

## EFFECTIVENESS OF MIND MAPPING TO INCREASE STUDENT'S SCIENTIFIC LITERACY

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### **Abstract**

*This study aims to determine the effectiveness of the mind maps model to improve students' science literacy. This type of research is a meta-analysis study. This study analyzed 14 effect sizes obtained from google scholar, DOAJ, ScienceDirect and ERIC databases. The inclusion criteria are publications published in 2019-2023, research comes from journals or proceedings indexed by SINTA, Scopus and WOS, Research has experimental classes with mind mapping models and conventional model control classes, research must be in Indonesian and English and data has sample size, standard deviation and mean value. Data analysis with the help of JASP applications. The results of the study concluded From the study it can be concluded that the results of the study concluded the value of summary effect size or mean effect size of  $rE = 0.937$ ;  $Z = 6.768$ ;  $p < 0.001$ . This finding explains that the mind mapping model is effective in increasing students' science literacy in learning with high categories.*

**Keywords:** Mind mapping; Effect Size; Science Literacy, Meta-analysis

### **Introduction**

Science literacy is a student's ability to solve a problem in the field of science (Noor, 2010; Rahman et al., 2023; Rita et al., 2021). Science literacy plays an important role in training students to cultivate scientific attitudes in learning (Muniati et al., 2023; Suwono, 2022). In addition, science literacy helps students be actively involved in understanding issues and ideas related to science (Adiwiguna et al., 2019). Alatas & Fauziah, (2020) science literacy is the main factor measured in the education curriculum system in Indonesia. Indonesia's science literacy is currently still relatively low (Aiman & Ahmad, 2020; chsan, 2023; Elfira et al., 2023).

Based on the results of the 2018 PISA survey conducted by the OECD, the literacy rate of Indonesian students obtained a score of 396, ranked 71 out of 78 countries

(Ichsan et al., 2022; Ni'mah, 2019; Utomo et al., 2023). The low level of student literacy is influenced by various factors. Furthermore, PISA research in, (Fakhriyah et al., 2017) low student literacy caused 29% of students only understand content, 34% process and 31% only understand the context of science learning. In the learning process, teachers only direct students to memorize science material (Ramli et al., 2022; Jufrida et al., 2019). The ability of students to solve science problems in learning is still low (Supriyadi et al., 2023; Atta et al., 2020; Adnan et al., 2021). Furthermore, the selection of learning models applied is not appropriate to encourage students' science literacy.

*Mind mapping* is a learning model that can train students in improving science literacy in learning (Artayasa et al., 2021; Hariyadi et al., 2023). *Mind mapping* is a learning model that requires students to make a creative summary of material according to the mind map (Alderbashi & Moussa, 2022; Polat et al., 2017). According to (Marxy, 2017) said that *the mind mapping* model can improve student learning outcomes. *Mind mapping* model students learn to remember learning material faster (Gündüzalp, 2023), so as to increase Shiva's science literacy.

Research (Alomery et al., 2022; Rahmatika et al., 2019) said the implementation of *the mind mapping model* can develop students' critical thinking skills and reading interest in learning. Priantin (2016) research on *mind mapping* models can encourage students' creative thinking skills and learning achievement. Yaniatun & Jaya (2022), the *mind mapping* learning model can improve student motivation and cognitive learning outcomes. Therefore, the gap in research is that many studies on *mind mapping* models have not been found research describing the effect of *mind mapping* model size on students' science literacy. Based on these problems, the study aims to determine the effectiveness of *mind maps* models to improve students' science literacy.

## **Research Method**

This research is a type of meta-analysis research. Research meta-analysis is a type that collects and analyzes primary research that can be analyzed statistically (Razak et al., 2021; Trullàs et al., 2022; Oktarina et al., 2021; Diah et al., 2022; Nurtamam et al., 2023). According to Borenstein et al., (2007) has stages consisting of determining inclusion criteria, 2) collecting empirical data and coding data, 3) data analysis and interpretation.

