Section: Biochemistry

Original Research Article

MIND MAPPING VS. CONVENTIONAL NOTE MAKING IN BIOCHEMISTRY: A COMPARATIVE INTERVENTIONAL STUDY AMONG FIRST-YEAR MBBS STUDENTS

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ABSTRACT

Background: In medical education, particularly in subjects such as biochemistry, students face challenges in managing vast amounts of content. Selecting effective self-directed learning strategies is crucial for enhancing knowledge retention. Among the various techniques, mind mapping and conventional note-making are widely used, but their comparative effectiveness remains underexplored.

Objectives: Primary Objective: To compare the immediate and one-month delayed post-test scores following mind mapping versus conventional note-making for learning Biochemistry among Phase I MBBS students.

Secondary Objective: To determine student perceptions regarding the effectiveness of mind mapping and conventional note-making as learning strategies.

Materials and Methods: A comparative interventional study was conducted among 110 Phase I MBBS students at Government Medical College, Manjeri. Students were divided into two groups: one group used mind mapping, and the other used conventional note-making to study selected Biochemistry topics. A pre-test, an immediate post-test, and a one-month delayed retention test (MCQ-based) were conducted. Students' perceptions were assessed using a validated questionnaire with a 10-point Likert scale. Data were analyzed using independent t-tests and descriptive statistics.

Results: Both learning strategies significantly improved post-test scores compared to pre-test scores ($p < 0.0001$). However, there was no statistically significant difference in the immediate or delayed post-test scores between the mind-mapping and conventional note-making groups ($p > 0.05$). Notably, a higher proportion of students perceived mind mapping as more effective in clarifying objectives, enhancing conceptual understanding, and increasing engagement.

Conclusion: Mind mapping and conventional note-making are equally effective in improving learning outcomes and knowledge retention in Biochemistry. However, mind mapping is more positively perceived by students for its clarity, engagement, and support in conceptual understanding. Integrating mind mapping as a supplementary tool in medical education may enhance learner motivation and comprehension.

Keywords: Mind Mapping, Note-Making, Biochemistry Education, Medical Students, Self-Directed Learning, Knowledge Retention, Learning Strategies, Competency-Based Medical Education (CBME), Active Learning, Undergraduate Medical Education.

INTRODUCTION

In the context of Competency-Based Medical Education (CBME), medical students are expected to engage in self-directed learning actively (SDL) and develop higher-order cognitive skills to manage the vast and complex medical curriculum.[1] Biochemistry, being an introductory science course in Phase I of the MBBS, is well known for having complex and abstract concepts, as well as a high content volume. Accordingly, it is essential to determine which learning strategies are most effective in enhancing conceptual learning and promoting long-term retention of knowledge.[2]

Conventional note-taking and mind mapping are two essential methods used by students for summarizing information.[3] Note-taking is presented in an organized and linear manner to help students learn how to summarize and arrange information. However, it may not always provide better support for comprehension or retention, particularly when addressing highly interconnected biochemical concepts. Mind mapping, on the other hand, is a form of visual learning invented by Tony Buzan, in which various colors, images, and keywords form an associative network around a central idea or concept, using anonymous nodes interconnected and layered, collated with related ideas or other terms.[4] This non-linear, pseudo-graphic format is thought to activate both the left and right sides of the brain, improve understanding, and facilitate the remembrance of complex information.

A few empirical studies have suggested that mind mapping can be a valuable tool for enhancing students' involvement, critical thinking, and information retrieval, for example, Jianping et al. (2017). Mathew et al. (2023) demonstrated that medical students achieved higher academic performance when using mind maps compared to other study modes.[5,6] Such advantages made mind mapping in medical education a better option; however, the acceptance of mind mapping in medical education is challenging due to a lack of familiarity and training. Furthermore, the majority of these studies have focused on performance or perceptions alone, with few directly comparing the relative effectiveness of mind mapping against traditional note-making strategies in a controlled classroom setting.

In particular, the evidence base for these methods of teaching and learning has not been adequately compared with each other in the Indian context, especially in areas such as biochemistry. Moreover, little research has focused on long-term knowledge retention or learner preference or engagement, which are essential for establishing ongoing study habits for MBBS students.

Filling this lacuna, the present study aimed to assess the relative effectiveness of mind mapping and customary note-taking as a self-directed learning strategy for Biochemistry. It was also intended to compare immediate and delayed post-test scores, as well as student perceptions of usefulness, clarity, and engagement, for each method.

