Effectiveness of Mind Mapping in the Improvement of Students Academic Performance: A Systematic Review

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ABSTRACT

Background: The effectiveness of learning strategies in improving students' academic performance has been a subject of growing interest. Mind mapping, a structured visual learning technique, has been widely recognized for its ability to enhance knowledge retention, cognitive processing, and conceptual understanding. This systematic review examines the effectiveness of mind mapping in improving students' academic performance across different educational settings and disciplines.

Objectives: The study aims to synthesize existing research on mind mapping interventions, assess their impact on student learning outcomes, and identify the key components that contribute to its effectiveness.

Methods: A systematic review methodology was employed, with searches conducted across six academic databases, including ScienceDirect, ProQuest, Sage Journals, Taylor & Francis, PubMed, and Google Scholar, covering the period from 2015 to 2025. Boolean operators were used to refine search results, and eligibility criteria were applied to select empirical studies utilizing experimental designs, including quasi-experimental and randomized controlled trials. The quality of selected studies was appraised using the Joanna Briggs Institute (JBI) critical appraisal tool for quasi-experimental studies and the Risk-Of-Bias VISualization (ROBVIS) tool for RCTs. Data analysis followed the Synthesis Without Meta-Analysis (SWiM) guidelines.

Results: Six studies were included in the review, conducted in China, Indonesia, Ghana, and Thailand. The reviewed studies demonstrated that mind mapping significantly improved students' academic performance by enhancing comprehension, problem-solving skills, and long-term knowledge retention. The intervention models varied across studies, including interactive mind mapping, concept mapping, cooperative learning, and mastery learning approaches. The most effective components of mind mapping included structured visual organization, collaborative note-taking, online integration, and formative assessments.

Conclusion: Mind mapping has proven to be an effective pedagogical tool that fosters critical thinking, conceptual understanding, and improved academic performance across diverse educational settings. However, further research is recommended to explore the long-term effects of mind mapping interventions, compare its effectiveness across different subjects, and assess its impact on students with varying learning styles.

Keywords: Mind Mapping, Concept Mapping, Academic Performance, Knowledge Retention, Cognitive Processing, Learning Strategies, Systematic Review.

1. INTRODUCTION

In the fast-paced world of education, students often struggle with retaining vast amounts of information, organizing complex ideas, and making meaningful connections between concepts (Machado & Carvalho, 2020). Traditional note-taking methods can be overwhelming and inefficient, leading to cognitive overload and poor academic performance (Voyer et al., 2021). Mind mapping, a visual learning technique that harnesses the brain's natural inclination for pattern recognition and association, has emerged as a powerful tool to enhance comprehension, memory retention, and critical thinking (Israel et al., 2020).

Mind mapping not only enhances students' ability to retain and recall information but also promotes active engagement in the learning process by encouraging structured thinking and conceptual organization (Shrivastava & Shrivastava, 2022). Unlike traditional linear note-taking methods, mind mapping allows learners to visually map out key ideas, interconnections, and hierarchical structures, making complex subjects more digestible and easier to comprehend (Jabade & Nadaf, 2024; Qingsong et al., 2024). Research has shown that students who incorporate mind mapping into their study routines experience improved problem-solving skills, increased creativity, and a greater ability to synthesize information across different subjects (Abdulkhaled & Pangandaman, 2025; Qingsong et al., 2024; Sagita et al., 2024; Yenan et al., 2021). This cognitive approach fosters deeper learning, as students actively organize and relate new knowledge to their existing understanding, rather than passively absorbing information. Also, mind mapping has been found to benefit diverse learning styles, particularly visual and kinesthetic learners, by providing an interactive and engaging method for organizing thoughts and concepts (Pangandaman, 2023; Pribadi & Susilana, 2021; Yang et al., 2022).

Beyond individual academic improvement, mind mapping facilitates collaborative learning by enabling students to work together in structuring and refining information (Abdulmalik & Pangandaman, 2024; Fung, 2024; Luangkrajang, 2022). In group settings, students can use mind maps to brainstorm ideas, create concept frameworks, and develop comprehensive study guides, thereby reinforcing cooperative learning and knowledge exchange (Fung, 2024). Moreover, the adaptability of mind mapping across various educational levels and disciplines makes it a versatile tool in both traditional and digital learning environments. As technology advances, digital mind mapping tools further enhance this technique by allowing for real-time collaboration, interactive elements, and multimedia integration, making learning more dynamic and accessible (Pangandaman et al., 2024; Sagita et al., 2024; Sajadi et al., 2023; Yang et al., 2022). Given these benefits, the integration of mind mapping into modern educational strategies holds great potential for improving students' academic performance, critical thinking, and knowledge retention, ultimately bridging the gap between memorization and meaningful learning (Pangandaman, 2023; Pangandaman, Ali, et al., 2019; Pangandaman, Boloron, et al., 2019).

This study aims to systematically evaluate the effectiveness of mind mapping as a learning strategy in enhancing students' academic performance across various educational levels and disciplines. By synthesizing existing research, this review seeks to determine how mind mapping influences knowledge retention, conceptual understanding, critical thinking, and overall learning outcomes.

2. METHODS

Study Design

This study employed a systematic review as the research method. The researchers utilized the PICO (People/ Participants, Intervention, Comparison, and Outcomes) framework to formulate questions specific to the improvement of students' academic performance through mind mapping. The research question guiding this study was "How effective is mind mapping in the improvement of students' academic performance?"

