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META-ANALYSIS OF MIND MAPPING IN VOCABULARY LEARNING OF THE PAST DECADE

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Abstract: The type of research used is meta-analysis research aimed at determining the level of effectiveness or quality of mind mapping in vocabulary learning, including at elementary, middle, high school, and college levels. This quality was examined using several previous research results that collected data with inclusion and exclusion conditions from the Google Scholar, DOAJ, and Scopus databases. The search results found up to 51 dates that met the requirements with the number of students (N), F-counts, t-counts, and r-counts. The results of data analysis obtained by the simulation software JASP showed that the impact on learning media vocabulary based on mind mapping is 73% significant, which included the High category. The highest level of education as a moderator variable, the impact of using mind mapping for teaching vocabulary is particularly significant at the high school level, with an estimated effect of 96%. Based on the number of participants, the application of mind mapping has more influence on participants totaling more than 30 students with an estimate of 0.928 (strong category), while the lowest effect is seen from the number of participants who collected more than 91 students with an estimate of 0.529, meaning that this mind mapping learning model is most appropriate to be applied in high school rows with more than 30 participants to maximize student learning outcomes.
Keywords: *level education; mind mapping; vocabulary.*

INTRODUCTION

Vocabulary acquisition plays a crucial role in mastering a language (Susanto, 2017). It cannot be claimed that vocabulary plays a vital role in

facilitating students to communicate both in spoken and written form (Noprianto & Purnawarman, 2019), Vocabulary is very high in learning a language whether in historical or not (Respati & Nur, 2019), English vocabulary is considered one of the sub-skills of the four integrated skills (writing, reading, speaking and listening) (Hasemhi, 2021), vocabulary is seen as an important component of language (Basuki et al., 2018), A good command of vocabulary enables someone to communicate effectively with others and vice versa (Octaviana et al., 2019), Vocabulary acquisition is given a lot of attention in second language classes (Otto, 2021), When learning a new language, learning vocabulary is key (Abduramanova, 2020), The importance of new words is very often emphasized, both in books and in verbal communication (Sabri et al., 2019), Without mastering vocabulary, the students will get difficulties when they are communicating with each other (Afzal, 2019; Octaviani et al., 2019).

This research is about mind-mapping media in learning vocabulary and how to influence mind-mapping media in vocabulary. Mind mapping is described by the Online business dictionary as a graphical approach for visualizing interactions between many ideas or pieces of information (Al Shdaifat et al., 2019), Using the mind mapping technique can create something new as it can stimulate thinking about the branch of association in which we have written (Megawati et al., 2021), Mind mapping is an educational technique that involves the visual implementation of ideas (Alhajaji et al., 2020), Mind mapping is a pattern that consists of at least images, symbols, and colors. These not only help students understand the vocabulary, but also make the students feel good, have fun, and engage their brains, eventually leading them to show interest in vocabulary mastery (Setianingsih et al., 2019), Mind maps have been used in foreign language teachings as a tool to activate Imparting and supporting students with previous knowledge of a topic them in organizing and recalling vocabulary (Luangkrajang, 2022), In other hand, Mind mapping is a helpful learning tool students brainstorming any topic and thinking creatively (Panggabean et al., 2019), In this study, mind-mapping technique was chosen to be used in increasing students' vocabulary (Delatu et al., 2020).

The use of mind mapping-based vocabulary learning media at the elementary school level is increasing simultaneously (Afriansya, 2019; Alwattar & Al-Balhan, 2018; Hanjani, 2018; Kim & Kim, 2012; Kusuma, 2015; Prabha & Abdul Aziz, 2020; Muhammad et al., 2019; Wu & Chen, 2018). Kusuma (2015) conducted an elementary school research discussing the results of The effect of Mind Mapping techniques on the Vocabulary Mastery with a total of 44 students and concluded that mind-mapping-based vocabulary learning media can improve student achievement with a count of r 0.801, while Kim (2012) conducted a study discussing learning styles and educational outcomes with a total of 31 students using Digital mind map as a Study tool in elementary english class and obtained a t-score of 14.19. And also Alwattar & Al-Balhan (2018) conducted a study on the effectiveness of the mind mapping strategy on the proficiency level of sixth-grade students in learning vocabulary with a total of 60 students and obtained an F-score of 1,684.

