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Original Article

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Introducing Concept Maps in Undergraduate Pathology Training: Cross Sectional Analysis of Students Perspectives

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Abstract

Background: This study was undertaken to understand the effectiveness and impact of incorporating concept mapping as teaching learning methodology in undergraduate medical curriculum. ***Methods:*** The study was conducted with 150 students over a period of 3 months. A pre-validated questionnaire was given to the students after the activity of concept map was conducted for the students. The data was analyzed using SPSS version 28 and expressed as frequencies and percentages. ***Results:*** 150 study participants were included in the present study, of which 79 (52.67%) were males and 71 (47.33%) were females respectively. 36% students agreed using concept maps in pathology studies before the introduction of the intervention. Many found creating concept maps time-consuming (44% agree, 13.33% strongly agree). A strong majority 84.67% felt concept maps are effective for visual learners. 66% students agreed that concept maps helped them better understand complex medical concepts. 66.67% students perceived that concept maps enhanced their ability to make connections between different medical topics. 75.33% students agreed that concept maps promote self-directed learning. 59.33% students supported introducing concept maps in other subjects also. 64.67% students agreed that concept maps are a valuable addition to undergraduate medical training. ***Conclusion:*** Introduction of concept mapping will enhance critical thinking and problem-solving skills of medical undergraduate students with increased students engagement, long term retention of knowledge and a self-directed learning tool. This would further enhance the students integrating technology in curriculum.

Keywords: ***concept mapping, critical thinking, medical, self-directed.***

Introduction

One of the main utilities of the concept mapping (CM) in medical education is the possibility of integrating various concepts which are frequently fragmented in many cognitive compartments [1]. To match pace with the changing curriculum and to enhance meaningful learning, a constant change in various teaching learning strategies is required, with more focus on interactive and student- centered teaching [2]. Concept maps are explained as diagrammatic representations with meaningful describing words explaining the interconnection between the concepts, preferably in a hierarchical manner [2]. Revised Bloom taxonomy, 2001, identified as high levels of cognitive performance, namely evaluation and synthesis of knowledge [3]. Creating concept maps is like creating a framework regarding all the essential elements of a topic, integrating various aspects with clinical reasoning/ etiology /pathogenesis/ clinical presentation and management. This is considered as the highest level/order in blooms taxonomy. Students can review what they already know, organize new information, understand new parts of a topic, and connect past and new knowledge that helps them remember information for a long time in a more connected way, which is very important for their growth and success in a medical career [4]. Joseph D. Novak and his research team at Cornell University developed concept maps in the 1970s to help visually represent and evaluate how students' understanding of scientific ideas changed over time. Their work was based on David Ausubel's assimilation theory, which emphasizes that learning is most effective when new knowledge is connected to what the learner already knows[5].

Hence this study was undertaken to understand the effectiveness and impact of incorporating concept mapping as teaching learning methodology in undergraduate medical curriculum.

Materials and Methods

The present study was conducted following approval from the Institutional Ethics Committee, involving Phase II MBBS students at a tertiary care teaching hospital in Eastern India.

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Study period: 3 months

Sample size: 150 students

Inclusion Criteria: Students willing to give consent to participate in the study

Exclusion Criteria: Students not willing to participate.

Study Tools: Validated questionnaire. The questionnaire was divided into two parts -perception of students regarding introduction of concept maps in Pathology and evaluation of the use of concept maps in medical training. Ten minutes were given to complete the questionnaire post activity.

Statistical plan: The data collected from undergraduate medical students regarding their perspectives on the concept mapping as a teaching learning methodology was first subjected to descriptive statistical analysis. Categorical variables were summarized using frequencies and percentages.

To assess associations between categorical variables, Chi-square test was employed.

The Kruskal-Wallis test, a non-parametric method, was used to compare attitude scores or responses measured on ordinal scales. Finally the calculated value was compared with the tabulated value at a particular degree of freedom and the level of significance was determined.

Observations

150 study participants were included in the present study, of which 79 (52.67%) were males and 71 (47.33%) were females respectively. There was no significant differences in gender distribution among the study population.