Table 1. Description of PICO

People/ Participants	Students
Intervention	Mind Mapping
Comparison	Traditional lecture-based teaching methods
Outcomes	Improvement of students' academic performance

Search Methods

A comprehensive literature search was conducted across seven academic databases, namely ScienceDirect (8,965), ProQuest (502,830), Sage Journals (94,570), Taylor & Francis (184,614), PubMed (11), and Google Scholar (1,970,000) and covering the publication period from 2015 to 2025 (N=2,760,990). The search strategy utilized Boolean operators (AND, OR) to combine relevant keywords and phrases systematically. Quotation marks ("") were used to conduct exact phrase searches, while parentheses ( ) were applied to group similar concepts and refine search results. The keywords employed in the search were: ("mind mapping" OR "concept mapping") AND ("students" OR "learners") AND ("academic performance" OR "learning outcomes" OR "knowledge retention") AND (effectiveness OR efficacy) AND (systematic review OR meta-analysis OR literature review).

Inclusion and Exclusion Criteria

To ensure the selection of high-quality and relevant literature for this systematic review on the effectiveness of mind mapping

in the improvement of students' academic performance, specific inclusion and exclusion criteria were established. The selected studies had to involve students as participants, regardless of their academic level, and be published in accredited international, peer-reviewed journals between 2015 to 2025 to ensure the inclusion of recent findings. Only empirical studies employing experimental designs, including randomized controlled trials (RCTs), quasi-experimental, or true experimental designs, were considered. Additionally, only articles written in English were included to maintain consistency in analysis and interpretation. Studies were excluded if they were reviews, conference proceedings, study protocols, case reports, surveys, or theses/dissertations, as the focus was on primary empirical research. Articles that were not available for full-text download or had limited accessibility were also excluded. By adhering to these rigorous selection standards, this systematic review aims to incorporate high-quality, evidence-based studies that provide reliable insights into the impact of mind mapping on students' academic performance.

Screening of Articles

The screening process was performed by four reviewers (HKP, NTD, NPM, JCL, and MSA) and encompassed multiple stages. Initially, relevant keywords were identified across the seven selected databases. Subsequently, the titles and abstracts were evaluated to determine their appropriateness based on the inclusion criteria. The availability of full texts was assessed, considering their alignment with the study's requirements. In cases of disagreement between the reviewers (HKP, NPM, JCL, and MSA), a third group of reviewer (RIH, MMS, IUM, SPM, RHK, and AMM) was involved to reconcile any discrepancies and ensure the accuracy of the screening process. This reconciliation step aimed to promote consistency and accuracy in the decision-making process (Waffenschmidt et al., 2019).

Data Extraction

Following a rigorous screening process, six articles that met the inclusion criteria were selected for data extraction. The data extraction process was systematically conducted to ensure the accuracy and reliability of the information gathered from each study. A grid synthesis format was employed by all reviewers to extract key details, ensuring consistency across the selected literature. This process focused on gathering essential information, including the authors, publication year, country of study, research objectives, study design, educational setting, intervention model, duration of implementation, key results, and specific components of mind mapping techniques that contributed to the improvement of students' academic performance. This structured approach facilitated a comprehensive analysis of how mind mapping has been applied in various educational contexts and its effectiveness in enhancing learning outcomes.

Each article was meticulously examined to capture critical insights related to the methodology and findings of the studies. The study design and school setting were given particular attention, as they played a significant role in determining the applicability and generalizability of the results. Furthermore, the intervention model was analyzed to assess the ways in which mind mapping was integrated into the learning process, including whether it was used as a standalone strategy or in combination with other instructional methods. The duration of the intervention was also considered, as this factor could influence the long-term retention of knowledge and overall academic improvement. Special emphasis was placed on identifying the specific elements of mind mapping—such as concept structuring, hierarchical organization, and visual interconnections—that were most effective in fostering cognitive development and knowledge retention among students.

To facilitate further analysis and synthesis, the extracted data from all six studies were systematically compiled and summarized in a structured table (Table 2, Appendix 1). This tabular presentation provided a clear comparative view of the studies, allowing for deeper insights into patterns, trends, and commonalities across different educational settings. By organizing the findings in this manner, the review aimed to highlight the strengths and limitations of mind mapping as an academic tool, offering a comprehensive perspective on its role in improving students' academic performance.

Quality Assessment of Selected Articles

To ensure the reliability and validity of the selected studies, a rigorous quality assessment process was conducted using well-established critical appraisal tools. The Joanna Briggs Institute (JBI) critical appraisal checklist was employed for evaluating quasi-experimental research, while the Critical Appraisal Skills Programme (CASP) checklist was used for assessing randomized controlled trials (RCTs). The JBI tools, accessible through JBI Global, have undergone extensive peer assessment and are officially endorsed by the JBI Scientific Committee (Lockwood et al., 2020). These tools facilitated the structured evaluation of the methodological quality, credibility, and relevance of the quasi-experimental studies included in the review. Meanwhile, for RCTs, the Risk-Of-Bias VISualization (ROBVIS) checklist was applied to assess the potential for bias in study design, conduct, and reporting. This ROBVIS tool, available at Risk of Bias Info, offers a comprehensive framework for identifying and categorizing biases, ensuring a transparent and systematic appraisal of each randomized study (McGuinness & Higgins, 2021).

The critical appraisal process was systematically conducted by HKP, NPM, JCL, and MSA, who independently reviewed qeach study to minimize subjectivity and enhance the reliability of the assessment. To ensure consistency and fairness, any

disagreements among the primary reviewers were resolved through consultation with a secondary group of reviewers (RIH, MMS, IUM, SPM, RHK, and AMM), who provided additional insights based on the established guidelines from JBI and ROBVIS. This multi-layered evaluation process aimed to maintain the highest standards of methodological rigor, ensuring that only high-quality, well-designed studies were included in the systematic review. By implementing this thorough quality assessment strategy, the study ensured that its findings on the effectiveness of mind mapping in improving students' academic performance were based on reliable, unbiased, and scientifically robust evidence (Table 4).

