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RESEARCH ARTICLE

Effectiveness of Mind Mapping for Slow Learners: A Crossover Study Among Medical Students in Eluru

Dr. S. Priyadharshini[1], Dr. V. Nagaguhan [2], Dr.Kanaka Sreenivasulu [3] Dr. Sanjay Joseph Fernandes [4], Dr.Thanuja Ande[5]

[1] Professor &Head, Department of anatomy, Alluri sitaramaraju academy of medical sciences, Malakkapuram, Eluru,west Godavari, ORCID: 0009-0003-8314-8341
[2]Associate Professor, Department of Biochemistry, Aiims Mangalagiri, Guntur. ORCID: 0000-0001-7091-1967
[3]Professor, Department of anatomy, Alluri sitaramaraju academy of medical sciences,, Malakkapuram, Eluru, west Godavari
[4]Professor, Department of anatomy,, Alluri sitaramaraju academy of medical sciences, Malakkapuram, Eluru,west Godavari
[5]Professor, Department of anatomy, Alluri sitaramaraju academy of medical sciences, Malakkapuram, Eluru,west Godavari

*Corresponding Author
Dr. S. Priyadharshini

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Abstract: ***Background***: Slow learners, despite having average intellectual capabilities, often face challenges in traditional educational environments due to passive and text-heavy instructional methods. Innovative, learner-centered strategies such as mind mapping may offer improved outcomes for this population. ***Objective*** To evaluate the effectiveness of mind mapping compared to traditional tutorial-based instruction in improving academic performance among slow learners. ***Methods*** A randomized crossover study was conducted with 50 slow learners aged 18–20 years, divided into two groups (A and B). Group A received tutorial-based instruction in Phase 1 and mind mapping in Phase 2, while Group B received the reverse. Each phase focused on a specific topic in anatomy and was separated by a one-week washout period. All participants were trained in the mind mapping technique prior to intervention. Performance was assessed via standardized post-tests, and data were analyzed using descriptive statistics and paired t-tests. ***Results*** Mind mapping consistently yielded significantly higher scores than tutorial-based instruction in both phases. In Phase 1, Group B (mind mapping) outperformed Group A (tutorials) with mean scores of 15.60 ± 4.99 vs. 11.68 ± 2.91 ($p < 0.000001$). In Phase 2, Group A (mind mapping) outperformed Group B (tutorials) with scores of 15.87 ± 5.73 vs. 13.08 ± 4.45 ($p < 0.01$). Paired t-tests confirmed the effectiveness of mind mapping at the individual level. Qualitative feedback also highlighted high student engagement, improved comprehension, and better organization of content. ***Conclusion*** Mind mapping proved to be a significantly more effective instructional method for slow learners compared to traditional tutorials. Its visual and structured approach enhanced understanding, retention, and motivation. Educational institutions should consider incorporating mind mapping into remedial teaching strategies to promote inclusive and effective learning.

Keywords: Mind mapping, slow learners, crossover study, instructional methods, visual learning, academic performance, medical education

INTRODUCTION

Slow learners are students who exhibit below-average academic performance despite possessing average intellectual capacity and no significant cognitive impairments **(1).** These learners often struggle with traditional instructional approaches, which typically rely on linear, text-heavy formats that may not support their information processing and retention needs **(2).** As a result, slow learners are at a disadvantage in conventional classroom settings, highlighting the necessity of adopting more inclusive and learner-centered pedagogical strategies.

One promising approach for addressing the learning needs of slow learners is mind mapping, a visual technique for organizing and synthesizing information. Developed by Tony Buzan, the mind mapping method involves creating a central image or concept from which related ideas branch out in a hierarchical and interconnected structure **(3).** By transforming complex textual content into simplified visual diagrams that incorporate keywords, images, and colors, mind maps can facilitate better comprehension, engagement, and recall. These characteristics make mind mapping particularly well-suited to learners who benefit from visual-spatial aids and structured learning tools.

While traditional teaching methods such as lectures and tutorials are commonly used in many educational settings, they are often limited by their passive and unidirectional nature **(5).** This can impede the development of critical thinking, creativity, and long-term knowledge retention, especially for students who require more interactive or visual methods of instruction. In disciplines such as medicine, where students are expected to assimilate large volumes of complex information in a short time, innovative teaching methods are essential to support effective learning and knowledge integration **(6).**

In response to these challenges, mind mapping has emerged as a viable instructional alternative in medical and general education alike. Its capacity to organize large bodies of information visually not only supports memory enhancement but also fosters deeper cognitive engagement and motivation among learners **(4,7).** For

slow learners in particular, mind mapping offers the dual benefit of simplifying learning content and promoting active learning habits that are crucial for academic success.