Consequently, the purpose of the present study was to compare the efficacy of two SDL techniques—mind mapping and conventional note-taking—on the learning and achievement of students concerning the Biochemistry of Phase I MBBS. The primary objective was to investigate and compare the immediate learning effects and one-month delayed knowledge retention of students using mind mapping versus traditional note-taking. Beyond these performance-based results, the study also aimed to examine the subjective experiences of learners by recording their opinions about the usefulness, clarity, and interest of each delivery method. Combining both objective scores and qualitative feedback, the present study aimed to provide a comprehensive insight into the educational effectiveness and student acceptance of using mind mapping to promote self-directed learning in undergraduate medical education.

MATERIALS AND METHODS

Study Design and Duration: This was a comparative interventional study conducted over a 3-month period, from October to December 2024, at the Department of Biochemistry, Government Medical College, Manjeri, Kerala. The aim was to assess the implementation of mind mapping as a learning tool in comparison to conventional note-taking among Phase I undergraduate MBBS students in the Biochemistry subject.

Study Population and Grouping: A total of 110 Phase I MBBS students participated in the study. All participants provided written informed consent and were present during the teaching sessions. Students who were absent on the intervention days were excluded from the analysis. Based on alphabetical order, students were divided into two equal groups: Group A (mind mapping) and Group B (conventional note-making), each with 55 students.

Ethical Considerations: The study was approved by the Institutional Research Committee (IRC/GMCM/263 dated 04/10/2024) and the Institutional Ethics Committee (IEC/GMCM/154 dated 17/10/2024). Participation was voluntary, and confidentiality was maintained throughout the study. To ensure equitable learning opportunities, Group B students were taught mind mapping after the survey was completed.

Intervention Procedure: Four topics were selected from the undergraduate Biochemistry curriculum: carbohydrate digestion and absorption, lipid digestion and absorption, protein digestion and absorption, and amino acid chemistry. The investigator taught mind mapping techniques to Group A in a 1-hour session. A 10-minute pre-test consisting of 10 MCQs was first administered to both groups. Students then studied the assigned

topic using a standard textbook for 20 minutes. A 20-minute note-making session followed this: Group A created mind maps, while Group B made conventional linear notes. An immediate post-test, using the same set of MCQs, was then conducted for both groups for 10 minutes. Each topic was taught in separate sessions using a structured learning approach.

Retention Assessment: To assess long-term knowledge retention, a delayed post-test was conducted one month after the final session without prior notice. This assessment used the same MCQs (10 per topic) and had a total duration of 40 minutes. All students completed this test under standard exam conditions.

Student Perception Assessment: Following the learning sessions, students' perceptions of the two teaching-learning strategies were collected using a validated questionnaire. The instrument consisted of 10 items, rated on a 10-point Likert scale (0 = strongly disagree to 10 = strongly agree), addressing aspects such as clarity of objectives, concept understanding, recall, engagement, and feasibility. Qualitative feedback was also gathered through open-ended questions.

Data Collection and Statistical Analysis: Pre-test, immediate post-test, and delayed post-test scores were recorded for each student. Mean scores and standard deviations were calculated for each group. Between-group comparisons were performed using independent t-tests. Descriptive statistics were used to summarize perception data, with Likert scale responses expressed as percentages. All statistical analyses were conducted using SPSS version 25, with a p-value < 0.05 considered statistically significant.

RESULTS

Improvement in Learning Outcomes Within Groups: The effectiveness of both mind mapping and conventional note-making in enhancing immediate learning outcomes was assessed by comparing pre-test and post-test scores across four Biochemistry topics. As shown in **Table 1**, both groups exhibited statistically significant improvement in post-test scores compared to their pre-test scores ($p < 0.0001$ for all topics). This indicates that each method, regardless of style, successfully improved student understanding and recall of the material.

Table 1: Pre- and Post-Test Scores

Topic	Mind Mapping (Pre-test)	Mind Mapping (Post-test)	Note Making (Pre-test)	Note Making (Post-test)
1	2.71	6	2.47	5.93
2	4.24	6.59	4.89	6.22
3	4	8.02	4.05	8.01
4	4.26	7.13	4.39	6.89

Comparison of Immediate Post-Test Scores Between Groups: Although both methods improved scores, comparisons between the mind-mapping and conventional note-making groups did not reveal any statistically significant differences in immediate post-test performance. As detailed in **Table 2**, the mean post-test scores for the mind mapping group were slightly higher for each topic, but the p-values ranged from 0.239 to 0.976, indicating no significant difference between the two groups.

Table 2: Post-Test Comparison Between Groups

Topic	Mind Mapping (Mean ± SD)	Note Making (Mean ± SD)	p-value
1	6.00 ± 3.48	5.93 ± 1.49	0.891
2	6.59 ± 1.57	6.22 ± 1.71	0.239
3	8.02 ± 1.72	8.01 ± 1.69	0.976
4	7.13 ± 1.75	6.89 ± 1.77	0.476

Overall Academic Performance: An aggregate comparison of the total post-test scores for all topics, presented in **Table 3**, showed that the mind-mapping group achieved a slightly higher mean score (6.93 ± 1.79) compared to the conventional note-making group (6.77 ± 1.84). However, this difference was not statistically significant ($p = 0.194$), suggesting comparable overall performance between the two learning strategies in terms of short-term knowledge acquisition.

