sure.

At the end of the workshop, 81% of the participants were confident of being able to construct concept maps in other subjects as well and 92% wanted similar sessions in the future.

Discussion:

We observed in our workshop that pre-test scores ranged from 2 to 12 whereas the post-test scores

ranged from 7 to 12. Twenty five of the 150 students had scored 6 or lower in the pre-test while in the post-test, none had scored less than 7. Eighty nine had pre-test scores ranging from 7 to 10, while only 28 fell in this range with the post-test. In the pre-test, 12 students had obtained a full score and this number rose to 92 with the post-test. The mean pre-test score was 8.77 ± 2.21 , the mean post-test score was 11.33 ± 1.03 . The massive improvement observed in post-test scores and the larger proportion of perfect scores in the post-test amply demonstrates the effectiveness of concept mapping as a learning technique.

Developed by Joseph Novak and colleagues, concept mapping is a learning technique that is an offshoot of David Ausubel's meaningful learning theory^{1,2} which states that learning becomes more meaningful when it begins from what a learner knows³ and then moves into newer territory.

True learning cannot be simplistic, happening in linear fashion⁴ by adding on information to that already existing like bogeys being added to a train. Rather, it is a complex process in which the learner has to apply his mind, sequence the knowledge he is gaining and create links between the information he already knows and what he is newly acquiring. This linking and sequencing contributes to a meaningful learning experience, where the learner himself constructs his learning into a cognitive net⁴.

Identifying key concepts, establishing an order for them, sequencing them and creating cross linkages – these are the basic steps in making a concept map. There are many different ways to organize a concept map eg as a web or a hierarchy or a flowchart⁵, with the underlying theme being that it must clearly define the relationship between different pieces of information by using appropriate linking phrases⁶. Use of colours and other highlighting techniques can add to the usefulness of a concept map. This kind of learning will greatly benefit a “visual learner” and is a great way of reviewing topics before the exams. With concept mapping, even a complicated topic can be broken down into bite-sized pieces and easily assimilated by the learner.

The first time of trying might not yield the perfect concept map but one “learns by doing”. So a concept map is only going to improve every time it is reworked. Each time a learner does this, he is involved in a learning exercise, increasing his learning both in depth and extent. This kind of learning will lead to a higher level of competence in the learner.

In medical education, the various disciplines tend to be compartmentalized, and the onus is on the learner to put all the information together and develop for himself a complete picture. Concept mapping is invaluable in this respect and helps to integrate information and concepts from the various disciplines into a cohesive whole, so the learner can get a 360 degree idea of any topic⁵.

This is exactly what the chief resource person was trying to drive home in his address to the students at the end of the workshop. He emphasized that concept mapping should be used as a tool for both horizontal and vertical integration of any topic. He advised them to add biochemistry and anatomy points to the maps, save them carefully, then add pharmacology, pathology and microbiology the next year and then medicine and surgery the following year. That way, in course of time, it would become a complete concept map and serve as a ready reckoner for all details pertaining to that topic. It would facilitate revising and recapitulating as well as sharing of this information.

A capable doctor should be capable of reflecting on his findings in a particular patient, evaluating the various options open to him and then deciding on a course of action. This is what we call critical thinking and it is the hallmark of a competent doctor. This ability can be triggered, stimulated, developed and honed with the use of concept maps^{6,7}.

Another very important benefit from this technique of learning is that it builds learner confidence and helps the learner become more independent in his learning. This was beautifully brought home to us in the workshop, where we observed that some of our students, who we felt might be disinterested, came up with really excellent and detailed concept maps.

From the feedback obtained from the students, we learned that a majority found the demonstration session on concept mapping useful (94%) and felt it made construction of the concept map easier (90%). The hands-on session also was very well-received with 95% stating that it encouraged their active participation. Ninety three percent felt that concept mapping helped with understanding of the subject matter and 89% said it would help in revising before an examination in a short time.

The time given for constructing the concept map was considered adequate by only 58% of participants, while 16% felt that it was inadequate. This is understandable and one of the challenges faced

by learners when they first try out this method of learning. Though we had allotted about two hours for the mapping session, this is a technique where one “learns by doing”; therefore, anyone trying concept mapping for the first time will invariably feel this way. In fact, this is one of the reasons for learner resistance to the use of concept maps especially in the initial stages⁶ when the learner has to “feel his way” around, and his progress with a concept map is somewhat tentative and slow. As he gets the “feel” of this tool, however, he will be able to work more confidently and produce better concept maps.

Teaching faculty also may have an issue with concept maps in that it will differ between individuals and will also “evolve” with time. They need to be aware that the differences between individuals stem from their differing cognitive structures and that the evolution of the map is a result of the learning process and the growth that has taken place⁶.

It was remarkable to see the interest shown by all 150 students in the introductory sessions featuring the talk on concept mapping and the concept mapping demonstration. We attributed it to plain curiosity at first, and were pleasantly surprised to find that all 150 took the hands-on mapping session very seriously, and wholeheartedly and enthusiastically worked on their concept maps. To see the whole group engaged in this activity in all seriousness and sincerity was very rewarding for the organizers.

At the end of the workshop, 81% of the participants were confident of being able to construct concept maps in other subjects as well and 92% wanted similar sessions in the future.

The workshop helped us understand the immediate benefits of concept mapping in a learner. A longitudinal study into learning by the use of concept maps will serve to throw light on how these maps help in the evolution of a medical student into a practising physician with competent clinical reasoning and critical-thinking skills.

Conclusion:

From this experience, we learned that concept mapping is an effective learning technique and such innovative learning techniques are very much

appreciated and welcomed by students. It is therefore up to faculty members to be aware of innovative approaches to learning, so they can appropriately mentor their students. With proper guidance and encouragement, students can be led into meaningful learning experiences that could result in enhanced understanding, assimilation and recall and these would ultimately translate into the making of a competent professional.

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Authors’s contribution:

Data gathering and idea owner of this study: Preetha Paul

Study design: Preetha Paul, Jamunarani Srirangamasamy

Data gathering: Preetha Paul, Rajarajan Easuraj, Sasikumar Arumugam

Writing and submitting manuscript: Preetha Paul, Rajarajan Easuraj

Editing and approval of final draft: Preetha Paul

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