Risk of Bias

For quasi-experimental designs, the risk of bias in individual studies was assessed using a structured cutoff approach. Studies were categorized as having a low risk of bias if they scored "yes" for 70% or more of the appraisal questions, a moderate risk if they scored "yes" for 50 to 69%, and a high risk if the "yes" scores were below 50% (Kennedy et al., 2019). Based on the assessment, four studies were classified as having a low risk of bias, indicating strong methodological rigor, while one study was deemed to have a moderate risk of bias, primarily due to unclear responses in key evaluation criteria (Table 3).

For randomized controlled trials (RCTs), the ROBVIS risk of bias tool was utilized to ensure a systematic and transparent assessment. The evaluation focused on key domains, including allocation concealment, blinding, incomplete outcome data, selective reporting, and other potential sources of bias (Hayudini et al., 2025; Pangandaman et al., 2025). Among the five RCT-based studies, one study had an unclear overall bias, while two studies lacked clear blinding information. Additionally, one study had unclear outcome data and selective reporting, suggesting limitations in the study's transparency and methodology (Table 4). Despite these limitations, the majority of the RCT studies demonstrated adequate measures to minimize bias, enhancing the reliability of the findings.

Table 3. Risk of bias assessment for quasi experiment design

Author & Year [sample respondents']	JBI assessment tools										Interpretation[b]
	Q1[a]	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	% Yes	
Luo Xinge et al., 2024 [n=120]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
M. Khayrun et al., 2024 [n=70]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Nyagblormase et al., 2021 [n=71]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Simon Moyom Laar et al., 2024 [n=100]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Xu Qingsong et al., 2024 [n=30]	Yes	Not	Not	Yes	Yes	Not	Not	Yes	Not	56%	Moderate risk of bias

Notes:

[a] Q1 – Q9 indicate questions 1 to 9 based on the JBI risk assessment

[b] The risk of bias was ranked as high when the study reached up to 49% of "yes" scores, moderate when the study reached from 50 to 69% of "yes" scores, and low when the study reached more than 70% of "yes" scores

[c] Not means "Unclear"

Table 4. ROBVIS risk of bias tool for RCT

Author (s) & year	Sample size (n)	Allocation concealment	Blinding	Incomplete outcome data	Selective reporting	Other bias	Overall
Luo Xinge et al., 2024	120	+	+	+	+	?	+
M. Khayrun et al., 2024	70	+	?	+	?	?	?
Nyagblormase et al., 2021	71	+	?	?	+	?	+

Simon Moyom Laar et al., 2024	100	+	+	+	+	?	+
Xu Qingsong et al., 2024	30	+	?	+	+	?	+

Note: (+) indicates a low risk of bias, (-) indicates a high risk of bias, (?) shows unclear risk of bias

Data Analysis

The authors employed the Synthesis Without Meta-Analysis (SWiM) guidelines for data (Pangandaman et al., 2024). These guidelines were utilized to systematically synthesize quantitative data regarding the effects of mind mapping interventions on students' academic performance, ensuring structured and transparent reporting. The synthesis was conducted through nine key reporting items, which allowed for a comparative and thematic analysis of the selected studies.

The first step involved categorizing studies based on essential components, including authors and publication year, country, study design, setting, intervention model, duration, results, and the components of mind mapping in academic settings (Table 2). The included studies were thoroughly reviewed to ensure they met the inclusion criteria and aligned with the research objectives. Data analysis focused on evaluating the study designs, intervention strategies, assessment tools, and the reported effects of mind mapping on academic performance. Particular attention was given to variations in the implementation of mind mapping techniques, the duration of interventions, and the extent to which mind mapping influenced learning outcomes, knowledge retention, and cognitive processing.

The extracted findings were summarized and presented in Table 2, facilitating a comparative evaluation of similarities and differences in reported outcomes across the studies. This comparative approach provided insights into the effectiveness of different mind mapping applications, highlighting the most impactful components—such as visual diagrams, structured peer discussions, collaborative mapping, and formative assessments—in enhancing students' academic achievements. By structuring the data synthesis in this manner, the analysis ensures a clear and coherent representation of how mind mapping contributes to improving educational outcomes across diverse academic settings.

Table 2. Data extraction of the selected studies

No	Authors, year of publication, and country	Design	Setting	Intervention model	Duration	Results	Components of Mind Mapping in the Academic Setting
1	Luo Xinge et al. (2024), China	Quasi-experimental study	University	Interactive Mind Mapping	12 weeks	Significant improvement in English language performance and motivation.	Visual diagrams, concept interconnections, peer collaboration
2	M. Khayrun et al. (2024), Indonesia	Quasi-experimental study	High School	Mind Mapping in Cooperative Learning	10 weeks	Significant improvement in students' learning outcomes in Islamic Religious Education.	Structured maps, group discussions, peer evaluations
3	Nyagblormase et al. (2021), Ghana	Quasi-experimental study	College of Education	Mind Mapping for Online Learning	10 weeks	Mind mapping facilitated knowledge retention but did not strongly improve conceptual understanding.	Graphic organizers, online collaboration, self-paced learning

4	Simon Moyom Laar et al. (2024), Ghana	Quasi-experimental study	High School	Concept Mapping in Science Education	12 weeks	Concept mapping significantly enhanced student performance in cellular respiration.	Hierarchical mapping, formative assessments, structured learning plans
5	Xu Qingsong et al. (2024), Thailand	Randomized controlled trial	University	Mastery Learning with Mind Mapping	8 weeks	Mind mapping improved sculpture learning performance beyond the standard mastery threshold.	Personalized mapping, skill-building, iterative assessments
6	Yinghui Shi et al. (2022), China	Randomized controlled trial	University	Collaborative Note-Taking with Mind Mapping	6 weeks	Collaborative note-taking with mind mapping enhanced cognitive load efficiency and academic performance.	Collaborative cloud-based mapping, real-time feedback, cognitive load management

3. RESULTS

3.1 Characteristics of the selected studies

A total of 2,760,990 articles were initially identified through six databases (ScienceDirect, ProQuest, Sage Journals, Taylor & Francis, PubMed, and Google Scholar). After applying limiters (year of publication, type of article, subject area, and open access), 2,548,645 articles were excluded. From the remaining 212,345 articles, 86 articles were selected for title and abstract screening. After filtering based on inclusion criteria, 21 full-text articles were assessed for eligibility, along with four articles from the reference list. Following further screening and quality assessment, a total of six articles were finally included in this systematic review (Figure 1).