Table 3: Overall Post-Test Score Comparison

Group	Post-test Score (Mean ± SD)	p-value
Mind Mapping	6.93 ± 1.79	0.194
Note Making	6.77 ± 1.84	

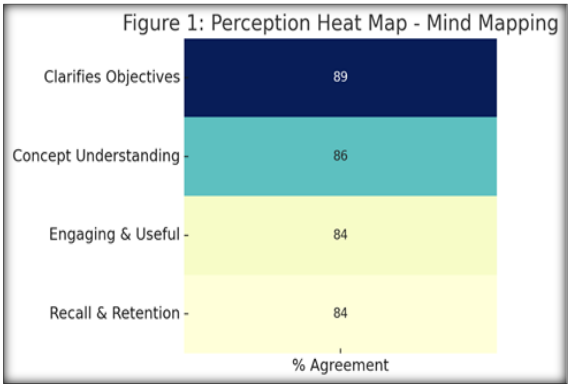
Long-Term Knowledge Retention: Long-term retention of knowledge was assessed one month after the intervention using the same set of MCQs without prior notice. As shown in **Table 4**, the mind-mapping group had a mean retention score of 7.62 ± 1.07, which was slightly higher than the 7.23 ± 1.49 achieved by the conventional note-taking group. While this difference favors mind mapping, it did not reach statistical significance ($p = 0.118$). These results suggest that both strategies are

effective in promoting long-term retention, with a modest, though non-significant, edge for mind mapping.

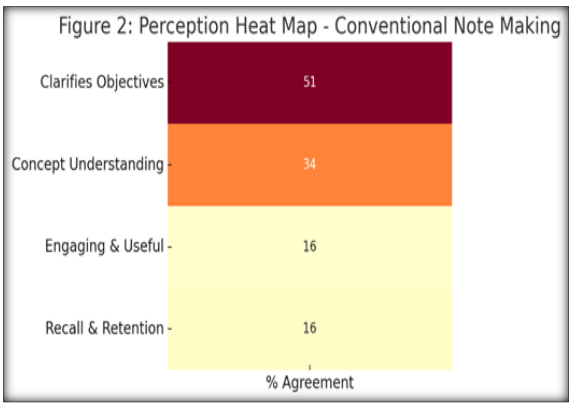
Table 4: Long-Term Retention Score Comparison

Group	Retention Score (Mean ± SD)	p-value
Mind Mapping	7.62 ± 1.07	0.118
Note Making	7.23 ± 1.49	

Student Perception of Learning Methods: Learner perceptions were evaluated using a 10-item Likert-scale questionnaire. As illustrated in **Figure 1**, a high proportion of students in the mind mapping group strongly agreed that the method helped clarify learning objectives (89.1%), enhanced their understanding of concepts (86.2%), and was both engaging and helpful (84.2%). A substantial number (83.9%) also reported that mind mapping supported better recall and long-term retention.



In contrast, students using the conventional note-making method expressed relatively lower levels of agreement across these same parameters. As shown in Figure 2, only 50.9% felt that it helped clarify objectives, 33.9% agreed that it improved their understanding of the concept, and just 15.8% found it engaging or helpful. Moreover, only 16.4% of students felt it aided recall and retention. These findings highlight a significant perceptual advantage for mind mapping as a preferred learning strategy.



DISCUSSION

The current study was conducted to assess and compare the efficacy of the mind mapping technique with conventional note-taking in learning Biochemistry at the Phase I MBBS level. In both groups, the immediate post-test scores were significantly higher than the pre-test scores, suggesting that each approach assisted learning. Furthermore, both methods performed similarly in the one-month delayed post-test, indicating that either is effective in knowledge retention. However, students in the mind mapping group had slightly higher, though non-significant, mean scores and more positive perceptions of engagement, clarity of concepts, and ease of recall.

These results align with earlier publications when compared to the literature. Maroufi et al. (2023) found that mind mapping facilitated information recall in medical students who utilized it, and they scored higher in a post-test compared to those who used conventional methods.[7] Similarly, Zeng et al. (2022) indicated that although mind mapping did not statistically outperform the traditional method in the short term, students perceived it as a valuable tool for self-study.[8] He et al. (2024) also favored mind maps as a method for visually structuring and integrating medical material.[9] Our study is consistent with these findings, suggesting that although mind mapping is shown to increase student engagement and perception, it does not significantly improve test scores. The insignificant difference in scores may be due to students' limited prior exposure to the mind-mapping technique or the complexity of some of the selected topics, which did not fully leverage the advantages of visual learning.

