Original Article

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Mind Mapping as a Novel Method in Teaching the Morphology of Skin Lesions: A Quasi-Experimental Study

VIJAYASANKAR PALANIAPPAN[1*], MD, DNB; KALIAPERUMAL KARTHIKEYAN[1], MD; REENAA MOHAN[2], MD

[1]*Department of Dermatology, Venereology and Leprosy, Sri Manakula Vinayagar Medical College and Hospital, Pondicherry – 605107, India;* [2]*Department of Community Medicine, Sri Manakula Vinayagar Medical College and Hospital, Pondicherry – 605107, India*

Introduction: Mind mapping is a visual mapping technique used in a few disciplines of medical education to represent ideas linked to and arranged around a central core idea or topic through different subtopics/categories. We aimed to utilize this technique to teach the undergraduate medical students the morphology of skin lesions and assess its effectiveness.

Methods: This pre- and post-test quasi-experimental study was done among 144 undergraduate medical students. A total of 144 students were selected, and odd and even roll numbers were categorized into two groups using simple random sampling. Group 1 (intervention group) students were taught using mind mapping technique and Group 2 (control group) with traditional lecture-based teaching. A Computer-Assisted pre-test and post-test were carried out. A feedback questionnaire was administered to the intervention group to explore the students' perceptions regarding mind mapping as a learning tool. The data were analysed using SPSS software (version 16), and the difference in the mean pre- and post-test scores was found using independent sampled-t-test.

Results: Pre and post-test score distribution was 5.04±1.27 and 11.44±2.52 (P≤0.001), respectively, in the intervention group. In the control group, the pre and post-test score distributions were 4.83±1.39 and 8.04±1.63, respectively. The mean rank of the mind mapping group was higher (76.43) than the lecture group (67.5). Among the students, 97.2% agreed on the fact that mind mapping enhanced their interest in learning, and 91.7% of the students were satisfied with mind mapping as the learning method.

Conclusion: To kindle the interest and develop critical thinking skills in students, faculty members should continue to explore and evaluate the efficacy of various learning and teaching strategies. Mind mapping could be a novel and integral part of conventional teaching techniques in medical education as evidenced by our student's performances.

Keywords: Mind mapping, Dermatology, Medical education

**Corresponding author:*
Vijayasankar Palaniappan, MD, DNB;
Department of Dermatology, Venereology and Leprosy, Sri Manakula Vinayagar Medical College and Hospital,
Pondicherry – 605107, India
Tel: +91-9442567116
Email: vijayasankarpalaniappan@gmail.com

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Introduction

Mind mapping is a visual mapping technique first developed by Tony Buzan inspired by the notes of Leonardo da Vinci (1). A mind map is a simple learning tool that is used to represent the ideas linked to and arranged around a central core idea or topic using different subtopics/categories. It is structured in a centrifugal and

more horizontal manner with the study topic in the centre and its details diverged in the periphery. All these core characteristics of mind maps are entrenched in the development of semanti networks, a strategy for representing knowledge in the 1950s (2, 3).

Mind mapping, as a teaching tool, has been used in medical education in general as well as in specific subjects like Anatomy, Community Medicine, Physical therapy, and Chiropractic education (4-7). A mind map presents the content in a visual, non-linear format. This engages the learner to think and explore the concepts using visuospatial relationships and pictorial descriptions, and consequently helps the students to organize and retain information (7, 8).

An age-old proverb apt for diagnosis of skin disorders is "The eyes see only what the mind knows". A piece of sound knowledge on the fundamentals of the description of the morphology of skin lesions (e.g., primary lesion such as macule, secondary lesion such as lichenification) is of utmost importance for the characterization and recognition of skin diseases. Hence, the morphology of skin diseases is the first course that undergraduate students usually learn in their dermatology curriculum. In our department, that topic is routinely taken in a lecture-based format describing the various lesions of dermatology. The students listen to the topic and usually linearly take notes; write down the content in their notebook.

The present study was conducted to evaluate the effectiveness of the mind map technique as a teaching tool for the morphology of skin lesions and to compare its effectiveness with conventional lecture-based teaching of the same topic in medical undergraduates. Also, we explored the perceptions of the students regarding mind mapping as a learning tool.