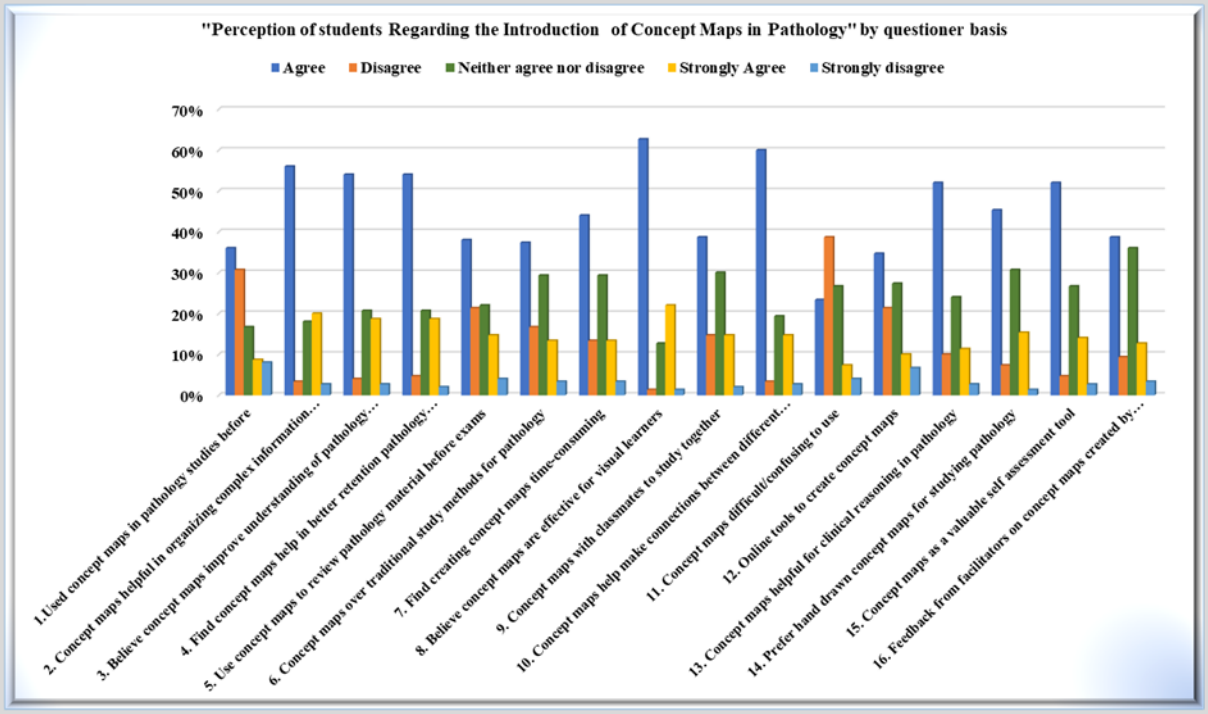

Figure 1: Perception of students regarding Concept Maps in Pathology

36% students agreed using concept maps in pathology studies before the introduction of the intervention, 30.67% disagree, 16.67% neither agree nor disagree. Regarding the helpfulness of concept maps in organizing complex pathology information, 56% agreed and 20% strongly agreed, with significantly higher overall agreement. Most students (54%) agreed that concept maps improve understanding of pathology concepts (*p* < 0.0001). Similarly, 54% agreed and 18.66% strongly agreed that concept maps aid better retention of pathology material (*p* < 0.0001).

Before exams, a majority supported using concept maps to review material (38% agree, 14.67% strongly agree). Many found creating concept maps time-consuming (44% agree, 13.33% strongly agree). A strong majority (62.67% agree, 22% strongly agree) felt concept maps are effective for visual learners. Using concept maps collaboratively with classmates was favored by most students (38.67% agree, 14.67% strongly agree). Additionally, 60% agreed and 14.67% strongly agreed that concept maps helped connect different pathology topics (*p* < 0.0001).

Conversely, 38.67% disagreed and 4% strongly disagreed that concept maps were difficult or confusing to use (*p* < 0.0001). Over one-third used online tools to create concept maps (34.67% agree, 10% strongly agree; *p* < 0.0001), while a preference for hand-drawn maps was expressed by 45.33% agree and 15.33% strongly agree (*p* < 0.0001).

Concept maps were also regarded as valuable self-assessment tools by 52% agree and 14% strongly agree (*p* < 0.0001), and facilitator feedback on student-created maps was valued by 38.67% agree and 12.67% strongly agree (*p* < 0.0001).

The questionnaire items related to organizing complex information in pathology, enhancing understanding of pathology concepts, aiding material retention, and supporting clinical reasoning showed positive correlations, these were not statistically significant ($p = 0.306$; $p > 0.05$).

There were significant differences among students in their perceptions regarding the use of concept maps to review pathology material, make connections between different pathology topics, and serve as a valuable self-assessment tool, showed varying degrees of correlation among students, with a statistically significant p-value ($p < 0.0001$).

There were significant differences among students in their perceptions of using concept maps as effective tools for visual learners and for collaborative study with classmates showed varying correlations among student responses, with a statistically significant p-value ($p < 0.0001$).

