

THE EFFECT MIND MAPPING MODEL IN SCIENCE LEARNING

Made Susilawati *

Universitas Persekutuan Guru 1945 NTT, Indonesia
Correspondensi author email: madesusilawati@gmail.com

Yuyun Suprpto

Aviation Polytechnic Surabaya, Indonesia

Loso Judijanto

IPOSS Jakarta, Indonesia

Imam Subasman

Bunga Bangsa Islamic University Cirebon, Indonesia

Tomi Apra Santosa

Bunga Bangsa Islamic University Cirebon, Indonesia

Abstract

The purpose of the study was to determine the influence of the mind mapping model on science learning. This type of research is a meta-analysis study. The data source came from an analysis of 11 national and international journals. Research inclusion criteria are research must be indexed Science and Technology Index (SINTA), DOAJ, Scopus and Web of Science (WOS), Research published in 2017-2023, research must be experimental methods, Research has a relationship between mind mapping models in science learning, Research must be in the form of international journals or proceedings, Journals must use Indonesian and English, and publications obtained by the Google Scholar database base, Frontiers journal, ERIC, ProQuest and Wiley. Data analysis by calculating the effect size of the entire study, heterogeneity test, analyzing publication bias and p-value test to test the hypothesis with JSAP application. The results concluded that the average value of summary effect size was 0.67 medium criteria. This finding explains that the mind mapping model has a relatively moderate positive effect on science learning. The moderator's analysis showed more effective mind mapping models at the educational level and sample size

Keywords: Mind mapping; Effect Size; Science Learning; Meta-analysis

INTRODUCTION

Science learning is a learning that leads students to have a scientific attitude and think critically in learning (Margunayasa et al., 2019). Science learning helps students understand the symptoms or phenomena that occur in the universe (Sutama et al., 2014; Suhaimi et al., 2022; Wang et al., 2015; Ichsan et al., 2022). Anindyta & Suwarjo (2014) science learning aims at how students are able to find theories, concepts and principles to be learned. Furthermore, science learning trains students to think systematically and

concretely in learning (Tiarini et al., 2019; Zhang, 2022; Dewi et al., 2022). However, science learning experiences many obstacles in school.

Science learning activities do not involve active students so that learning is teacher-centered (Ong et al., 2020; Nurtamam et al., 2023; Ulfah, 2018). The learning process does not lead students to think scientifically and critically (Putri et al., 2019; Luciana et al., 2023; Tompo et al., 2016; Abdi, 2014). Not only that, the results of the 2018 PISA survey conducted by the OECD showed that Indonesia's science literacy in science learning was relatively low, only obtaining a score of 396, ranking 71 out of 78 countries (Utomo et al., 2023; Elfira et al., 2023; Razak et al., 2022; Zulkifli et al., 2022; Oktarina et al., 2021). The low learning of science is also caused by the selection of inappropriate learning models (Adnan et al., 2021; Gumilar & Wardani, 2020).

The *mind mapping* model is one of the learning models that is suitable to be applied in science learning (Astuti, 2019; Nurroeni, 2013). The mind mapping learning model is a learning model that helps students remember learning material more effectively (Susilana, 2021; Leontyeva, 2021; Sezer, 2022). The student mind mapping model summarizes a learning material creatively and effectively with students with their minds (Cantona & Sudarma, 2020; Arulselvi, 2017). The *mind mapping* learning model of students in independent and group learning in mating a concept according to the mind map (Susilana, 2021; Yıldızlı et al., 2020).

Research (Marxy., 2017; Mudiono et al., 2018) the *mind mapping* model has a significant influence on student learning outcomes. Research Ristiasari et al., (2012) mind mapping learning model affects students' critical thinking skills. Furthermore, research from outside Indonesia (Sezer, 2022; Cengis , 2023; Polat et al., 2017) Explain that the mind mapping model is effective in improving students' understanding of concepts and thinking skills in learning.

The gap in this study, there are many studies on mind mapping learning models, there has been no research that describes the effect of mind mapping model size in science learning. Therefore, this study aims to determine the influence of the mind mapping model on science learning.

