Original Article

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Quick Response Code:

Website: www.jehp.net

DOI: 10.4103/jehp.jehp_146_20

Concept map as a teaching and learning tool for medical students

Sulakshana Shridhar Baliga, Padmaja Ravindra Walvekar, Girija Jagadish Mahantshetti

Abstract:

BACKGROUND AND AIM: Concept maps hold great potential for the students as it helps in the formulation of new concepts as well to evaluate the learning ability of the students. However, the use of concept maps as a teaching tool in medical students in India has not been explored, to the best of our knowledge. This study was conducted to assess the use of concept maps in improving learning among medical students.

MATERIALS AND METHODS: This study was conducted among III MBBS students belonging to two batches. This study was carried out in two stages. In first stage, pretest was taken to test the knowledge of students. Later, introductory class was taken on tuberculosis and concept map was used to explain the given concept and later posttest was taken. In second stage, feedback was taken from the students regarding the concept map. Pre- and post-test results were compared using Wilcoxon test.

RESULTS: Significant difference between pretest (4 ± 1.593) and posttest (10 ± 0.762) score was seen ($P < 0.0001$). More than 50% of students scored full marks in posttest, whereas no one got full marks in the pretest. Positive response (82.09%) was received from the students when feedback was taken regarding the use of concept map.

CONCLUSION: Concept maps are found to be an effective teaching and learning tool for medical students. They can be used to enhance meaningful learning in students and can be practiced more in the students for better understandings of the concepts.

Keywords:

Concept formation, feedback, knowledge, learning, map, medical students

Introduction

Medical schools have adapted alternative strategies toward educational programs at the national and international level. Such a change was necessary to ensure that students were prepared for a lifelong, self-directed learning.[1] Learning is closely dependent on reading. Reading is a primitive but necessary skill that is indispensable in daily life. The process involves relevant knowledge activation and closely linked language skills for successful information exchange through text.[2] While everyone is acquainted with reading, effective reading is a skill that a few acquire. To incite effective reading, there are three learning strategies. First is metacognitive, this is a scientifically declared best learning strategy and is a self-regulated mechanism which empowers learners. Through metacognition, learners are assessed accurately on current knowledge, identification of the need for new knowledge, and strategies to assimilate the new knowledge.[3,4] Second is cognitive learning, it is a predominant strategy which involves translating, repeating, taking notes, grouping of concepts, elaboration, contextualization, imagery, and keywords. Third is social strategies, which are also called affective strategies and is the exchange of ideas driven by group discussions and transaction with others.[5]

Department of Community Medicine, J.N. Medical College, Belagavi, Karnataka, India

Address for correspondence:
Dr. Padmaja Ravindra Walvekar, Department of Community Medicine, J.N. Medical College, KAHER, Belagavi - 590 010, Karnataka, India.
E-mail: padma_walv@yahoo.co.in

Received: 14-02-2020
Accepted: 23-11-2020
Published: 28-01-2021

How to cite this article: Baliga SS, Walvekar PR, Mahantshetti GJ. Concept map as a teaching and learning tool for medical students. J Edu Health Promot 2021;10:35.

Of the many metacognitive strategies, concept mapping is proven to improve meaningful and independent learning.[6] The concept map was first developed by Joseph Novak and Bob Gowin at Cornell University in 1972.[7] Concept maps are graphical representations of a given concept. This reflects the student's cognitive framework and offers insight into their understanding.[8] The placement of the concepts is hierarchical and linked by arrows with labeled explanatory phrases.[6]

Teaching and learning through concept maps have been explored in medical education.[9] The primary benefits of concept maps are: it promotes meaningful learning of medical concepts, provides an additional resource for learning, enables the instructors to provide feedback to students, and offers means of assessment of learning and performance.

In medical education, it is important that the educators bear in mind the central theoretical underpinning of concept maps to provide specific suggestions on constructing meaningful maps. Students use concept maps for reading assignments, map the pathophysiology of a disease, or link the medication regimen of a patient with the disease.[10]

Concept maps hold great potential for the student as it helps in the formulation of new concepts as well to evaluate the student in relation to learning.[11] However, the use of concept maps as a teaching and learning tool for medical students in India has not been explored, to the best of our knowledge. Although the concept map is already tested method, not very much in use as a part of learning. Using a concept map as a teaching and learning tool helps in active learning as learning is at a higher level than just memorization. Hence, the present study was planned to evaluate the effectiveness of concept maps as a teaching tool and to compare its effectiveness against traditional teaching practices.