Therefore, this study aims to evaluate the effectiveness of mind mapping compared to traditional tutorial-based instruction among slow learners**.** By examining differences in academic performance using a controlled, crossover design, this research seeks to determine whether mind mapping can serve as a more effective pedagogical tool for enhancing learning outcomes in this specific population.

MATERIAL AND METHODS

Participants

A total of 50 slow learners from phase 1 MBBS aged 18 to 20 years were recruited for this study. Participants were identified based on their academic performance, teacher recommendations, and prior assessments indicating below-average achievement without intellectual disabilities. Informed consent was obtained from both the participants

Study Design

This study employed a randomized crossover design to evaluate the effectiveness of mind mapping compared to traditional tutorial-based instruction. Participants were randomly assigned to one of two groups (Group A and Group B), each consisting of 25 students. Before the mind mapping session, participants will receive a 45-minute training lesson on the mind mapping technique. This training will include explanatory slides describing the principles of mind maps and guidance on how to construct them effectively. The topic chosen for phase 1 was Radial nerve and phase 2 was Median nerve.

- Group A received tutorial-based instruction during Phase 1, followed by mind mapping instruction in Phase 2.
- Group B received mind mapping instruction during Phase 1, followed by tutorial-based instruction in Phase 2.

A washout period of one week was implemented between phases to minimize potential carryover effects.

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RESULTS AND OBSERVATIONS:

In both Phase 1 and Phase 2, mind mapping consistently resulted in significantly higher scores compared to traditional tutorial-based instruction:

• During Phase 1, participants who received mind mapping (Group B) outperformed those who received tutorials (Group A) with a large and highly significant difference.

• In Phase 2, the same pattern persisted: Group A, which switched to mind mapping, scored higher than Group B, which switched to tutorials.

This consistent improvement across both groups and phases strengthens the evidence that mind mapping is a more effective instructional method for slow learners. The crossover design also helps rule out group-based confounding variables, indicating that the method of instruction itself (rather than participant group) drove the performance improvements.

To further validate these findings, a paired t-test was conducted to compare individual performance under both instructional methods.. In this study, the paired t-test showed a significant improvement in scores with mind mapping, confirming that the differences observed were not due to random variation, but rather to the instructional method itself. These consistent findings across both phases of the study underscore that mind mapping is a more effective teaching strategy, especially for slow learners, likely due to its visual and organized structure that enhances comprehension and retention.

Tables:

a) Comparison of post-test marks between Mind mapping and Tutorials groups (Phase 1):

	Mean	Std Deviation
Mind mapping (Group B)	15.60	4.99
Tutorials (group A)	11.68	2.91

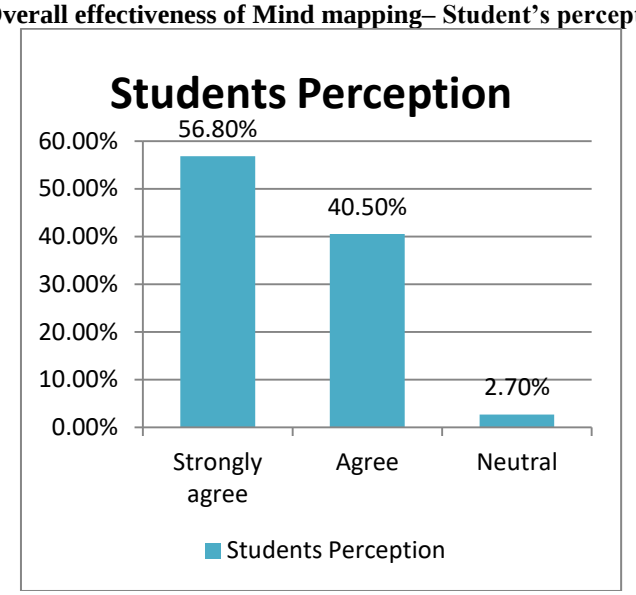
Phase 1(P< 0.000001)

b) Comparison of post-test marks between Mind mapping and Tutorials groups (Phase 2):

	Mean	Std Deviation
Mind mapping(group A)	15.87	5.73
Tutorials(Group B)	13.08	4.45

Phase 2 (p < .001)

c) Overall effectiveness of Mind mapping– Student's perception:



DISCUSSION

The present study evaluated the effectiveness of mind mapping as an instructional technique for slow learners through a crossover design. Results across both Phase 1 and Phase 2 showed that mind mapping significantly enhanced academic performance compared to traditional tutorial-based methods. In Phase 1, Group B (mind mapping) significantly outperformed Group A (tutorials), and the same pattern was observed in Phase 2 when the instructional methods were switched. These findings align with previous research demonstrating the cognitive benefits of mind mapping for organizing and retaining complex information (3,4).