RESEARCH METHOD

This type of research is meta-analysis research. Meta-analysis is a type of research that collects primary data that can be analyzed statistically (Tamur et al., 2020; Rahman et al., 2023; Ichsan et al., 2023; Chamdani et al., 2022; Suryono et al., 2023; Shanti et al., 2022). The keyword for source search is a mind mapping model for science learning. The inclusion criteria are that research must be indexed by the Science and Technology Index (SINTA), DOAJ, Scopus and Web of Science (WOS), Research published in 2017-2023, research must be experimental methods, Research has a relationship between mind mapping models in science learning, Research must be in the form of international journals or proceedings, Journals must use Indonesian and

English, and publications obtained by the Google database base scholar, Frontiers journal, ERIC, ProQuest.

Furthermore, the steps in this meta-analysis research are determining inclusion criteria, searching and collecting data, analyzing and interpreting data based on effect size (Susanti et al., 2020; Borenstein & Rothstein, 2007). In the process of collecting data, 110 studies were obtained, there were only 11 studies that met the inclusion criteria. Collection instrument with code sheet. Code sheets are used to get all the information related to the data source. The information obtained consists of the year of publication, sample size, level of education and source of publication. Quantitative analysis by calculating the effect size value of the entire study, heterogeneity test, publication bias and p-value test with JASP software. The criteria for effect size values are guided by (Cohen, 1988) which is $0.00 < ES < 0.20$ low criteria; $0.20 < ES < 0.80$ medium criteria and $ES > 0.80$ high criteria.

RESULT AND DISCUSSION

From the analysis of 110 researchers from national and international journals about the influence of mind mapping models on learning, only 11 studies were obtained that had met the inclusion criteria. Research that has met the inclusion criteria is analyzed journal code, year of publication, sample size (N), education level, publication source, effect size value and effect size criteria. The results of the research analysis can be seen in table 1.

Table 1. Analysis of Research that Meets the Inclusion Criteria

Journal Code	Year	Sample Size	Education Level	Sumber publications	Effect Size	Effect size criteria
PL 1	2018	42	SMA	Google Scholar	0.67	Medium
PL2	2019	64	SMA	ERIC	0.82	High
PL3	2022	110	JUNIOR	ERIC	1.25	High
PL4	2022	88	SMA	Google Scholar	0.47	Medium
PL4	2021	75	JUNIOR	Frontier Journal	0.80	Medium
PL6	2021	100	SD	Wiley	0.76	Medium
PL7	2021	60	SD	Google Scholar	0.94	High
PL8	2023	42	PT	ProQuest	0.88	High
PL9	2022	38	PT	ProQuest	0.60	Medium
PL10	2021	48	SMA	Google Scholar	0.72	Medium

PL11	2023	90	JUNIOR	Google Scholar	0.91	High
Description: High School: High School; Junior High School: Junior High School; Elementary : Elementary School; PT : Higher Education						

Based on table 1. Explain from 11 studies that meet the criteria where 6 studies have medium criteria effect size values ($0.20 \leq ES \leq 0.80$) and 5 studies have high effect size criteria ($ES \geq 0.80$). Next, search the data source through five journal databases, namely Google Scholar, Frontier Journal, Wiley, ERIC, and ProQuest. In the study the sample size ranged from 38 – 110 students. The level of education analyzed comes from elementary, junior high, high school and higher education (PT). Furthermore, the analysis of *effect size* based on education level using a mind mapping model on science learning can be seen in Table 2.

Table 2. Effect Size Analysis by Education Level		
Education Level	Effect Size Value	Average Effect Size
SD	0.76	0.85
	0.94	
JUNIOR	1.21	0.97
	0.80	
	0.91	
SMA	0.87	0.67
	0.82	
	0.47	
	0.72	
Higher Education (PT)	0.88	0.74
	0.60	

Based on Tab 2.explained from the analysis of the effect of education level where the average effect size of the elementary level is 0.85, junior high school is 0.97, high school is 0.67 and PT is 0.74. These results show that *the mind mapping* model at the elementary and junior high school education levels has a high positive influence on students' science learning. The next step is to test the heterogeneity of 11 studies analyzed with Q statistics and selection of estimation models. The results of heterogeneity can be seen in the Table. 3

Table 3. Heterogeneity Test Results				
Type	n	Q _b	df (Q)	P-value
Fixed	11	76.109	10	<,001
Random	11			

Based on Table 3. To explain the value ($Q = 76.109$; $p < 0.001$) then the analyzed research is heterogeneously distributed. Furthermore, the model used in this study was a random effect model. Next, analyze publication bias with funnel plots. When meta-

analysis research is resistant to publication if it is symmetrical to the vertical line of the funnel plot (Öztürk et al., 2022; Yıldırım, 2022). Furthermore, to increase the validity of publication bias, it is necessary to carry out the *Roshental fail Safe* (FSN) test and Egger's test (Turgut, 2018; Ridwan, 2022). So, the results of the publication bias analysis with funnel plots can be seen in figure 1.