Materials and Methods

This pilot study was conducted in a medical college, for a period of 4 months. Participants of the study were two batches of 3rd-year MBBS students of the same college. A total of 86 students III MBBS students were included in the study by convenient sampling method. The study was done only in MBBS phase III students in two batches.

The study was conducted in two stages.

1. Stage 1

Before the start of the study, a sampling frame was designed, and the list of students enrolled for the class was obtained. Setting up of the experiment was in accordance to the pre- and post-test design. The concept map was designed by the teacher [Supplementary Figure 1] and was internally assessed for its effectiveness by an internal expert team being faculty members of the college.

Before the commencement of the experiments, an introductory class was provided to the participants. Post which, a simple test was conducted to assess the extent of concept understanding and the test result scores were considered as the pretest scores. For the posttest scores, the principal investigator used a predesigned concept map to explain the same concept. Following the session, another test was carried out, the results of which was considered as posttest results.

2. Stage 2

The students were divided into six groups and were given to prepare concept map on diarrhea and were asked to submit the prefinal copy of concept maps. The faculty gave feedback on prepared concept maps. They incorporated the components of feedback received and submitted the final copy. Assessment of concept maps was done, and prize was given for the best concept map in each group [Supplementary Figure 2].

The students were asked to fill a predesigned satisfaction questionnaire to assess their perception toward the concept map after stage 2. Four responses for each question were provided – strongly agree, agree, strongly disagree, and disagree. The response of strongly agree and agree was converted into a percentage of agreement, and the same was followed for disagree. The first four questions investigated whether concept mapping truly enhanced learning, while the remaining determined the effective acceptance of concept mapping.

Ethical clearance was obtained from the institutional ethics committee.

Statistical methods

Data were analyzed using R software version 3.6.0 (R Foundation of Vienna, Austria). Wilcoxon test was used to compare the pre- and post-test scores of participants. Categorical variables are given in the form of a frequency table. Pre- and posttest scores of participants were given in median ± standard deviation form.

Results

Comparison of the pre- and post-test scores of participants was done; each test included ten questions. Pre- and post-test score distribution was 4 ± 1.593 and 10 ± 0.762, respectively [Figure 1a and b].

More than 50% of students scored full marks in posttest assessment [Graph 1b], whereas pretest scores were low [Graph 1a]. The posttest score was significantly better compared to pretest score ($P < 0.0001$).

Almost all the participants reacted positively toward concept mapping as strongly agree (82.09%). However, there was no response for disagree and strongly disagree [Table 1].[12]

Discussion

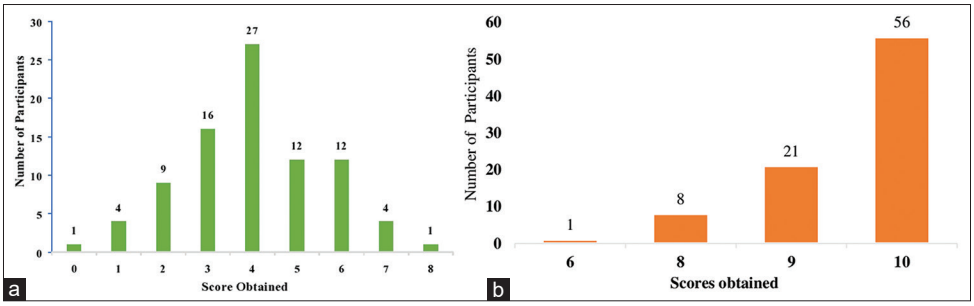
This study was done to assess the effectiveness of concept map as teaching as well as learning tool. Pretest and posttest were taken, and significant difference was seen in the results. Positive feedback was obtained from the students regarding the use of concept map.

In a study conducted by Sargolzaie *et al*.,[13] on eighty medical interns where one group was trained by concept mapping and other by book reading showed a significant mean difference in concept map group. Similarly, in a study by Mukhopadhyay *et al*.,[14] improvement in the percentage of the median score was seen in the concept map group than the book reading group. In both the studies, it has been seen that group using concept map has shown improvement in the learning capacity of students consistent with the present study.