Some previous studies have also conducted research at the junior high school level such as (Ansi & Sambayu, 2020; El-beltagy, 2019; Khalil et al., 2019; Luangkrajang, 2022; Riska, 2019; Sahrawi, 2013; Selvarajasingam et al., 2021; Syafrizal et al., 2018; Zahra, 2015). Syafrizal et al (2018) has conducted research on the effectiveness of using mind mapping strategy and making inference toward students vocabulary achievement with a total of 30 students and obtained the result that mind mapping-based vocabulary learning media can improve student learning outcomes with an F value of 0.120, While Sahrawi (2013) conducted research at the junior high school level which discusses the Effectiveness Of Mind Mapping For Teaching Vocabulary with 112 students and obtained the results that vocabulary learning with Mind mapping media can improve learning outcomes with a calculated r value of 0.950, While Zahra (2015) conducted research with a total of 32 students at middle school and concluded that mind mapping-based vocabulary learning media can improve students' learning outcomes with a calculated r-value of 0.750.

Furthermore, in terms of studies dealing with the use of mind mapping research in senior high school, there are many studies has been carried out (Elkareem et al., 2019; Heidari & Karimi, 2015; Khodabandeh, 2021; Nia & Pratama, 2019; Rahayu et al., 2019; Waloyo, 2017; Wikandari, 2022). (Heidari & Karimi, 2015) has conducted research at the senior high school level which discusses the effect of mind mapping on vocabulary learning can improve student learning

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outcomes with a total of 40 students and obtained an F score of 721,210. (Wikandari, 2022) also researched learning vocabulary using mind mapping can improve students learning outcomes with a total of 29 students and obtained an r value of 0.422, the last one is (Khodabandeh, 2021) has conducted the research about the impact mind mapping can improve students vocabulary with a total of students 35 and obtained t score is 19.248.

Finally, the use of mind mapping based for vocabulary learning media is increasing at college level (Al-Jarf, 2015; Alhajaji et al., 2020; Badr & Abu-Ayyash, 2019; Cao & Ismail, 2022; Hakim, 2022; Khudhair, 2016; Liu, 2016; Masoud & Ibrahim, 2017; Putra, 2012; Saed & Omri, 2019). Putra (2012) for example, has conducted research at the College level on the Application of Mind Mapping Techniques in Vocabulary Teaching with a total of 40 students and obtained an r value of 0.349, and also Masoud & Ibrahim (2017) researched mind mapping to teach vocabulary can improve students learning outcomes with a total of 62 students with an F score of 0.007, the last one is Alhajaji (2020) conducted the research about The study investigating the effect of employing Games, Mind-mapping and Twitter Hashtags as the GMT technique, on female Saudi university students' achievement in English vocabulary can improve learning outcomes with a total of 64 students and obtained a t value is 0.122.

From All the statements above, the information was gained that a lot of research related to mind mapping-based vocabulary learning media was done in learning. But so far there has been no research that further discusses the magnitude of the impact of the use of mind mapping on learning outcomes at all levels of education. And in this article, the author explains about impact mind mapping to teach vocabulary at all education levels such as collage, Senior High School, Junior High Scholl, and Elementary School. Conducting a meta-analysis on mind mapping in vocabulary learning has several important reasons, including: (1) providing empirical evidence: Meta-analysis allows us to collect, integrate and analyze existing research results on the use of mind mapping in vocabulary learning. Thus, we can have a more comprehensive view of the effectiveness and success of using this method in vocabulary learning; (2) gain a deeper understanding: Through meta-analysis, we can analyze data from various studies conducted previously. This allows us to gain a deeper understanding of the variability of the results, including the factors that influence the effectiveness of mind mapping in vocabulary learning; (3) providing practical guidance: The results of the meta-analysis can provide practical guidance for teachers, instructors, or educational practitioners in deciding whether mind mapping is an effective method to use in vocabulary learning. By looking at the overall results of existing research, meta-analysis can help provide recommendations that are based on empirical evidence; (4) identify the weaknesses and strengths of the method: Through meta-analysis, we can identify the weaknesses and strengths of using mind mapping in vocabulary learning. By knowing this, we can identify areas for improvement or development, as well as understand when and in what contexts the method can provide the greatest benefit; and (5) providing a foundation for further research: Meta-analysis can open the door for further research on the use of mind mapping in vocabulary learning. The results of this meta-analysis can serve as a foundation for researchers to identify remaining knowledge gaps and design more sophisticated follow-up studies.