The selected studies originated from China (2), Indonesia (1), Ghana (2), and Thailand (1). In terms of settings, four studies were conducted in university environments, two in high schools, and one in a college of education. The included studies primarily employed quasi-experimental (four studies) and randomized controlled trial (two studies) designs. Various mind mapping-based intervention models were utilized, including interactive mind mapping, cooperative learning, online learning, concept mapping, mastery learning, and collaborative note-taking (Table 2).

The duration of interventions varied across studies: two studies lasted 12 weeks, two lasted 10 weeks, one lasted 8 weeks, and one lasted 6 weeks. The findings from these studies indicated that mind mapping techniques significantly improved academic performance, knowledge retention, and cognitive processing across various subjects. The most effective components of mind mapping interventions included visual diagrams, structured peer discussions, online collaboration, and formative assessments, all of which contributed to enhancing students' academic achievements in different educational settings.

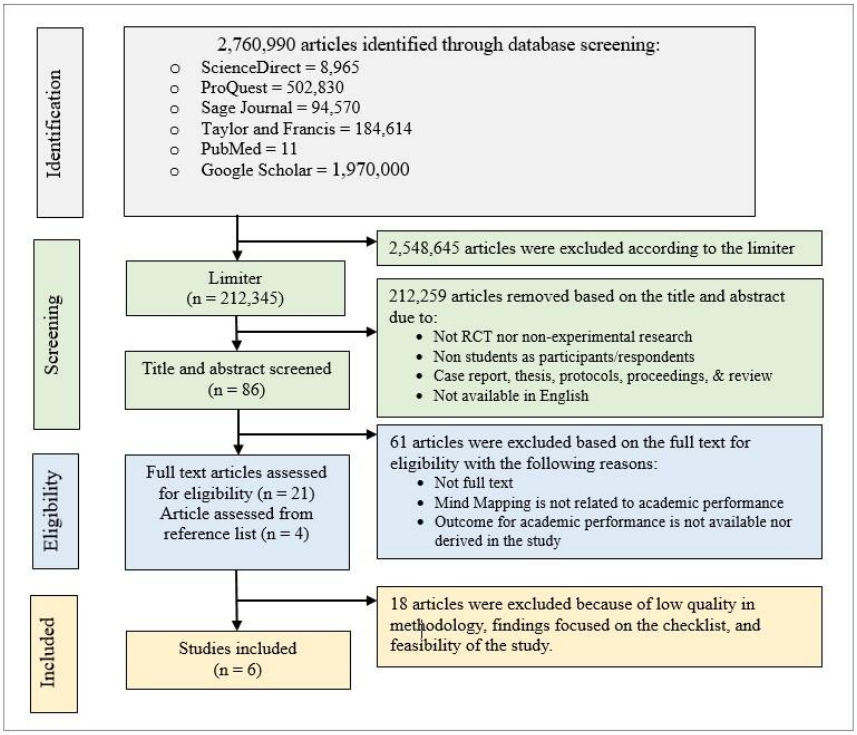

Figure 1. PRISMA flowchart

3.2 Participants and study settings

The participants in the reviewed studies consisted of students from various academic levels, including university students, high school students, and college of education students. The majority of the studies (four out of six) were conducted in university settings, while two studies took place in high schools, and one in a college of education. The participants were engaged in different subject areas where mind mapping techniques were applied as an intervention to enhance academic performance (Table 2).

The sample sizes varied across studies. The highest number of participants in the quasi-experimental studies was 120 students (Xinge & Baharudin, 2024), while the lowest was 30 students (Qingsong et al., 2024). In randomized controlled trial (RCT) studies, the sample sizes were also relatively small, with the highest being 100 participants (Laar et al., 2024) and the lowest at 30 participants (Qingsong et al., 2024) (Table 3 and Table 4). The participant distribution suggests that quasi-experimental studies tended to have larger sample sizes than RCT studies, which may impact the generalizability and statistical power of the findings.

The study settings also influenced the nature of the mind mapping interventions. While university-based studies primarily focused on academic knowledge retention and conceptual understanding, high school and college-based studies emphasized interactive learning and skill development. The intervention models, such as interactive mind mapping, cooperative learning, and mastery learning, were tailored to the specific educational environments and student demographics. These variations highlight the versatility of mind mapping techniques across different educational settings and student populations.

3.3 Characteristics of the intervention and components of the Mind Mapping in the Academic Performance of Students

The implementation of mind mapping interventions in the selected studies included various innovative approaches aimed at enhancing students' academic performance. These interventions ranged from interactive mind mapping, cooperative learning strategies, concept mapping in science education, and mastery learning techniques. Some studies integrated collaborative note-taking approaches to enhance cognitive load efficiency and knowledge retention. Unlike previous research that focused on flipped classrooms, the interventions in this review emphasized active student engagement through structured visual learning techniques (Table 2).

The duration of the interventions varied across studies. Two studies lasted for 12 weeks, while two were conducted over 10 weeks, one lasted 8 weeks, and one lasted 6 weeks. This variability in intervention duration suggests that mind mapping techniques can be effectively implemented in both short-term and long-term academic settings. The intervention models were designed to facilitate deeper conceptual understanding, improve problem-solving abilities, and enhance information

retention. Notably, the use of mastery learning combined with mind mapping in Qingsong et al. (2024) demonstrated a significant positive impact on students' sculpture learning performance, further showcasing the adaptability of mind mapping techniques across various disciplines.