One study was found to be similar to the current study, in which Bala *et al*.[15] carried out study on 150 MBBS students, in which pre- and post-test was conducted using concept map on HIV/AIDS. There was a significant increase in student's score after concept map ($P < 0.05$). Student's feedback about the effectiveness of concept map was also positive.

According to the study findings by Taie,[12] who conducted a study to see effect of concept mapping as an innovative teaching strategy to enhance cognitive learning found that there was a high significant difference between experimental students' knowledge about concept mapping before and postawareness sessions. Concept map improved student's meaningful learning levels and most of experimental students perceived concept map positively.[16]

Concept mapping is an effective teaching tool and is an excellent way to evaluate students' critical thinking. It can be used in a variety of settings and replace the traditional care plan as it is innovative teaching tool as it engages the student and prepares the student for future clinical decision-making in a complex and diverse health-care environment.[17] Mapping helps students to assess existing knowledge to organize and integrate information, gain insights into new and existing knowledge, can help in relating basic sciences concepts to clinical presentation of the patient.[18] Most of all it



Graph 1: (a): Pretest scores (b) post test scores

Table 1: Perceptions of the participants towards concept mapping

Question	Strongly agree (%)	Agree (%)	Strongly disagree	Disagree
Concept mapping helped me learn	84.9	15.1	-	-
Concept mapping helped me integrate and clarify the interrelationships among curriculum contents	80.2	19.8	-	-
Concept mapping learning strategy stimulated me to learn and think independently	83.7	16.3	-	-
Concept mapping helped me reduce the barriers and enhance my interest in learning	77.9	22.1	-	-
Concept mapping can be a new medical teaching and learning approach	82.6	17.4	-	-
I think the concept mapping strategy can be easily used in other curricula	80.2	19.8	-	-
I will consider using the concept mapping learning strategy in other curricula	81.4	18.6	-	-
I was satisfied with using concept mapping to learn	84.9	15.1	-	-
I liked using concept mapping to assist me to learn	86.0	14.0	-	-
I can soon adapt to concept mapping	79.1	20.9	-	-

is the most important visual training tool for practical teaching to medical students.[13,19]

In different studies, different topics were selected for concept mapping such as animal surveillance,[13] HIV/AIDS,[15] while in the current study, tuberculosis was selected, but the results showed a positive impact. Some studies have been done on medical students[13,15] specifically, while some have been done on nursing students,[17] but in both cases, results were positive.

Limitations

Limitations of the study were that some students found that preparing the concept maps is time consuming. These concept maps were prepared by students for limited topics only. This study was a pilot study. The assessment of the instrument of the study for reliability was not done. Future studies will be done to take a follow-up of the students whether they are implementing the idea of the concept maps in their regular studies or not. In the future will try to inoculate this in the curriculum and make it an ongoing process in teaching students and active learning by students.

Conclusion

Concept maps have found to be effective teaching and learning tool. The pre- and post-test results indicate that concept maps help in a better understanding of the participants. More than 50% of students got full marks after using concept mapping method. Positive feedback toward concept mapping from the students indicates the effectiveness of the concept maps. Using concept maps, learning abilities can be enhanced and can be considered for medical education to improve learning.