Mind mapping likely supports slow learners by visually simplifying and structuring information, thereby compensating for deficits in working memory and processing speed (1). Unlike traditional tutorials that often rely on linear note-taking and passive learning, mind maps engage multiple cognitive processes such as association, imagery, and categorization that facilitate deeper comprehension and recall (3,7). Furthermore, the use of color, spatial structure, and keywords may increase student engagement and motivation, which are crucial for this learner population (8).

The crossover design used in this study adds robustness to the findings by minimizing individual differences between groups. Since each participant effectively served as their own control across phases, the significant performance improvements can be more confidently attributed to the instructional method itself rather than extraneous variables such as prior knowledge or group ability levels.

Additionally, student feedback collected through a validated questionnaire, highlighted a generally positive perception toward the mind mapping strategy. Many students noted that it was engaging, helped organize information better, and made revision more efficient. This aligns with previous research highlighting the motivational and metacognitive benefits of mind mapping (8).However, several students reported challenges such as initial unfamiliarity with the technique and difficulty in designing maps under time constraints. This suggests the need for adequate training and practice in implementing mind mapping, especially for novice users.

This overwhelmingly positive perception indicates that students found mind mapping to be a highly engaging and beneficial tool for learning. The fact that nearly all respondents either agreed or strongly agreed suggests that mind mapping effectively caters to students' learning needs, particularly in organizing complex medical content in a visual and structured format.

The high percentage of strong agreement (56.8%) aligns with previous research demonstrating the motivational and cognitive benefits of mind mapping(8) found that mind maps enhanced information retrieval and critical thinking among medical students, contributing to more effective self-directed learning (8). Furthermore, the visual nature of mind maps aids memory retention by employing dual coding (visual and verbal), which has been shown to improve recall and comprehension (9).

The minimal percentage of neutral responses (2.7%) may reflect either unfamiliarity with the technique or a preference for traditional methods. Nonetheless, the absence of negative feedback implies that, once adequately trained, students generally perceive mind mapping as a valuable tool.

Students shared positive feedback in their open-ended responses. One student mentioned, "Using colors and images made learning more enjoyable and less monotonous." This shows that mind maps can make learning more fun and interesting. The use of colors and pictures helps students stay engaged and makes it easier

for them to understand and remember the information (9).

Another student said, "Mind mapping encouraged me to think critically about how topics were connected rather than just memorizing facts." This suggests that mind mapping helps students understand the bigger picture and develop important thinking skills like analyzing and connecting ideas, which are very important in medical education (10).

Limitations

Despite the promising results, several limitations should be considered:

1. Small sample size: Although the crossover design helps control variability, a larger and more diverse sample would enhance the generalizability of findings.
2. Short-term assessment: The study measured immediate learning outcomes; long-term retention and application of knowledge were not assessed.
3. Single-institution setting: All participants were from the same educational context, which may limit external validity.
4. No control over study habits: Variations in students' independent study behavior outside instructional sessions could have influenced performance.

Future research should consider longitudinal designs to evaluate the sustainability of learning gains from mind mapping and extend the methodology to different educational settings and populations.

CONCLUSION

This study provides strong empirical evidence supporting the use of mind mapping as an effective instructional tool for slow learners. Compared to traditional tutorial-based teaching, mind mapping significantly enhanced academic performance in both phases of the crossover design. Given its visual and organizational benefits, mind mapping appears particularly suited to the learning needs of students who struggle with conventional methods. Educational institutions should consider integrating mind mapping into remedial and mainstream instructional strategies to promote more inclusive and effective learning.

Author Contributions for the study:

S. Priyadharshini: Conceptualization, Methodology
Thanuja Ande: Data Collection
V. Nagaguhan: Data Analysis
Kanaka Sreenivasulu: Writing-Drafting the manuscript
Sanjay Joseph Fernandes: Reviewing and Editing

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