Methods

Study design and setting

To fulfil the study objectives, we carried out a quasi-experimental study on sixth-semester undergraduate medical students in the Department of Dermatology at Sri Manakula Vinayagar Medical College and Hospital (SMVMCH), tertiary care center in Puducherry, India. A total of 144 students were selected and categorized into two groups by simple random sampling, and the participants with odd roll numbers were allocated to Group 1 and even numbers to group 2. Group 1 (intervention group) and Group 2 (control group) comprised 72 students each. Both groups were taught about the morphology of skin lesions. The academic sessions on the selected topic for Group 1 students were run by mind mapping technique and for Group 2 students through a conventional lecture-based manner. The content reference for both modes of teaching was taken from standard Dermatology textbooks.

Group 1 – Intervention group

We chose FreeMind written in Java as the mind mapping software in our study at the researcher's convenience. The mind map was designed by one of our faculty and internally assessed for its effectiveness by an expert team comprising three experienced faculty members. Before the commencement of clinical rotation, the students of the intervention group were oriented about mind mapping. None of the students was aware of mind mapping before the session. A two-hour session of mind mapping on the morphology of skin lesions was conducted using the predesigned mind map for 72 students.

The program allows the users to expand and collapse subtopics/categories in the map. Images of patients encountered in our dermatology department with different skin morphology are stored in our department image bank database. From that for each morphological lesion, two different clinical images were selected. For example, in the case of macules, hypopigmented macules and hyperpigmented macules were included. These images were embedded as a hyperlink in the FreeMind software, so that they were displayed by just clicking that corresponding node. Students were encouraged to take notes based on the Mind map structure showing relationships, hierarchies, and connections between individual subtopics.

Group 2 - Control group

Students in the control group were oriented about the learning outcomes of the session. A 2-hour interactive lecture session on the morphology of skin lesions was carried out through the Microsoft Powerpoint™ software. It consisted of a total of 32 slides that included the basics and the definition of various primary and secondary lesions along with the clinical images. The students were involved in the linear note-taking by recording each topic, and writing down as simple sentences. A small 10-minute refreshment break was provided to break the monotony. At the end of the lecture, group discussion of that topic and students' doubts were addressed.

Computer-Assisted image-based assessment

To assess the level of knowledge on the selected topic before the commencement of

academic sessions, was conducted a simple test. Students of both groups were allocated a separate desktop computer in the the digital library of our institution. Each computer was preloaded with a Microsoft Powerpoint™ presentation consisting of 20 clinical images which depicted different morphologies of skin lesions and the students were asked to identify them. It was programmed in such a way that each slide changed automatically every minute, and the total duration of examination was conducted for 20 minutes. The students were given examination answer sheets to write down their answers.

The test result scores were considered as the pre-test scores. Again, students of both groups were subjected to similar kinds of computer-based examinations after attending their respective mode of academic session, the results of which were considered as post-test marks. To increase the internal validity, we carried out a computer-assisted image-based assessment by a dermatology faculty who was not a part of this research team and was blinded to the intervention to nullify the investigator's bias on the students' performance. The answer sheets were evaluated separately by two faculties and the mean value was taken as the final mark.

Feedback collection

A feedback questionnaire that was prepared based on the literature review was administered to the intervention group to explore the students' perceptions regarding mind mapping as a learning tool (9). It consisted of a total of nine questions framed in a way to know the effectiveness of mind mapping as a teaching tool to learn the morphology of skin lesions. It also included questions to know the satisfactory levels of this teaching modality. Responses were recorded using a 5-point Likert scale, ranging from strongly disagree (score 1) to strongly agree (score 5). In the last part of the questionnaire, open-ended feedback regarding the usefulness of the session, suggestions to improve, and problems faced by them in mind mapping-based learning were obtained. The anonymity of the feedback was solicited.

Statistical analysis

The data were entered into MS Excel and analysed using the SPSS software (version 16) package. The students' scores in the pre-test and post-test of the intervention and control groups were presented as mean and standard deviation. The difference in the mean pre- and post-test scores was found using an independent sample t-test and a $P<0.05$ is considered significant. The content of the open-ended responses was analysed manually by two dermatology faculties.

Ethical Consideration

Institutional Research and Ethics Committee approval was obtained. Ethical principles such as respect for the participants, beneficence, justice and ensuring confidentiality was adhered to all through the study. Informed written consent was obtained from all participants.

Results

A total of 144 students who were studying at the sixth semester participated in the study. Among them, 69 (48%) were male and 75 (52%) were female. The majority of them (122; 84.8%) were from an urban background and the remaining 22 (15.2%) belonged to rural background.