The components of the mind mapping interventions included visual diagrams, structured peer discussions, online collaboration, formative assessments, and personalized mapping strategies. These components aimed to support students' cognitive processes, allowing them to organize and retain complex information more effectively. Additionally, in collaborative note-taking interventions, students benefited from real-time feedback, interactive discussions, and structured knowledge structuring. The findings across the reviewed studies highlight that mind mapping is a versatile tool that enhances academic performance by fostering active learning, improving comprehension, and aiding in long-term retention of knowledge.

3.4 Effects of Mind Mapping in the Academic Performance

The findings from the reviewed studies indicate that mind mapping significantly enhances students' academic performance across various disciplines and educational settings. The intervention of mind mapping techniques led to improvements in knowledge retention, problem-solving skills, conceptual understanding, and overall academic achievement. Students who engaged in mind mapping-based learning strategies consistently outperformed their peers in traditional learning settings, emphasizing its effectiveness as an active learning strategy (Khayrun et al., 2024; Laar et al., 2024; Nyagblormase et al., 2021; Qingsong et al., 2024; Shi et al., 2022; Xinge & Baharudin, 2024).

For instance, Luo & Siti Mastura (2024) examined the impact of interactive mind mapping on the performance and motivation of English language students in China. The study revealed that students who used interactive mind mapping exhibited significant improvements in language retention and motivation compared to those using conventional learning methods (Luo & Siti Mastura, 2024). Similarly, Khayrun et al. (2024) explored the cooperative learning method of mind mapping in Islamic Religious Education (PAI) and found that the intervention group scored significantly higher than the control group, demonstrating the effectiveness of mind mapping in structuring and comprehending abstract religious concepts (Khayrun et al., 2024).

Moreover, Nyagblormase et al. (2021) investigated the role of mind mapping in online learning for chemistry students. The findings indicated that while mind mapping improved knowledge retention, it had limited impact on deep conceptual understanding, suggesting that its effectiveness depends on how it is integrated with other instructional strategies (Nyagblormase et al., 2021). Additionally, Laar et al. (2024) demonstrated that concept mapping significantly improved students' understanding of cellular respiration, resulting in higher post-test scores and enhanced conceptual retention (Laar et al., 2024).

The study by Qingsong et al. (2024) showed that mastery learning combined with mind mapping enhanced students' performance in sculpture education. The results indicated a statistically significant improvement in students' sculpture skills, highlighting how structured visual learning techniques contribute to practical and applied learning disciplines (Qingsong et al., 2024). Furthermore, Shi et al. (2022) found that collaborative note-taking using mind mapping strategies significantly enhanced cognitive load efficiency and academic performance among university students (Shi et al., 2022).

Overall, the statistical analysis across these studies revealed significant differences between students who used mind mapping and those who did not, underscoring its value as a pedagogical tool. The primary advantages of mind mapping interventions included enhanced structured thinking, improved recall, and better problem-solving abilities. These findings affirm that mind mapping is an effective instructional approach that fosters deeper learning, student engagement, and academic success across diverse educational contexts (Khayrun et al., 2024; Laar et al., 2024; Luo & Siti Mastura, 2024; Nyagblormase et al., 2021; Qingsong et al., 2024; Shi et al., 2022).

4. DISCUSSION

This systematic review analyzed six studies examining the effectiveness of mind mapping in enhancing students' academic performance. Initially, 2,760,990 articles were identified across six databases, with 2,548,645 excluded based on various criteria. After further filtering, 21 full-text articles were assessed for eligibility, with four additional articles identified from reference lists. Following a rigorous screening and quality assessment process, six studies were included in the final review. These studies originated from China (2), Indonesia (1), Ghana (2), and Thailand (1), representing diverse educational settings and research methodologies (Khayrun et al., 2024; Laar et al., 2024; Luo & Siti Mastura, 2024; Nyagblormase et al., 2021; Qingsong et al., 2024; Shi et al., 2022).

The studies reviewed encompassed quasi-experimental (four studies) and randomized controlled trial (two studies) designs. Four studies were conducted in university settings, two in high schools, and one in a college of education. Mind mapping interventions varied across studies, with approaches including interactive mind mapping, cooperative learning, concept mapping, mastery learning, and collaborative note-taking. The duration of interventions ranged from 6 to 12 weeks,

demonstrating the flexibility of mind mapping techniques in different academic settings (Khayrun et al., 2024; Laar et al., 2024; Nyagblormase et al., 2021).

The results of all reviewed studies confirmed significant improvements in students' academic performance when mind mapping was integrated into the learning process. Notably, students in the intervention groups consistently outperformed those in traditional learning environments, indicating the efficacy of mind mapping in enhancing structured thinking, knowledge retention, and problem-solving skills (Laar et al., 2024; Qingsong et al., 2024). For instance, Luo & Siti Mastura (2024) demonstrated that interactive mind mapping significantly improved English language students' motivation and retention, while Nyagblormase et al. (2021) found that mind mapping facilitated knowledge retention but had limited effects on conceptual understanding in online chemistry learning. Similarly, Shi et al. (2022) found that collaborative note-taking using mind mapping significantly enhanced cognitive load efficiency and academic performance among university students.

These findings collectively emphasize mind mapping as a valuable pedagogical tool that enhances student engagement, comprehension, and academic success across diverse educational disciplines. Future studies should further explore the long-term impact of mind mapping interventions and their applicability across various subjects and student populations (Khayrun et al., 2024; Laar et al., 2024; Luo & Siti Mastura, 2024; Nyagblormase et al., 2021; Qingsong et al., 2024; Shi et al., 2022).