The study's primary benefit lies in its comparative interventional element, sufficient sample size, and combination of quantitative measures with qualitative feedback, which together generate evidence of effectiveness. The research also employed a tested MCQ instrument and a constructed Likert-scale survey to gather students' views. However, there were limitations after all. The follow-up period was brief (1 month) and was insufficient to account for the long-term retention of information. Furthermore, the level of pre-knowledge of mind mapping could not be ruled out for some students in the conventional note-making group, which may have affected the consistency between the two groups. Additionally, the use of time to search for students less experienced with the innovation may be a limitation of mind map construction.

In summary, although both mind mapping and traditional notes are effective for enhancing Biochemistry learning outcomes, students had a more favorable impression of mind mapping in the aspects of engagement, conceptual clarity, and

retention. These findings indicate that a mind map is a practical, student-centered tool that can serve as an adjunct to conventional teaching in undergraduate medical education. Its incorporation into the curriculum, accompanied by proper faculty development and student orientation, could improve the quality of self-directed learning and student satisfaction.

CONCLUSION

This research demonstrated that hand-drawn mind maps and conventional note-taking are two effective strategies for improving short-term comprehension and long-term retention of Biochemistry concepts among Phase I MBBS students. Although there was no statistically significant difference in test results, a slight edge was observed in favor of mind mapping, with higher mean scores and more positive student attitudes. Participants remarked that they found it easier to see and remember objectives (subject), concepts, and relationships, and they were more engaged. They had better recall using mind maps than traditional note-taking, even for taking notes on what they were learning.

According to these results, we recommend mind mapping as a supplementary learning method in medical education, particularly in content-intensive courses such as biochemistry. To achieve its full potential, orientation sessions, and structured practice should be offered to both faculty and students. Moreover, the integration of mind mapping within routine teaching and assessment can facilitate deep learning, enhance creativity, and address the needs of CBME. Further studies with a larger follow-up in different institutions are required to determine whether mind mapping has a long-term effect on improving academic results, as well as to assess its applicability to other disciplines in the medical field.

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Conflict of Interest: The authors declare that there is no conflict of interest.

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REFERENCES

1. Dulloo, P., & Charokar, K. (2022). Self-directed Learning Theory to Practice: A Footstep towards the Path of being a Life-long Learner. Journal of Advances in Medical Education & Professionalism, 10, 135–144. https://doi.org/10.30476/JAMP.2022.94833.1609.
2. Shannaq, B. (2025). E-Learning Integration and Teaching Strategies to Enhance Knowledge Retention in Higher Education. Emerging Science Journal. https://doi.org/10.28991/esj-2025-09-02-017.
3. Zipp, G., Cahill, T., D'Antoni, A., & Olson, V. (2010). Does the mind map learning strategy facilitate information retrieval and critical thinking in medical students? BMC Medical Education, 10, 61–61. https://doi.org/10.1186/1472-6920-10-61.
4. Anderson, D., Camburn, B., Wood, K., Sanaei, R., Arlitt, R., Raviselam, S., & Jensen, D. (2020). Computer-aided mind map generation via crowdsourcing and machine learning. Research in Engineering Design, 31, 383–409. https://doi.org/10.1007/s00163-020-00341-w.
5. Jianping, X., Qun, X., Ying, G., Jianyun, Y., Haiyun, L., Jianyu, Y., & Xia, L. (2017). Using Mind Maps to Improve Medical Student Performance in a Pharmacology Course at Kunming Medical University. Journal of the College of Physicians and Surgeons--Pakistan: JCPSP, 27 7, 404–408.
6. Mathew, S., Dayal, S., & Shankar, N. (2023). Effectiveness of mind mapping as compared to didactic lectures for teaching anatomy among first-year medical students - A randomized control study. European Journal of Anatomy. https://doi.org/10.52083/nqmt1904.
7. Maroufi, S., Abolghasemi, J., Majd, P., & Sajadi, A. (2023). Mind mapping in recalling and retrieving core contents in anesthesia technology students. Journal of Education and Health Promotion, 12. https://doi.org/10.4103/jehp.jehp_1423_22.
8. Zeng, Y., Shi, Y., Yang, H., & Dou, Y. (2022). Effects of mind mapping-based instruction on student cognitive learning outcomes: a meta-analysis. Asia Pacific Education Review, 24, 303-317. https://doi.org/10.1007/s12564-022-09746-9.
9. He, J., Zhan, J., Zeng, Y., Zhang, J., Wu, B., Zhong, H., Li, Z., & Zhu, L. (2024). Implementing mind mapping in small-group learning to promote student engagement in the medical diagnostic curriculum: a pilot study. BMC Medical Education, 24. https://doi.org/10.1186/s12909-024-05318-0.