A comparison of the pre and post-test scores of the participants was done in both groups; each test included twenty questions. Pre and post-test score distributions were 5.04±1.27 and 11.44±2.52, respectively, in the intervention group (95% CI: 5.876-6.929). In the control group, the pre and post-test score distributions were 4.83±1.39 and 8.04±1.63, respectively (95% CI: 3.478–2.9381). The mean difference was statistically significant in both groups ($P<0.001$) (Tables 1 and 2). As shown in Table 3, it was found that the increase in mean score was more in the intervention group in comparison to the control group. The mean rank of the mind mapping group was higher (76.43) than the lecture group (67.5).

Table 1: Socio-demographic profile of the sixth semester students

Variable	N (%)
Total participants	144
Gender	
Male	69 (48%)
Female	75 (52%)
Background	
Urban	122 (84.8%)
Rural	22 (15.2%)
Religion	
Hindu	98 (72%)
Muslim	28 (15.5%)
Christian	18 (12.5%)

The overall response to mind mapping was positive and encouraging. The majority of the participants (93.1%) agreed to prefer mind mapping in the future, 97.2% agreed the fact that mind mapping enhanced their interest in learning, and 91.7% of the students were satisfied with mind mapping as the learning method. The noted open-end responses of students about the mind map are shown in Table 4.

Table 2: Pre- and post-test evaluation between mind mapping group and lecture-based teaching group

	Group 1	Group 2	Independent sampled t test (t) and P-value
Pre test (Mean±SD)	5.04±1.27	4.83±1.39	T=24.3; P<0.001
Post test (Mean±SD)	11.44±2.53	8.04±1.63	T=23.6; P<0.001
Percentage of change (%)	74.62%	52.37%	P≤0.001
P-value, within groups	<0.001	<0.001	

*P-value≤0.05 is statistically significant using p independent sampled T-test, *Improvement % or Change %=(Post-test mean - Pre-test mean) 100/(Pre-test mean). *Only the scores of the students who participated in both the pre and post tests were included. Group 1=74.62%, Group 2=52.37 (change %).

Table 3: Five-point Likert scale response survey regarding the students' perceptions of mind mapping (1=Strongly Disagree to 5=Strongly Agree)

No.	Feedback	Mean	Percent Rating Agree+ Strongly Agree
1	Mind mapping covered the topic of subject effectively.	1.875	63 (87.5%)
2	Do you feel mind mapping enhances your observational skill?	1.722	52 (72.2%)
3	I prefer mind mapping as a teaching method in future.	1.930	67 (93.1%)
4	It enhances my interest of learning.	1.972	70 (97.2%)
5	I felt confident that I can adapt myself to mind mapping.	1.958	69 (95.8%)
6	I was satisfied with mind mapping as a learning method.	1.916	66 (91.7%)
7	It enhances your ability to describe the morphology of skin lesions.	1.944	68 (94.4%)
8	It illustrates important concepts and aids understanding.	1.819	59 (81.9%)
9	Are the concepts linked together and clearly describes the relationship?	1.972	70 (97.2%)

Table 4: Student's reflections on mind mapping learning technique

Titles
How does the mind mapping session facilitate your learning?
• We enjoyed learning the topic through this method.
• Easy understanding and correlation of concepts.
• The learning technique was not monotonous.
• This way of learning and notes taking was novel and kindled our interest.
• More involvement in the process of learning.
• Better interaction with the faculty.
• Unique learning experience.
• Non-linear notes are helpful in rapid revision of the topic.
What are the problems faced with this learning technique?
• Took more time than traditional method of learning.
• Found difficult to adopt this new teaching strategy.
• Images were lesser in number for few morphological lesions.
• Expansion and collapse feature of secondary topics led to distraction.
What are the suggestions to improve this learning technique?
• Same technique should be tried in didactic lectures for difficult topics.
• Prior sensitization workshop about mind mapping should be conducted.
• We want to make mind map on our own for easy understanding.
• The sessions should be made concise and finished off in short time.

Discussion

Mind mapping is a technique that visually creates and connects ideas. Dermatology, as a visual science, provides ample opportunities for mind mapping. In this context, a pre- and post-interventional quasi-experimental study was conducted in a medical college in South India among 144 second-year undergraduate students. It is observed that in the post-tests, the performance of the students who had mind maps as a learning tool was significantly better than those who had traditional lecture-based learning. In our study, feedback from the students in the intervention group favoured the utility of mind maps as a learning tool.

