



## CONCEPT MAPPING: A MEANINGFUL SELF-DIRECTED LEARNING TOOL FOR PROBLEM BASED LEARNING IN PHYSIOLOGY.

<sup>1</sup>Dr. Anju Anand Asia, <sup>2</sup>Dr. Abhay Mudey

<sup>1</sup>Assistant Professor, Department of Physiology, Government Medical College, Akola, Maharashtra.

<sup>2</sup>Professor and Head of the Department Community Medicine, Jawaharlal Nehru Medical College, DMIMS, Sawangi, Wardha, Maharashtra.

**Conflicts of Interest:** Nil

**Corresponding author:** Dr. Anju Anand Asia

**DOI:** <https://doi.org/10.32553/ijmsdr.v4i8.656>

### Abstract:

**Background:** Fostering meaningful and self-directed learning among medical graduates is essential to mold them into competent physicians. Concept mapping is one such educational tool facilitating meaningful learning by organizing and integrating information. In our study it was used as a learning tool for problem analysis in Physiology.

**Material and Methods:** Students of the first MBBS Professional year were divided into groups of fifteen; a group facilitator was allotted to each group. After initial practice, students constructed concept maps in Problem based learning (PBL) sessions on case based scenarios; each group finalized a map and then designed charts based on these maps. Student's analytical ability was determined through differences in score between MCQ based pretest and post test. Charts were evaluated and perception of students regarding effectiveness of concept maps designing was taken.

**Results:** One hundred and thirty two students completed the study. There was a statistically significant difference in the pre and post test scores. The items in the Concept maps charts evaluation sheet were ranked as good or excellent in 75% of Charts except the item on horizontal interlinking and cross linking hierarchy which was ranked as satisfactory in 63% of Charts. Students considered activity of collection of information, discussions, designing, active involvement and teamwork as useful.

**Conclusions:** Self designed Concept maps can be a novel approach for problem analysis in Physiology.

**Summary:** Concept maps are useful for summarizing information; integrating mapping in PBL can improve critical thinking ability of students and renew interest in a basic science subject like Physiology.

**Keywords:** Concept map, Problem based learning, Meaningful learning, Analysis.

### Introduction:

Rapid changes in medicine and need for future practitioners to remain competent in the evolving medical environment makes it necessary that learning involves critical thinking, clinical reasoning and problem solving [1]. Medical education is undergoing rapid transformation in terms of how knowledge is incorporated and applied by the student, pedagogical changes are being proposed to transform student into a critical reflexive individual who knows 'how to learn' [2]. There is a shift from teacher centered to learner centered approach. The competency based curriculum by Medical Council of India [3] too has emphasized that the Indian Medical Graduate must be able to function in various roles, one of these being a lifelong learner committed to continuous improvement of skills and knowledge. Commencing from the First Professional year of MBBS linear learning pattern needs to be shifted to integrated learning and critical thinking abilities. Use of concept maps responds to this need of meaningful learning. Mapping integrates various concepts which are frequently fragmented in many cognitive compartments. It helps students to assess existing knowledge and gain insight into new knowledge [4].

Concept maps have been used in Physiology to improve students understanding of pulmonary concepts [5]. Similarly Problem based learning [PBL] is a logical step to improve student ability to synthesize and integrate foundational concepts for understanding a clinical case/problem. Displaying and linking concepts for cognitive analysis of a clinical problem can be helpful [6]. Few studies [7,8] are reported on effectiveness of student generated concept maps in problem analysis. Hence this study was undertaken to study utility of concept mapping as an approach to active, self directed learning.

### Aim and Objectives

**Aim:** To evaluate the utility of concept mapping as a learning tool for problem solving.

**Objectives:**

1. To determine students learning outcome after using Concept mapping tool.
2. To determine students analytical ability through Problem based Concept map evaluation.
3. To estimate student perception regarding effectiveness of concept mapping as a learning tool.

## Methodology

Study design- Cross-sectional interventional study

Study setting--Department of Physiology, Government Medical College, Akola, Maharashtra.

Participants- One hundred and fifty students of 1<sup>st</sup> Professional year of MBBS were enrolled for the study.

Study design-- Institutional ethical committee clearance was taken prior to beginning the work. A two hour introductory sensitization session for students and faculty on Concept mapping was taken which included Organization, Steps of construction, Examples and Application of concept maps.