The findings of this systematic review are consistent with prior research on mind mapping as an active learning strategy in educational settings, particularly in enhancing knowledge retention, problem-solving skills, and academic performance (Jabade & Nadaf, 2024; Sagita et al., 2024). Mind mapping has been widely recognized as an effective tool for promoting deep learning and enhancing conceptual understanding, aligning with constructivist learning theories that emphasize active engagement and cognitive organization (Shrivastava & Shrivastava, 2022). A meta-analysis demonstrated that concept mapping strategies significantly improve students' ability to retain and retrieve information in complex learning environments, supporting this review's findings on the efficacy of mind mapping in academic settings (Barta et al., 2022).

Moreover, several studies have emphasized the effectiveness of mind mapping in structuring knowledge, fostering creativity, and improving academic outcomes across various disciplines (Su et al., 2021; Yenan et al., 2021). For example, a study found that students who used mind mapping demonstrated higher levels of comprehension and recall compared to those who relied on traditional note-taking methods (Su et al., 2021). This aligns with the findings of this review, where mind mapping techniques, including interactive mapping, concept mapping, and collaborative note-taking, were shown to enhance students' academic performance across different subject areas (Qingsong et al., 2024; Shi et al., 2022).

However, while most studies support the positive impact of mind mapping on student learning, some researchers have noted limitations and potential drawbacks. While mind mapping is beneficial for visual learners, it may not be as effective for students who prefer linear or text-based learning strategies (Hazaymeh, 2022). Similarly, another study suggested that the effectiveness of mind mapping largely depends on how well students are trained to use it, as improperly structured maps can lead to cognitive overload rather than improved understanding (Luangkrajang, 2022). This contrasts with findings from this review, where most studies reported significant academic improvements following mind mapping interventions (Khayrun et al., 2024; Laar et al., 2024; Xinge & Baharudin, 2024).

One key finding from this review was the significant improvement in students' academic performance and knowledge retention through various mind mapping approaches, such as cooperative learning, concept mapping, and mastery learning (Nyagblormase et al., 2021; Qingsong et al., 2024). This supports previous research indicating that structured visual learning techniques can enhance both short-term and long-term memory recall (Sajadi et al., 2023). Additionally, research demonstrated that concept maps help students develop metacognitive skills, allowing them to better organize and synthesize information, which is consistent with this review's findings on the effectiveness of collaborative note-taking and structured peer discussions in improving academic performance (Qingsong et al., 2024; Shi et al., 2022).

These findings suggest that mind mapping is a valuable pedagogical tool that can enhance learning across multiple disciplines (He et al., 2024). However, further studies should explore the long-term retention effects of mind mapping, its adaptability to various learning styles, and its impact on higher-order cognitive processes (Jabade & Nadaf, 2024). Additionally, future research should focus on how educators can integrate mind mapping into curriculum design to optimize student engagement and performance (He et al., 2024).

Despite the positive outcomes observed in the reviewed studies, it is essential to acknowledge that the implementation of mind mapping as an academic intervention requires careful planning and consideration of contextual factors. Effective integration of mind mapping techniques into educational curricula necessitates adequate training for educators, access to digital and physical resources, and a supportive learning environment (He et al., 2024; Jabade & Nadaf, 2024). Research has shown that while mind mapping can significantly enhance knowledge retention and cognitive processing, its effectiveness largely depends on how well students and instructors understand and apply the technique (Khayrun et al., 2024; Sajadi et al., 2023). Moreover, technological advancements in digital mind mapping tools provide opportunities for interactive learning, yet challenges such as student adaptability and instructor proficiency remain crucial considerations for successful

implementation (Shi et al., 2022).

It is important to note that the quality assessment of the included studies indicated a low risk of bias for most studies (Khayrun et al., 2024; Xinge & Baharudin, 2024). However, one study was classified as having a moderate risk of bias, and some unclear elements regarding blinding and outcome data were observed in the assessed randomized controlled trials (Nyagblormase et al., 2021; Qingsong et al., 2024). These factors should be carefully considered when interpreting the results and generalizing the findings to broader educational contexts. Additionally, differences in intervention duration, student demographics, and subject areas may have influenced the variability in outcomes, highlighting the need for future studies to further examine how mind mapping can be optimized across diverse learning environments (Shi et al., 2022).

Further research is needed to explore the long-term effects of mind mapping interventions on academic performance and cognitive development. In particular, comparative studies analyzing different mind mapping approaches—such as interactive mapping, mastery learning, and cooperative learning models—could provide valuable insights into which methods yield the most significant learning benefits across different educational disciplines (Qingsong et al., 2024; Xinge & Baharudin, 2024). Moreso, longitudinal research examining knowledge retention over extended periods would offer a clearer understanding of how mind mapping contributes to sustained learning outcomes and higher-order cognitive skills development (Hamzah et al., 2022; Liu et al., 2023).

5. IMPLICATIONS AND LIMITATIONS

The findings of this systematic review highlight the significance of incorporating mind mapping techniques into educational curricula as a means of enhancing students' academic performance, cognitive processing, and knowledge retention. The evidence from this study supports the use of mind mapping in diverse educational settings, demonstrating its effectiveness in fostering critical thinking, structured learning, and improved comprehension across various disciplines. By engaging students in active learning through visual organization and conceptual mapping, mind mapping models empower learners to develop a deeper understanding, make connections between ideas, and effectively apply knowledge in both theoretical and practical learning contexts. Integrating mind mapping into educational programs and teacher training can contribute to the development of more efficient study strategies, ultimately leading to better academic performance, improved information retention, and greater student engagement.

One limitation of this study is that the search was restricted to articles published in English and indexed in accredited international journals, which may have led to the exclusion of relevant studies published in other languages or regional journals. This limitation introduces potential publication bias, thereby restricting the generalizability of the findings across different educational and cultural contexts. Additionally, this study focused on research published between 2015 and 2025, ensuring an analysis of recent advancements in mind mapping techniques, but potentially excluding earlier foundational studies that could provide additional insights into its long-term effectiveness.