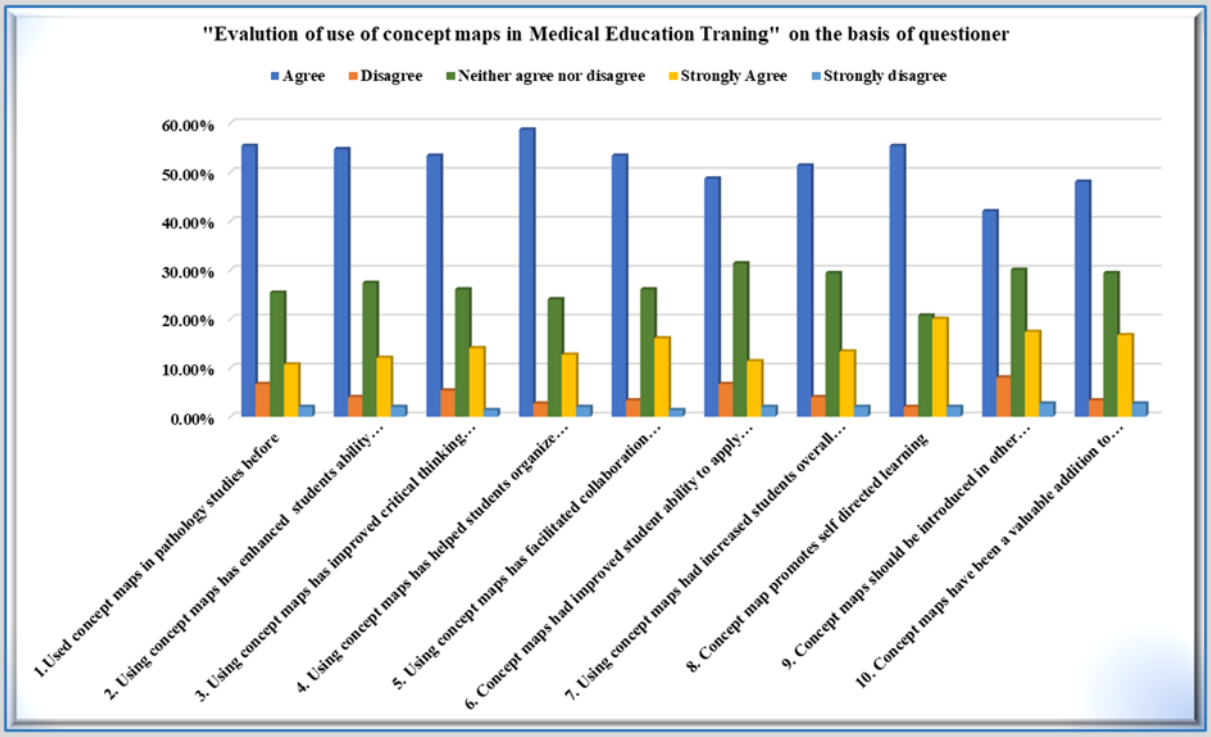

Figure 2: Evaluation of use of Concept Maps in Medical Education training

A majority of students (55.33%) agreed and 10.67% strongly agreed that concept maps helped them better understand complex medical concepts. A smaller proportion disagreed (6.67%) or strongly disagreed (2%), while 25.33% were neutral. Agreement levels were significantly higher than disagreement, with a p-value < 0.0001. Most students (54.67% agree, 12% strongly agree) reported that concept maps enhanced their ability to make connections between different medical topics. Only 4% disagreed and 2% strongly disagreed, while 27.33% were neutral. This difference was statistically significant (p < 0.0001).

About 53.33% agreed and 14% strongly agreed that concept maps improved their critical thinking in medical education. Disagreement was low (5.33% disagree, 1.33% strongly disagree), and 26% were neutral. The difference was significant (p < 0.0001).

A large portion of students (58.67% agree, 12.67% strongly agree) felt concept maps helped them organize and prioritize information. Only 2.67% disagreed and 2% strongly disagreed, while 24% remained neutral. This was statistically significant (p < 0.0001).

More than half of the students (53.33% agree, 16% strongly agree) believed concept maps facilitated collaboration and communication with peers. Disagreement was minimal (3.33% disagree, 1.33% strongly disagree), and 26% were neutral. The results were significant (p < 0.0001).

Students agreed (48.67%) or strongly agreed (11.33%) that concept maps improved their ability to apply knowledge in clinical settings. A smaller percentage disagreed (6.67%) or strongly disagreed (2%), while 31.33% were neutral. The response distribution showed significant agreement (p < 0.0001).

Concept maps were perceived to increase overall satisfaction and engagement in medical training by 51.33% of students, with an additional 13.33% strongly agreeing. Only 4% disagreed and 2% strongly disagreed; 29.33% were neutral. The difference was statistically significant (p < 0.0001). A total of 55.33% agreed and 20% strongly agreed that concept maps promote self-directed learning. Disagreement was low (2% disagree, 2% strongly disagree), and 20.67% were neutral. The difference was significant (p < 0.0001).