Students were divided into groups of fifteen and a group facilitator was allotted for each group, each group was assigned a set of topics covered during lectures. This was followed by a Multiple choice question (MCQ) based pretest. Questions for pretest were analytical and reasoning based, prepared by all faculty members after thorough discussion. With the aid of group facilitator, students practiced map construction to acquaint themselves with this technique for a period of three weeks. The facilitator guided them on structural organization and integration of concepts.

Four PBL sessions for two hours per week were conducted, wherein each group was handed over a case scenario accompanied by questions based on specific learning objectives outlined by senior faculty members. Students of each group reviewed the case and searched for answers using multiple resources .Concept maps based on these case scenarios were constructed individually by each student on paper, analyzed by multiple group discussions which took place twice to thrice a week. The facilitator co-ordinated all activities. At the end of four weeks, one map was finalized by each group and students then designed charts based on these maps.

Concept maps Charts had been designed on case scenarios on Diabetes insipidus, Peptic ulcer, Chronic Obstructive and restrictive lung diseases, Hypertension, Hemophilia, Paroxysmal atrial tachycardia and Myasthenia gravis. A case scenario on Diabetes insipidus included a brief patient history, Pathophysiology of the disorder and Physiologic concepts behind key investigations and basic management. Key nodes of the map were in form of figures and words.

Charts were set for display with group representatives presenting it .A gallery walk was then arranged and queries were answered by the respective groups. Evaluation of the charts was done by senior faculty members, taking into consideration eleven items. The structured grading rubric was adapted from the one advocated by Novak and Gowin (1984) (9).

CONCEPT MAP CHART EVALUATION SHEET: Scale - 1: Poor 2: Fair3: Average 4: Good 5: Excellent

### ITEMS

Coverage of core concepts

Hierarchy

Conceptual clarity

Integration

Analysis

Interlinking

Cross-linking

Labeling

Creativity

Presentation

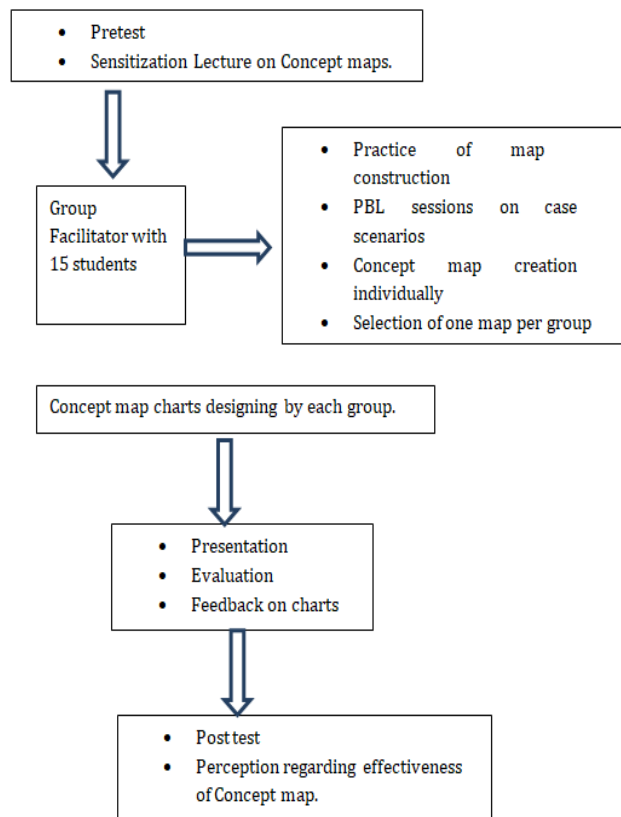
Team work

### TOTAL POINTS

Feedback on the quality, structural organization and integration of concepts was given immediately after the presentation. Perception of students regarding effectiveness of Concept maps was taken through a prevalidated questionnaire consisting of open ended questions and close ended questions.

A post test for all the respective groups was taken at the end of this activity.

Study design sequence:



Statistical analysis method: Student“ t” test to calculate ‘p’value for comparison between pretest and post test scores.

## Results

A total of one hundred and thirty two students completed the study.