By conducting a meta-analysis on mind mapping in vocabulary learning, we can gain a more comprehensive understanding, provide practical guidance, and identify the strengths and weaknesses of this method. In addition, meta-analysis can also serve as a foundation for further research that can continue to enrich our understanding of the use of mind mapping in vocabulary learning.

METHOD

This research is a kind of meta-analysis research. Meta-analysis is research conducted by researchers in a way to collect research data, summarize, review, and analyze research data from several previous research results (Ratu et al., 2022). The inclusion criteria (eligibility criteria) refer to research characteristics related to population issues based on level, country, year, variables related to "mind mapping-based vocabulary Learning Methods". The eligibility criteria refer to the characteristics of the publication, which is concerned in that year (studies published since 2012-2022), using full english, and the type of publication (Article, Journal, Thesis). While the exclusion criteria are used to obtain articles that can be used for statistical analysis of meta-analysis from articles obtained based on inclusion criteria. The

exclusion criteria are research data in the form of the number of samples (N), the percentage of each error indicator, the Effect Size (ES) value, and the Standard Error (SE) (Syaharuddin et al., 2021). The procedure research, according to Figure 1:

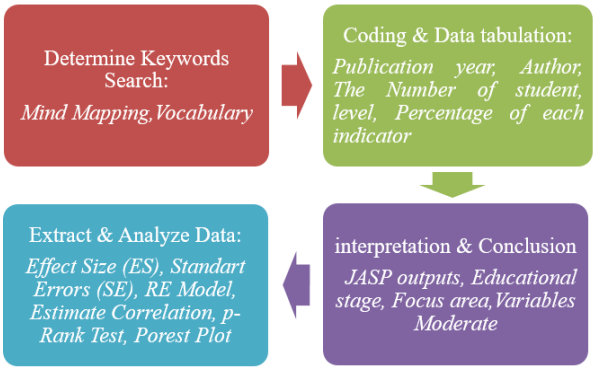

Figure 1. *The procedure research*

(1) Search articles from the Google Scholar indexer database, DOAJ, and Scopus according to the criteria mentioned above. (2) Microsoft Excel encoding and tabulation includes year of publication, author name, country, level, class, value N, F-count, T-count, and R-count. (3) Converting F and t values to r values with the formula:

$F = \sqrt{t^2}$ (1)

$t = \sqrt{F}$ (2)

$r = t \frac{t}{\sqrt{t^2+N-2}}$ (3)

(5) Calculation of Effect Size (ES) and Standard Error (SE) values

$z = ES = 0{,}5 \times In \frac{1+r}{1-r}$ (4)

$SE = \sqrt{\frac{1}{n-3}}$ (5)

(6) Run simulations and data analysis with JASP software. (7) The analysis of the results found from the articles is a data reference. (8) Draw conclusions from the results of the meta-analysis.

Table 1. *Classification of Glass's effect sizes*

Effect Size (ES)	Category
$ES \leq 0.15$	Negligible effect
$0.15 < ES \leq 0.40$	Small effect
$0.40 < ES \leq 0.75$	Moderate effect
$0.75 < ES \leq 1.10$	High Effect
$1.10 < ES \leq 1.45$	Very High Effect
$1.45 < ES$	High Influence

RESULTS AND DISCUSSION

Data selection results

The results of the data set search yielded 113 data, according to the inclusion and exclusion criteria 51 and the data did not match the inclusion and exclusion criteria is 62. The data collected in this study are the Fischer test score (F), student test (t), correlation test (r), and amount of research data (N). During the learning method, levels can also be processed or further data analysis can be carried out with certain conditions. From the collected data that there are values of F and t, these two values need to be changed to the value of r, as well as the value of ES according to equation (4) and SE according to equation (5). Regarding the conversion results according to Table 2 below.