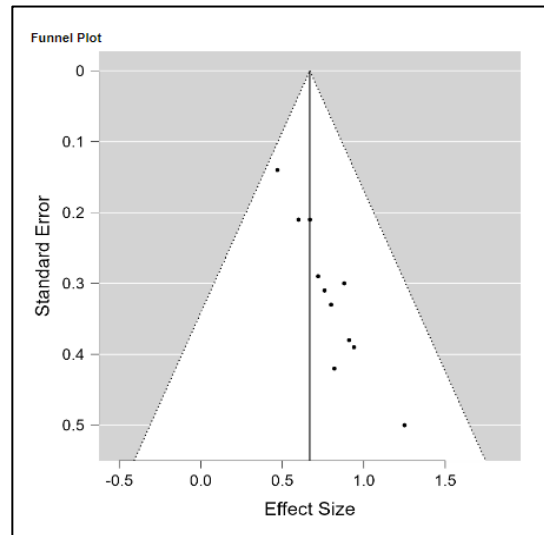


Figure 1. Standard Funnel Plot Error

Figure 1. Showing effect size analysis with funnel plots, it is not clear whether it is symmetric or asymmetric. Therefore, it is necessary to perform the *Roshental fail Safe* (FSN) test. *Roshental fail Safe* (FSN) test results can be seen in table 4.

Table 4. *Roshental fail Safe* (FSN) Test Results

<i>Bias Condition</i>	
Z value for the observed study	8.521
P value for the observed study	0.001
Alpha (α)	0.050
Tails	2
Z value for Alpha	1.05
Number of Observed Studies	11
FSN	299

Based on Table 4. explained from the analysis of the *Roshental fail Safe* (FSN) Test, an FSN value of 299 was obtained. Furthermore, the FSN test results are combined with the formula $FSN/5.n + k = 299/ 5.11 + 10 = 4.6 > 1$. In this analysis research no publication bias was found. The next step is to perform the Egger's test to find out whether the curve is symmetrical or asymmetric. Egger test results can be seen in Table 5.

Table 5. Egger's Test Results

	Z	p
Sei	2.189	0.029

Table 5. explaining the results of Egger's test obtained values ($Z = 2.189$; $p < 0.029$) then the curve is symmetrical. The findings concluded that in this study there was no publication bias. Next, perform a hypothesis test to calculate the summary effect size value. The results of the summary effect size test can be seen in Table 6.

Table 6. Summary Effect Size

Coefficients				
	Estimate	Standard Error	z	p
intercept	0.669	0.079	8.521	<.001

Note. Wald test.

Based on Table 6. shows that the test value summary effect size ($r_E = 0.079$; $Z = 8.521$; $p < 0.01$) with moderate criteria. The results of these findings conclude that the application of the *mind mapping* model has a moderate positive influence on science learning. Research (Prastiwi & Haryani, 2018; Utaminingsih & Widjanarko, 2022) The mind mapping model has a significant influence on improving student learning outcomes in science learning. The results of the study (Wibowo, 2017) explained that the mind mapping learning model can encourage increased student achievement.

The mind mapping model can train students to be more creative and innovative in presenting a learning material (Yıldızlı et al., 2020; Polat et al., 2022). The mind mapping model can help the process of mutual interaction between students and teachers. Research Octavianingrum et al., (2019) effective mind mapping model to train students to remember concepts and subject matter well. Furthermore, the application of the mind mapping model in science learning fosters students' creative and critical thinking processes in learning (Sihombing et al., 2018; Permana et al., 2019). Therefore, the application of the mind mapping model will provide a solution for teachers in creating an attractive atmosphere for students.

Conclusion

From this meta-analysis study, it can be concluded that the average value of summary effect size is 0.67 medium criteria. This finding explains that the mind mapping model has a relatively moderate positive effect on science learning. The moderator's analysis showed more effective mind mapping models at the educational level and sample size. The *mind mapping* model can encourage learning outcomes and the process of remembering subject matter faster.

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