Quantitative data analysis:

**Table 1:** Difference between pretest and post test scores

Study participants	Pre test Mean $\pm$ SD	Post test Mean $\pm$ SD
132	4.9 $\pm$ 1.8	8.5 $\pm$ 2.0*
*Paired 't' test : t value : (-16.4)		p value <0.0001; Significant

Qualitative data analysis ---On evaluation it was found that the items in the Concept maps Charts evaluation sheet were ranked as good or excellent in 75% of Charts except the item on horizontal interlinking and cross linking hierarchy which was ranked as satisfactory in 63% of Charts.

**Table 2:** Perception of students regarding effectiveness of concept mapping activity on Likert scale

Questions	Strongly agree	Agree	Neutral	Disagree
Case scenarios in PBL for applying basic Physiology concepts improves critical thinking ability.	98(74%)	29(21%)	5(4%)	0
Concept Mapping helps to derive interrelationship between key points.	86(65%)	35(26%)	10(8%)	1(1%)
Group discussions were quite useful	90(68%)	33(25%)	7(5%)	2(2%)
Making our own maps improves understanding and aids in retaining information.	102(77%)	23(17%)	7(5%)	0
I would utilize it as a learning tool.	92(69%)	36(27%)	4(3%)	0

**Table 3:** Reasons cited for the Enriching and useful part of Concept map Chart construction.

PERCENTAGE OF STUDENTS	REASON
62	Collecting information
68	Discussions and designing
59	Visualization of concepts
65	Active involvement
55	Teamwork

Some valuable suggestions by students were:

- Conducting frequent and larger number of case study discussions.
- Summarizing every lecture at the end with a concept map by the faculty.

- Using incomplete maps for students to complete as a part of assessment,

## Discussion

The objective of this study was to introduce Concept mapping for problem solving and analysis in Physiology .Post test scores were significantly higher compared to pretest scores. Horizontal interlinking and cross linking hierarchy of concepts for the Concept maps Charts was ranked as satisfactory .The Chart designing activity encouraged group learning and team work as reflected through the response to feedback questionnaire and the active enthusiastic participation.

Concept map was developed by Joseph Novak and collaborators [9,12] at Cornell university in 1970's based on meaningful learning theory by David Ausubel[10,11].The theory proposed that knowledge should be understood, significantly relevant and well integrated. In a case specific model of Concept mapping, students incorporate basic science concepts, relevant clinical science concepts and self generated hypothesis into a final product [5].The concept maps constructed by the students in our study included information from the case with explanation of mechanism, Physiology behind investigation and management. Such self-generated concept maps greatly foster self directed meaningful learning [12,13].Meaningful learning is efficient and long lasting because of integration and linkages made with prior knowledge , this facilitates transfer of new information into long term memory leading to self directed learning. Student replaces unidirectional linear thinking with thinking that proceeds in multiple directions.[5] Through this study the strengths of two complimentary tools- Problem based learning and Concept maps were consolidated to achieve meaningful and self directed learning [ 7,14]. Concept map construction compels student to search concepts, their interrelationship in a more innovative and holistic manner. The activity in our study too promoted development of student learning strategies both individually and as a group which was indicated by satisfaction expressed by the students. In some studies concept maps were used to foster development of group and collaborative learning [15,16], groups using concept maps performed significantly better on problem solving examination especially students with low cognitive competence.[17] Such activities create a sense of inclusion, ownership ,positive attitude to learning and enhance student metacognitive skills. [18] Daley et al have used mapping skill as a learning and assessment strategy. [19,20] Concept maps Chart construction was used by us as an assessment strategy and indicated that students encounter difficulty in moving towards structural knowledge.[7,21] Feedback was given to the groups immediately after their presentation , this fosters student

learning and performance [15,16,22,23]. When effective and immediate feedback is not given it is less beneficial, it helps to identify misconceptions and incongruities [2]. Concept map with a proper feedback produces a measurable increase in student problem solving performance and decrease in failure rate. [24]

Implications—With the revised Competency based Medical Education Curriculum stressing on greater number of hours for self directed learning in addition to didactic lectures, a simple learning tool as concept mapping can be routinely used by students themselves for summarizing information by noting and linking key words. Integration of mapping in PBL would not only generate interest in a basic science subject like Physiology but also prove helpful for the new pattern of Post graduate examination which focuses on application of basic concepts in Medicine. Similarly self designed Concept map charts serve as long term useful resource material for students.