In medical education, lectures are the most commonly used method of teaching. Powerpoint™ lectures are usually convenient and have the advantage of being stuffed with the tiniest detail. However, the audience may fail to see the connections between the slides which can cause poor attention in class (9). Visual mapping

is a technique that displays complex information visually with graphical organization and presentation. A few examples of this technique are concept maps, mind maps, visual metaphors, and conceptual diagrams (10).

Mind mapping is a study technique in which information from different sources is converted into a diagrammatic representation of vital keywords related to the study topic (11). It allows the students to recognize the intra- and inter-relationships between various concepts, thereby reflecting the kind of real-world thinking principally in the clinical setting (12). Mind mapping can be used as a teaching resource to prepare and review the lectures, have a quick revision of notes, and update the new information. It can be used in situations such as problem-based learning, one-to-one context, small group teaching, as an assessment tool, and for individual revision (13). Although concept maps have similar characteristics, they differ from mind maps with their top-down structure, with linking keywords or phrases to depict the relationships between the concepts (5).

Farrand et al. (2002) were the first to study the effectiveness of mind mapping among undergraduate medical students. It was found to provide improved long-term factual recall of written information. However, the motivation to use this technique was lower when compared to the self-selected study technique. They stressed the importance of motivating the audience group before adopting it as a study learning technique (11).

Wickramasinghe et al. developed a method to score the mind maps prepared by the students based on the structure and content, but they described neither the method nor the data to support it. Based on their study findings, it was concluded that mind mapping, as a teaching tool, may not be effective in enhancing short-term information retention (14).

Choudhari et al. studied the effectiveness of visual mapping techniques, i.e. concept mapping and mind mapping as a learning tool in Community-based Medical Education (CBME) for the subject of community medicine among undergraduate medical students. One group of students was given the assignment to draw visual maps, while the other group had a Question-Answer session with built-in discussion. When a surprise written examination was conducted on the topics taught, the mean score of the students of visual mapping techniques was significantly higher than the other group (15).

Van Gog et al. propose that a learning strategy that combines verbal reports along with mind mapping aids the learners to make inferences about categorizing or relate concepts together (16). D'Antoni et al., in their study on medical students, found that those who had learned through mind mapping retrieved information successfully in the short term. However, their critical thinking and information retrieval did not increase in the long term as compared to the standard note-taking group (12). A meta-analysis of designs used to teach scientific problem-solving found that those that built integrated frameworks of knowledge such as mind maps were the effective ones (17).

The application of mind mapping in teaching has been reported to improve the critical thinking of nursing students (18). Learning with understanding permits the consolidation of newer concepts with previously learned concepts, thereby contributing to the retention of information in long-term memory (5). The information obtained by integrating the concepts in mind maps helps the students to attain a metacognitive level (19). In medical education, the unique added colours and pictures of mind maps appeal to a wide range of students with visual- and linear-oriented learning styles (12). In our study, the faculty who took the mind mapping session observed that students were more attentive, showed good interest, and were more interactive while learning through it.

A majority of the undergraduate medical students who utilised mind maps in the pharmacology course wanted the lecturers to utilise it as an alternative to conventional teaching formats such as the PowerPoint (20). Mind maps have also been reported as a good online teaching and assessment method during the COVID-19 pandemic (21). A recent meta-analysis showed that mind mapping when combined with problem-based learning could improve self-learning and practical abilities of the students (22).

The major limitation of our study was that mind maps were designed by the faculty and students were encouraged to listen and take notes rather than asking them to make a mind map on their own. Smaller sample size and risk of contamination bias was another limitation in which students of the intervention group might have influenced the control group participants with their experience and notes.

Conclusion

Critical thinking and active learning are integral parts of medical education. To kindle the interest and develop critical thinking skills in students, the faculty should continue to explore and evaluate the efficacy of various learning and teaching strategies. This study is one of the first

kinds, which have utilized mind mapping in dermatology and assessed its effectiveness against time-tested lecture-based learning. Based on our study, we suggest that mind mapping could be a novel and integral part of conventional teaching techniques in medical education as evidenced by our student's performances.

Authors' Contribution

All authors contributed to the discussion, read, and approved the manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflicts of Interest: None Declared.

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