6. CONCLUSION

This systematic review highlights the significant role of mind mapping as an effective educational strategy for enhancing students' academic performance, knowledge retention, and cognitive processing. The findings demonstrate that integrating mind mapping techniques into various learning environments fosters structured thinking, improves comprehension, and strengthens problem-solving skills. By providing a visual and organized approach to learning, mind mapping enables students to develop deeper connections between concepts, leading to better engagement and long-term retention of knowledge. The study further emphasizes the adaptability of mind mapping across different educational levels and disciplines, showcasing its versatility as a pedagogical tool that supports both theoretical understanding and practical application.

While the results affirm the effectiveness of mind mapping, certain limitations must be considered, such as language restrictions in the literature review and potential biases in study selection. Future research should expand the scope by including studies from diverse educational settings and assessing the long-term impact of mind mapping on academic success. Additionally, comparative studies evaluating different mind mapping approaches could provide further insights into optimizing its application across various learning styles and subjects. Overall, this review underscores the importance of integrating innovative learning strategies like mind mapping to enhance student engagement and academic achievement in modern education.

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Conflict of Interest

The authors declare no conflict of interest.

REFERENCES

[1] Abdulkhaled, S. A. J., & Pangandaman, H. (2025). Association Between Computer Literacy and Utilization of Health Information Technology in Nursing Documentation and Plan of Care among Staff Nurses in a Tertiary Hospital [Research]. Journal of Client-Centered Nursing Care, 11(2), 0-0. https://doi.org/10.32598/jccnc.11.2.571.6

[2] Abdulmalik, P. P., & Pangandaman, H. (2024). Leadership Traits of Nurse Managers and Nurse Staff Commitment in the Philippines Hospitals. Indonesian Journal of Health Administration (Jurnal Administrasi Kesehatan Indonesia), 12(1), 49-61. https://doi.org/10.20473/jaki.v12i1.2024.49-61

[3] Barta, A., Fodor, L. A., Tamas, B., & Szamoskozi, I. (2022). The development of students critical thinking abilities and dispositions through the concept mapping learning method – A meta-analysis. Educational Research Review, 37, 100481. https://doi.org/https://doi.org/10.1016/j.edurev.2022.100481

[4] Fung, D. (2024). The synergy of peer collaboration and mind mapping in cultivating primary students' science understanding: an integrative pedagogy to enhance science concept acquisition. International Journal of Science Education, 46(2), 131-154. https://doi.org/10.1080/09500693.2023.2222549

[5] Hamzah, H., Hamzah, M. I., & Zulkifli, H. (2022). Systematic Literature Review on the Elements of Metacognition-Based Higher Order Thinking Skills (HOTS) Teaching and Learning Modules. Sustainability, 14(2), 813. https://www.mdpi.com/2071-1050/14/2/813

[6] Hayudini, M. A. A., Pangandaman, H. K., Mai-Alauya, S. A., Macarambon, R. d. R., Macalaba, S. P., Ali, N. A., Mukattil, N. P., Uddin, T. S., Salve, M. M., & Abdulhan, M. S. (2025). Effectiveness of the DOTS Program in Enhancing Management of Pulmonary Tuberculosis: A Systematic Review. Frontiers in Health Informatics, 14(2), 44-51.

[7] Hazaymeh, W. (2022). The Effectiveness of Visual Mind Mapping Strategy for Improving English Language Learners' Critical Thinking Skills and Reading Ability. European Journal of Educational Research, 11, 141 – 150. https://doi.org/10.12973/eu-jer.11.1.141

[8] He, J., Wu, B., Zhong, H., Zhan, J., Zhu, L., Zhang, J., Zeng, Y., & Li, Z. (2024). Implementing mind mapping in small-group learning to promote student engagement in the medical diagnostic curriculum: a pilot study. BMC Medical Education, 24(1), 336. https://doi.org/10.1186/s12909-024-05318-0

[9] Israel, C., Pinto Zipp, G., D'Abundo, M., & Deluca, D. (2020). Mind Mapping to Enhance Critical Thinking Skills in Physician Assistant Education: A Randomized Controlled Study. J Allied Health, 49(2), 135-140.

[10] Jabade, M., & Nadaf, H. (2024). Assessing the efficacy of mind mapping as a learning technique to enhance information retrieval in nursing students. Journal of Education and Health Promotion, 13(1), 371. https://doi.org/10.4103/jehp.jehp_321_24

[11] Khayrun, M., Lataf, B., Bahriani, D., Hn, F., & Fauzan, M. (2024). The Influence of Mind Mapping Type Cooperative Learning Methods towards the Learning Outcomes of Islamic Religious Education Students at SMAN 12 Makassar: Pengaruh Metode Pembelajaran Kooperatif Tipe Mind Mapping terhadap Hasil belajar Pendidikan Agama Islam Peserta Didik di SMAN 12 Kota Makassar. HAWARI : Jurnal Pendidikan Agama dan Keagamaan Islam, 5, 1-10. https://doi.org/10.35706/hw.v5i1.12134

[12] Laar, S., Azure, J., Wilmot, D., & Akotuko Ayimbila, E. (2024). Facilitating Academic Gains with Artifacts of Learning: Effect Concept Mapping on Performance in Cellular Respiration. British Journal of Education Learning and Development Psychology, 12, 99-113. https://doi.org/10.37745/ijeld.2013/vol12n299113

[13] Liu, Z., Kong, X., Liu, S., & Yang, Z. (2023). Effects of computer-based mind mapping on students' reflection, cognitive presence, and learning outcomes in an online course. Distance Education, 44(3), 544-562. https://doi.org/10.1080/01587919.2023.2226615

[14] Luangkrajang, M. (2022). Use of Mind-Mapping in Language Learning: A Cognitive Approach. Theory and Practice in Language Studies, 12, 1616-1621. https://doi.org/10.17507/tpls.1208.18

[15] Machado, C. T., & Carvalho, A. A. (2020). Concept Mapping: Benefits and Challenges in Higher Education. The Journal of Continuing Higher Education, 68(1), 38-53. https://doi.org/10.1080/07377363.2020.1712579