Table 2. *Results of data selection and ES and SE values*

No	Study	Level	N	R	ES	SE	Category
1	Study 1	Junior High School	25	0.872	1.342	0.213	High Effect
2	Study 2	Elementary School	31	0.935	1.696	0.189	High Effect
3	Study 3	Collage	40	0.349	0.364	0.164	Small Effect
4	Study 4	Junior High School	112	0.950	1.831	0.096	High Effect
5	Study 5	Collage	150	0.716	0.899	0.082	Moderate effect
6	Study 6	Collage	60	0.009	0.009	0.132	Negligible effect
7	Study 7	Junior High School	32	0.750	0.974	0.186	Moderate effect
8	Study 8	Elementary School	26	0.486	0.531	0.209	Moderate effect
9	Study 9	Collage	50	0.782	1.050	0.146	High Effect
10	Study 10	Elementary School	23	0.584	0.669	0.224	Moderate effect
11	Study 11	Collage	40	0.937	1.714	0.164	High Effect
12	Study 12	Elementary School	18	0.509	0.561	0.258	Moderate effect
13	Study 13	Collage	74	0.112	0.112	0.119	Negligible effect
14	Study 14	Junior High School	25	0.806	1.117	0.213	High Effect
15	Study 15	Collage	62	0.327	0.339	0.130	Small Effect
16	Study 16	Senior High School	36	0.892	1.431	0.174	High Effect
17	Study 17	Elementary School	44	0.306	0.316	0.156	Small Effect
18	Study 18	Collage	60	0.745	0.961	0.132	Moderate effect
19	Study 19	Collage	100	0.068	0.068	0.102	Negligible effect

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20	Study 20	Elementary School	80	0.394	0.416	0.114	Small Effect
21	Study 21	Collage	151	0.338	0.352	0.082	Small Effect
22	Study 22	Collage	21	0.316	0.327	0.236	Small Effect
23	Study 23	Elementary School	71	0.248	0.253	0.121	Small Effect
24	Study 24	Junior High School	77	0.304	0.313	0.116	Small Effect
25	Study 25	Junior High School	20	0.929	1.648	0.243	High Effect
26	Study 26	Senior High School	69	0.917	1.569	0.123	High Effect
27	Study 27	Junior High School	91	0.114	0.115	0.107	Small Effect
28	Study 28	Junior High School	116	0.278	0.286	0.094	Small Effect
29	Study 29	Senior High School	60	0.275	0.283	0.132	Small Effect
30	Study 30	Senior High School	66	0.606	0.703	0.126	Moderate effect
31	Study 31	Collage	64	0.015	0.015	0.128	Negligible effect
32	Study 32	Collage	90	0.214	0.217	0.107	Small Effect
33	Study 33	Elementary School	66	0.009	0.009	0.126	Negligible effect
34	Study 34	Senior High School	69	0.917	1.569	0.123	High Effect
35	Study 35	Senior High School	60	0.028	0.028	0.132	Negligible effect
36	Study 36	Collage	72	0.695	0.858	0.120	Moderate effect
37	Study 37	Collage	60	0.666	0.804	0.132	Moderate effect
38	Study 38	Senior High School	50	0.973	2.154	0.146	High Effect
39	Study 39	Collage	38	0.753	0.980	0.169	High Effect
40	Study 40	Collage	40	0.076	0.076	0.164	Negligible effect
41	Study 41	Collage	33	0.872	1.341	0.183	High Effect
42	Study 42	Senior High School	35	0.958	1.924	0.177	High Effect
43	Study 43	Collage	60	0.900	1.475	0.132	High Effect
44	Study 44	Collage	79	0.117	0.117	0.115	High Effect
45	Study 45	Collage	30	0.130	0.131	0.192	Negligible effect
46	Study 46	Junior High School	40	0.536	0.598	0.164	Moderate effect
47	Study 47	Senior High School	22	0.422	0.450	0.229	Moderate effect
48	Study 48	Collage	42	0.410	0.435	0.160	Moderate effect
49	Study 49	Senior High School	64	0.810	1.127	0.128	High Effect
50	Study 50	Collage	42	0.735	0.940	0.160	Moderate effect
51	Study 51	Senior High School	29	0.154	0.155	0.196	Small Effect

Based on Table 2. Above, which contains 51 eligible data. Divided into 7 data from the elementary school level, 9 data from the junior high school level, 11 data from the high school level, and 24 from the college level.