Acknowledgment

Authors are thankful to college authorities for permitting to conduct the study among medical students. We are also thankful to the students for their active participation.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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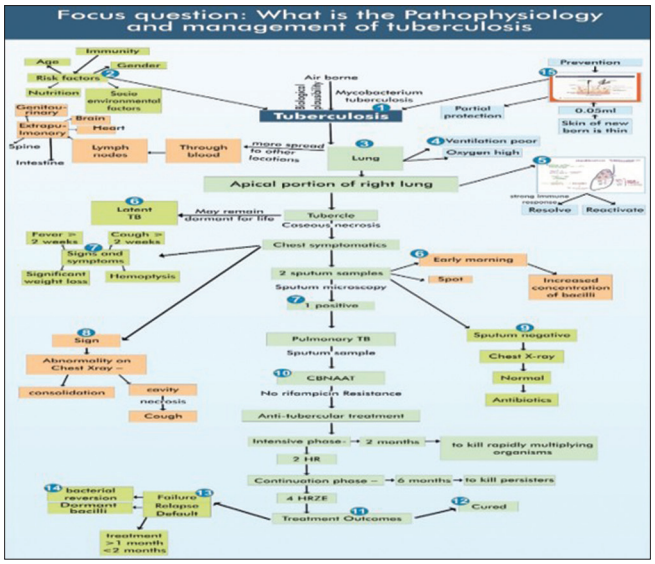
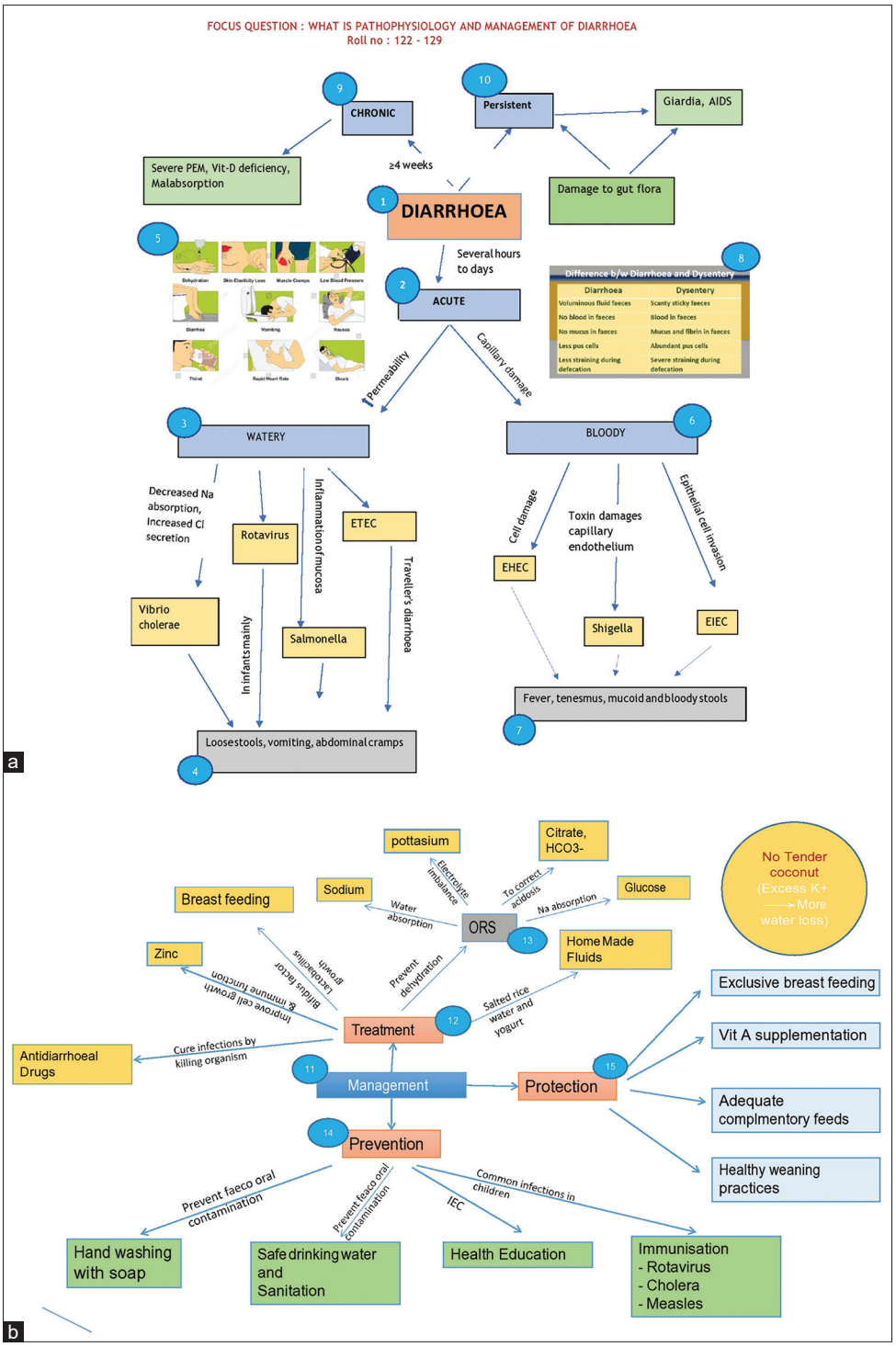


Supplementary Figure 1: Concept map prepared by teacher



Supplementary Figure 2: (a) Concept map prepared by students on diarrhoea part-1. (b) Concept map prepared by students on diarrhoea part-2