[16] Nyagblormase, G., Gyampoh, A., James, H., Aidoo, B., & Ernest, Y. (2021). Effect of Mind Mapping as a Learning Tool on Online Learning of Chemistry. Studies in Learning and Teaching, 2(2), 47-58. https://doi.org/10.46627/silet.v2i2.75

[17] Pangandaman, H. (2023). Challenges Faced by Digital Immigrant Nurse Educators in Adopting Flexible Learning Options During the COVID-19 Pandemic: A Phenomenological Study [Research]. Journal of Client-Centered Nursing Care, 9(4), 309-316. https://doi.org/10.32598/jccnc.9.4.571.2

[18] Pangandaman, H., Mukattil, N., Lambayong, J. H., Abdulhan, M., Hayudini, R., Salve, M., Matumadi, I., Macalaba, S., Kadil, R., & Mangontawar, A. (2024). A systematic review of the effectiveness of flipped classroom approaches in developing clinical skills among nursing students [Review Article]. Journal of Research Development in Nursing and Midwifery, 21(1), 6-10. https://doi.org/10.61186/jgbfnm.21.1.4

[19] Pangandaman, H. K., Ali, N. D., Lambayong, J. H. C., & Ergas, M. L. G. (2019). Philippine higher education vis-à-vis education 4.0: A scoping review. International Journal of Advanced Research and Publications, 3(3), 65-69.

[20] Pangandaman, H. K., Boloron, R. P., Lambayong, J. H. C., Ergas, M. L. G., Raki-in, R. M., Mai-Alauya, S. A. M., & Mukattil, N. (2019). Innovative classroom pedagogy In nursing education: A systematic review. International Journal of Health Medicine and Current Research, 4(4), 1543-1549.

[21] Pangandaman, H. K., Hayudini, M. A. A., Mai-Alauya, S. A., Macarambon, R. d. R., Macalaba, S. P., Ali, N. A., Mukattil, N. P., Tan, A. R. A., Adju, A. S., & Hashim, R. S. (2025). Non-Pharmacological Interventions for Primary Stroke Prevention: A Systematic Review. Frontiers in Health Informatics, 14(2), 26-35.

[22] Pribadi, B. A., & Susilana, R. (2021). The Use of Mind Mapping Approach to Facilitate Students' Distance Learning in Writing Modular Based on Printed Learning Materials. Başlık, volume-10-2021(volume-10-issue-2-april-2021), 907-917. https://doi.org/10.12973/eu-jer.10.2.907

[23] Qingsong, X., Karanyathikul, A., & Kotchasit, S. (2024). Effect of Mastery Learning Combined with Mind Mapping Technique on the Students' Sculpture Performance Ability for Junior University Students. International Journal of Sociologies and Anthropologies Science Reviews, 4(5), 53-60. https://doi.org/10.60027/ijsasr.2024.4558

[24] Sagita, M., Yuliasri, I., Faridi, A., & Pratama, H. (2024). Digital Cartography of Thought: Enhancing EFL Reading Comprehension Through Mind Mapping. EVOLUTIONARY STUDIES IN IMAGINATIVE CULTURE, 1078-1094. https://doi.org/10.70082/esiculture.vi.1169

[25] Sajadi, A. S., Majd, P. M., Maroufi, S. S., & Abolghasemi, J. (2023). Mind mapping in recalling and retrieving core contents in anesthesia technology students. J Educ Health Promot, 12, 397. https://doi.org/10.4103/jehp.jehp_1423_22

[26] Shi, Y., Yang, H., Yang, Z., Liu, W., Wu, D., & Yang, H. H. (2022). Examining the effects of note-taking styles on college students' learning achievement and cognitive load. Australasian Journal of Educational Technology, 38(5), 1-11. https://doi.org/10.14742/ajet.6688

[27] Shrivastava, S. R., & Shrivastava, P. S. (2022). Facilitating Deep Learning Among Medical Students Through the use of Concept Mapping. Medical Journal of Dr. D.Y. Patil Vidyapeeth, 15(5), 660-661. https://doi.org/10.4103/mjdrdypu.mjdrdypu_601_20

[28] Su, Y.-S., Shao, M., & Zhao, L. (2021). Effect of Mind Mapping on Creative Thinking of Children in Scratch Visual Programming Education. Journal of Educational Computing Research, 60(4), 906-929. https://doi.org/10.1177/07356331211053383

[29] Voyer, D., Ronis, S. T., & Byers, N. (2021). The Effect of Notetaking Method on Academic Performance: A Systematic Review and Meta-Analysis. Contemporary Educational Psychology. https://doi.org/https://doi.org/10.1016/j.cedpsych.2021.102025

[30] Waffenschmidt, S., Knelangen, M., Sieben, W., Bühn, S., & Pieper, D. (2019). Single screening versus conventional double screening for study selection in systematic reviews: a methodological systematic review. BMC Medical Research Methodology, 19(1), 132. https://doi.org/10.1186/s12874-019-0782-0

[31] Xinge, L., & Baharudin, S. M. (2024). The Effectiveness of Interactive Mind Mapping Technique on Performance and Motivation of College English Students in China. Educational Administration: Theory and Practice, 30(4), 10036-10054. https://doi.org/10.53555/kuey.v30i4.6172

[32] Yang, K. H., Chen, H., Liu, C. J., Zhang, F. F., & Jiang, X. L. (2022). Effects of reflective learning based on visual mind mapping in the fundamentals of nursing course: A quasi-experimental study. Nurse Educ Today, 119, 105566. https://doi.org/10.1016/j.nedt.2022.105566

[33] Yenan, D., Zhu, S., & Li, W. (2021). Promoting Sustainable Creativity: An Empirical Study on the Application of Mind Mapping Tools in Graphic Design Education. Sustainability, 13, 5373.