Next, the authors performed a hypothesis test and a publication bias test on the collected data. In a meta-analysis using JASP software seen while concluding, the z and p values are shown in the coefficient table. The hypothesis is as follows:

Hypothesis 1: Using mind mapping is effective to improve student learning outcomes in vocabulary learning

Hypothesis 2: There is no publication bias from the data used in the research

Hypothesis test

In the first stage, a heterogeneity test was carried out to see the categories data whether using fixed or random effects. As for the results according to Table 3.

Table 3. *Fixed and random effects*

	Q	df	P
Omnibus test of Model Coefficients	75.082	1	< .001
Test of Residual Heterogeneity	964.368	50	< .001

From JASP's results obtained via vocabulary learning media using mind mapping analysis, it can be seen that the data are heterogeneous with a large Q=964,368 and a value of p<0.001. Next, consider the estimate of the mind mapping in Vocabulary Learning according to Table 4.

Table 4. *Output JASP coefficients*

	Estimate	Standard Error	z	P
Intercept	0.734	0.085	8.665	< .001

Note. Wald test.

In Table 4 on the coefficients, you can see that the z-score is 8,665 and the p-value is 0.001, less than the 5% significance level (0.05). This means that the hypothesis is accepted, in this case, the true effect size is not equal to 0, in other words, all vocabulary learning based on mind mapping

has a significant impact on student learning outcomes 75%, while 25%% of other factors are influenced. a publication bias test was performed. This test is performed to see if the data collected can be used as representative of the population. This test can be viewed by the value in the returned rank correlation and regression test. Based on the results using JASP, the output shown in Table 5 and Table 6 below is obtained.

Table 5. *Rank correlation*

	Kendall's τ	p
Rank test	0.217	0.026

Table 6. *Regression test*

Regression test for Funnel plot asymmetry ("Egger's test")	z	P
	1.381	0.167

Table 7. *File drawer analysis*

	Fail-safe N	Target Significance	Observed Significance
Rosenthal		23957.000	0.050< .001

In Table 5 for rank correlation and regression, Kendall's score on mind mapping learning media can be seen as 0.217, indicating a large correlation coefficient between effect sizes and variance. In Table 6, the value of z represents the magnitude of the regression coefficient of 1.381 and the p-value of 0.167 is greater than the value of 0.05, showing that the second hypothesis is accepted, in other words, no identified publication bias. Table 7 shows how many studies that have an average effect size equal to 0 that should be added to the in the research sample so that the research results free from publication bias.

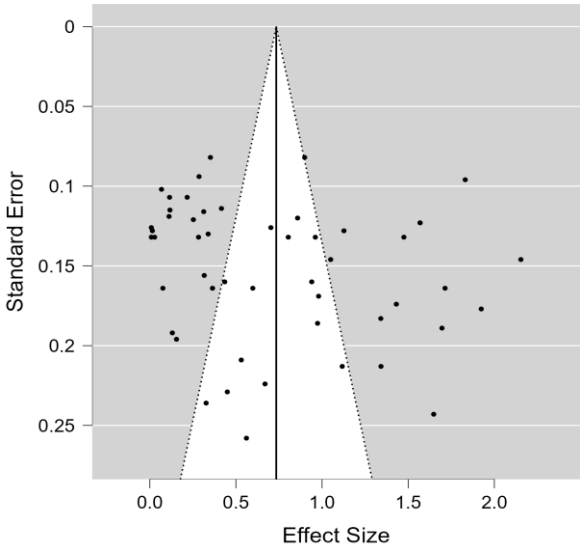

Figure 2. *Funnel plot*

Based on the results of the publication plotted in Fig. above, it can be seen that no missing studies are marked as open circles, all closed circles. In addition, from the forest plot image, a summary effect value of 0.73 with words, which is impacted by another effect of the mind mapping learning model, increases student motivation and learning outcomes by 73%, while 27% through other factors are influenced.