## **Eligibility Criteria**

In this meta-analysis research has inclusion criteria, namely publications published in 2019-2023, research comes from journals or proceedings indexed by SINTA, Scopus and WOS, Research has experimental classes with *mind mapping* models and conventional model control classes, research must be in Indonesian and English and the data has sample size, standard deviation and mean value. In the data collection process, only 14 studies that met the inclusion criteria were obtained (Table 2).

## Data Collection

The collection process is through google scholar, DOAJ, ScienceDirect and ERIC. Data search keywords are "mind mapping model", "science literacy" and "influence of mind mapping model on science literacy".

## Statistic Analysis

According to Glass in Setiawan et al., (2022), data analysis in meta-analysis research is calculating the value of effect size. The data analyzed illustrate the effectiveness of the mind mapping model on students' science literacy. According to Borenstein et al., (2009), the data analysis steps in the meta-analysis are 1) calculating the effect size value of the primary study; 2) conduct heterogeneity tests and determine estimation models; 3) check the publication bias of the entire study; 4) Calculate the p-value to test the hypothesis. Furthermore, the criteria for the size effect in the study are guided by (Cohen et al., 2007) can be seen in Table 1.

**Table 1.** Effect Size Value Category

Effect Size	Category Effect Size
$0.00 \leq ES \leq 0.20$	Low
$0.20 \leq ES \leq 0.80$	Medium
$ES \geq 0.80$	High

## Result and Discussion

From the 14 studies that met the inclusion criteria, the characteristics of the study consisted of journal code, year of publication, country, type of publication and effect size can be seen Table 2.

**Table 2.** Analysis of Research Characteristics Meeting Inclusion Criteria

Journal Code	Year	Country	Publication Type	Effect Size
C1	2022	Indonesian	Journal	2.06
C2	2020	Indonesian	Proceeding	1.17
C3	2020	Malaysia	Journal	0.64
C4	2019	Malaysia	Journal	0.96
C5	2022	Indonesian	Journal	0.41
C6	2021	English	Journal	0.82
C7	2021	Spanish	Proceeding	0.79
C8	2023	Egypt	Journal	1.08
C9	2023	China	Journal	0.66
C10	2023	China	Journal	0.95

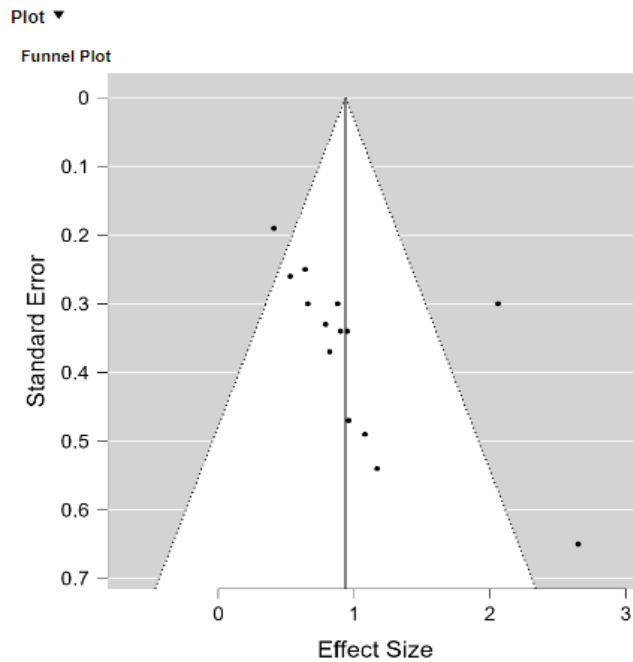
C11	2021	China	Journal	2.65
C12	2020	Turkish	Journal	0.90
C13	2021	Indonesian	Journal	0.88
C14	2020	Indonesian	Proceeding	0.53

Based on Table 2. From the analysis of research characteristics published in 2019-2020, research in the form of journals and proceedings from 7 countries was obtained, namely Indonesia, Malaysia, Egypt, England, China, Turkey and Spain. Furthermore, the effect size ranges from 0.41 to 2.65. According to the effect size criteria Cohen et al., (2007), from 14 effect size studies obtained 4 medium effect size criteria and 10 high effect size criteria. Next, conduct heterogeneity tests and determine the estimation models from the 14 studies analyzed. The results of the heterogeneity test can be seen in Table 3.