#### Conclusion:

Integrating Concept maps in PBL facilitates analytical ability as students use logic, link and relate concepts to one another to reach their own conclusions.

Suggestions---Exposure to incomplete maps developed by teachers and its discussion in PBL would be beneficial.

Limitations--- More numbers of PBL discussions were needed. Students should have been given more time for understanding basic knowledge in order to make maps with better interlinking.

#### References

- Daley BJ, Torre DM. Concept maps in Medical Education :An analytical literature review. *Med Educ* .2010;44:440-8
- Gomes A P. The Role of Concept Maps in the Medical Education .*Revista Brasileira de Educação Médica* .2011; 35 (2) : 275-282
- MCI Competency based Medical Education Curriculum.2018
- Pinto AJ ,Zeitz H J .Concept mapping : A strategy for promoting meaningful learning in Medical Education.*Medical Teacher*.1997;129(2): 114-21
- McGaghie WC, McCrimmon D R, Mitchell G,Thompson J A, Ravitch M M. Quantitative concept mapping in Pulmonary Physiology: Comparision of students and faculty knowledge structures. *Adv Physiol Educ*.2000;23:72-81
- Guerrero A P .Mechanistic Case diagramming: A tool for problem based learning . *Acad Med*.2001; 76:385-9
- Antonio B Rendas, Marta Fonseca. Toward meaningful learning in undergraduate Medical education using concept maps in a PBL pathophysiology course. *AdvPhysiolEduc* 2006; 30:23-9
- Chand L,K.Sowmya. Meaningful learning in medical science by self directed approach of Concept mapping .*J Educ Tech in Health Sci*.2018;5 (1) : 31-5
- Novak J DA.Theory of education .1977; Ithaca NY: Cornell University Press.
- Ausubel D.P.The psychology of meaningful verbal learning.1963;NewYork: Grune and Stratton.
- Ausubel DP,NovakJD. Educational Psychology: A cognitive view .New York: Holt, Reinhart and Winston;1968
- Novak JD,Gowin DB. Learning how to learn 1<sup>st</sup>edn Cambridge UK: Cambridge University Press ;1984
- Nesbit JC, Adesope OO. Learning with concept and knowledge maps: a meta-analysis. *Rev Educ Res* 2006;76(3):413-48
- Bhusnurmath SR, Bhusnurmath R, Goyal S. Concept map as an adjunct tool to teach Pathology Ind *J Patho Micro* 2017 ;60 (2),226-231
- Kinchin I, Hay D. Using concept maps to optimize the composition of collaborative student groups: A pilot study. *J.Adv.Nurs*. 2005; 51(2):182-187.
- Boxtel CV, Linden J. Collaborative concept mapping: provoking and supporting meaningful discourse. *Theory Pract* 2002;41 (1):40-6.
- Gonzalez HL, Palencia AP, Umana L A. Mediated learning experience and concept maps: A Pedagogical tool for achieving meaningful learning in Medical Physiology students .*Adv Physiol Educ*.2008;32:312-6
- Taber K.S. Student reaction on being introduced to concept mapping, *PhysicsEducation*.1994; 29: 276-81.
- Daley B, Shaw C et al. Concept maps: A strategy to teach and evaluate critical thinking. *Journal of Nursing Education*.1999; 38: 42-7.
- West DC,Pomerory JR,Park JK. Critical thinking in graduate medical education: A role of concept mapping assessment. *JAMA* .2000;284:1105-10,
- Dabbagh N. Concept mapping as a mind tool for critical thinking. *J Computing Teacher Educ*. 2001; 17: 16-24.
- Kinchin IM, Hay DB. How a qualitative approach to concept map analysis can be used to aid learning by illustrating patterns of conceptual development. *Educ Res* 2000;42 (1):43-57.
- Wu PH, Hwang GJ, Milred M, Ke HR, Huang YM. An innovative concept map approach for improving students' learning performance with an instant feedback mechanism. *Br J EducTechnol*2012;43:217-32.
- Morse D, Jutras F. Implementing concept-based learning in a large undergraduate classroom. *CBE Life Sci Educ* 2008;7 (2):243-53.