Students supported introducing concept maps in other subjects (42% agree, 17.33% strongly agree), with 8% disagreeing and 2.67% strongly disagreeing. About 30% were neutral. Agreement was significantly more common (p < 0.0001). Nearly half (48%) of students agreed and 16.67% strongly agreed that concept maps are a valuable addition to undergraduate medical training. Disagreement was low (3.33% disagree, 2.67% strongly disagree), and 29.33% were neutral. This finding was also statistically significant (p < 0.0001).

Students' responses regarding the use of concept maps before exams, their impact on critical thinking, organization and prioritization of information, and overall satisfaction and engagement with medical education showed no statistically significant differences. However, there was a positive correlation among these perceptions.

Students' responses regarding the use of concept maps to enhance their ability to connect different medical concepts, facilitate collaboration and communication among peers, and apply knowledge to real-life medical scenarios showed no statistically significant differences according to the questionnaire. However, these aspects demonstrated a positive correlation among student perceptions.

Students' perceptions that concept maps promote self-directed learning and should be introduced in other subjects showed statistically significant differences according to the questionnaire. Despite these differences, there was a positive correlation among student responses.

Discussion

In the present study 72.6% students agreed that the retention and exam score is well with the use of concept maps. Joshi U in his study found a difference in performance in exams when the students were exposed to concept mapping only once and he states that more research on these lines can be carried out to ascertain consistency [6].

Students have found the technique to be more useful in memorizing, retaining, and subsequently scoring more in exams [6].

Vink et al. reported in their study that participants really enjoyed the sessions with significantly increased motivation which corroborates with findings of the present study [7]. In the present study 51.3% and 13.3.% of the students agreed and strongly agreed that use of concept maps increases overall satisfaction and engagement in medical education training.

In the study by Jain A et al., There was a positive perception (84.79%) regarding the use of concept mapping as teaching strategy, 87.49% felt that the use of concept mapping helped in enhancement of learning and led to better understanding of the concept, 85% of students experienced gain in interest and acknowledged the fact that this method made the difficult topic interesting. In response to questions regarding the utility of this method, more than 90% of students found this method of teaching and learning as a future prospect to be used in the class for other topics also, more than 80% of the students understood the process of constructing a concept map [8]. High proportion of students were able to correlate the new information to already existing knowledge [8].

Interpretation of study conducted by Baig M et al indicated that concept maps helped in the deeper understanding of the topics and because of that students' obtained higher marks in problem-solving questions where they used maps [9]. In the present study, 63.33% of the students strongly agreed felt that creating concept maps proved helpful for clinical reasoning and problem based learning in Pathology. Baig M et al reported that concept mapping was beneficial in enhancing the understanding of the topic, promoted meaningful learning, supported self-assessment and motivated them to learn. Same study in response to open-ended questions noted that some students found it to be time-consuming and confusing [9]. 30.66 % students in our study felt it difficult to construct the concept maps and found them time consuming. In the present study 76 % students agreed that it helped in organising complex information in Pathology, 72.66 % improved understanding of the concepts, 68 % students felt it can be a useful tool for self-assessment. In the study conducted by Baliga SS, 100 % students agreed that concept mapping helped in integrating, clarifying the interrelationships among curriculum contents, used for the other curricula and stimulated the students to learn and think independently [10].

Study by Shete AN majority of the students perceived it as a useful way of summarizing information in an organized manner compared to their previous self-study techniques and many of them wanted to use for other subjects. The students felt that it may be helpful for understanding the subject and may help in better performance in the examinations [11]. Our study showed that 76 % students felts it useful in organising complex information in Pathology and 72.66%, 75.33% students perceived it a s a tool for self-directed learning, 59.33 % of the students felt that it should be introduced in other subjects also. Fonseca M 95.6% of the students in the study by Fonseca M et al considered that concept maps allowed the establishment of an orderly relation between core concepts [12]. Same study showed that 85.4% of students agreed it allowed establishing horizontal interrelations between the sequence of concepts [85.4%], 76.9% enhances the acquisition and organization of knowledge throughout the designing of the map and 70% considered it added value to pathophysiology learning [12].

Conclusion

Through this study researchers can gain insight into how students perceive and engage with concept mapping which can help identify the strengths and limitations of this teaching learning methodology. This can contribute to evidence-based practice of effective teaching learning methodologies in medical education. It will enhance critical thinking and problem-solving skills of medical undergraduate students with increased students engagement, long term retention of knowledge and positive student feedback. This would further enhance the students integrating technology in curriculum.

Declarations

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Conflict of Interest

NIL

Source of Funding

NIL

Ethical clearance

The study was approved by the University: MTMC/IEC/2024/84

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