**Table 3.** Fixed and Random Effect Model

	<b>Q</b>	<b>Df</b>	<b>P</b>
Omnibus Test of Coeficients Model	47.907	1	< 0.001
Test of Resdual Heterogeneity	110.895	13	< 0.001

Based on Table 3. The results of the analysis obtained values (  $Q = 110.895$  ;  $P < 0.001$ ) then the effect size in this study is heterogeneously distributed. This study used a random effect model to analyze 14 studies. The next step is to check the publication bias of the 14 studies analyzed. To check whether or not there is publication bias in the meta-analysis, it is very suitable to use funnel plots and calculate the value of Roshental Fail Safe N (FSN) (Borenstein eta al., 2007; Suryono et al., 2023; Suparman et al., 2021; Joseph, 2023; Chamdani et al., 2022). The results of the analysis with the funnel plot can be seen in figure 1.



**Figure 1.** Standard Funnel Plot Error

Based on figure 1. Explaining the results of funnel plot analysis is difficult to draw a conclusion whether the funnel plot is symmetrical or asymmetric. Therefore, it is necessary to perform the Rosenthal Fail Safe N (FSN) test. Rosenthal Fail Safe N (FSN) test results can be seen in Table 4.

**Table 4.** Rosenthal Fail Safe N (FSN) Test Results

<b>File Drawer Analysis</b>			
	<b>Fail-safe N</b>	<b>Target Significance</b>	<b>Observed Significance</b>
Rosenthal	557.000	0.050	<.001

Based on Table 4. Explaining the results of the Rosenthal Fail Safe N (FSN) test of 557, then  $k = 14$  is entered in the formula  $557 / 5.14 + 10 = 557 / 80 = 6.97 > 1$ . The results concluded that in the meta-analysis there was no publication bias from the 14 studies analyzed. The next step is to calculate the summary effect size value to test the results of the hypothesis. The results of the summary effect size or mean effect size test can be seen in Table 5.

**Table 5.** Summary test results of Effect Size or Mean Effect Size

**Coefficients**

	Estimate	Standard Error	z	p	95% Confidence Interval	
					Lower	Upper
intercept	0.937	0.138	6.768	<.001	0.666	1.209

Note. Wald test.

Based on Table 4. Explaining the results of the summary effect size test, the interval coefficient value of 95% lower is 0.666 and upper is 1.209. Furthermore, the value ( $Z = 6.768$ ;  $p < 0.001$ ) and the overall effect size value of 0.937 with high criteria. These results show that the application of the mind mapping model is effective in increasing students' science literacy in the learning process.

Research by Yasir et al., (2022) the mind mapping model is effective for improving students' science literacy skills in learning. This finding is supported (Hayati et al., 2022) the mind mapping model has a positive impact on encouraging students' literacy skills in learning. Mind mapping can train students to learn in groups and independently to create an interesting range of subject matter (Oliver, 2014; Copriady & Osman, 2018). In addition, the mind mapping learning model can grow students' interest and motivation in learning (Liu & Chen, 2017). The mind mapping model of students is easier to understand and remember information in learning. Mind mapping learning students can learn independently and creatively. Akanbi et al., (2021) students' mind mapping models are easier to understand concepts or subject matter.

**Conclusion**

From the study, it can be concluded that the results of the study concluded the value of summary effect size or mean effect size of  $rE = 0.937$ ;  $Z = 6.768$ ;  $p < 0.001$ . This finding explains that the mind mapping model is effective in increasing students' science literacy in learning with high categories. The mind mapping learning model helps students more easily remember the subject matter.

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