Finally, the author conducted a moderator variable test to see the level of influence of several other variables such as level of education, country, publication years, and a number of participants. The results are according to the table below.

The influence of mind mapping on vocabulary based on education level and country

Moderator variable analysis is needed to determine how much influence mind mapping as a vocabulary learning media has on education and country levels.

Table 8. *The influence of mind mapping based on level education and country*

Variable	Interval	N	Q-Test	Estimate	I^2 (%)	RE Model	Category
Level	College	24	286.787	0.569	92.556	0.57[0.57,0.90]	Moderate effect
	Senior High School	11	251.259	1.039	96.191	1.04[0.60,1.84]	High Effect
	Junior High School	9	226.849	0.900	95.248	0.90[0.49,1.31]	High Effect
	Elementary School	7	75.570	0.606	93.410	0.61[0.18,1.03]	Moderate effect
Country	Indonesia	20	452.141	0.788	95.902	0.79[0.51,1.07]	High Effect
	Non-Indonesia	31	452.757	0.698	94.018	0.70[0.49,091]	Moderate effect

The table above shows that the effect of using Mind Mapping media in learning vocabulary at the educational level is relatively strong at the high school level with an estimate of 1,039 (high effect), while at the college level it is 0,569 (moderate effect), at the junior high school level it is 0,900 (high effect), and finally at the elementary level it is 0,606 (moderate effect). This shows that mind mapping-based vocabulary learning media is very suitable for use at the senior high school level due to the following reasons:

(1) Concept linkage: At the high school level, students need to develop a deeper understanding of the relationships between concepts in language. Mind mapping allows students to illustrate the

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relationships and associations between words, clarifying language structures and patterns. By seeing these visualizations, students can more easily associate and remember new vocabulary.

(2) Information organization: Mind mapping helps students organize information in a structured way. In vocabulary teaching, students can group words by topic, category, or context of use. This helps students understand the context in which words are used and makes them easier to remember and apply in relevant situations.

(3) Visual and creative activity: Mind mapping involves visual and creative aspects, which suits the learning styles of many students at the high school level. Students can use colors, images, and symbols to enrich their mind maps, create stronger associations in their minds, and ease comprehension and retention of vocabulary.

(4) Development of visual thinking skills: Mind mapping involves the use of visual thinking skills, which are important in developing vocabulary comprehension. Students can draw visual representations of words, describing synonyms, antonyms, or other relationships. This helps students see the big picture of vocabulary and understand how words are interrelated, thus improving their comprehension and use in the right context.

(5) Active participation and collaboration: Mind mapping allows students to actively participate in the learning process. They can create their own mind maps, collaborate in groups, and share their ideas and knowledge with classmates. This activity not only strengthens vocabulary understanding, but also builds students' social and cooperation skills.

(6) Use of technology: In today's digital age, there are many tools and apps that allow students to create mind maps digitally. This can increase students' interest and enrich their learning experience. Students can use interactive mind mapping software or apps, with features such as colors, images, and easy editing, thus making the learning process more interesting and interactive.

By using mind mapping in vocabulary teaching in senior high school, students can develop deeper understanding, improve visual thinking skills, and actively engage themselves in the learning process. Mind mapping can also enrich students' learning experience through visual, creative and collaborative aspects. And also the use of mind mapping in Indonesia is very suitable for use because the estimate is 0.788 (high effect) while outside Indonesia the estimate is 0.698 (moderate effect).

The influence of mind mapping on vocabulary based on moderators' variable

At this stage, the author analyzes the data to determine the level of influence of learning outcomes using mind mapping when viewed based on publication years, and Amount of participants. The following table presents JASP output based on publication years and Amount of Participant.

Table 9. *The influence of mind mapping based on publication years and participants*

Variable	Interval	N	Q-Test	Estimate	I^2 (%)	RE Model	Category
Publications	2012-2019	30	534.322	0.734	94.508	0.73[0.53,0.94]	Moderate effect
Year	2020-2022	21	964.368	0.734	94.850	0.73[0.57,0.90]	Moderate effect
Amount of Participants	0-30	10	48.978	0.688	81.575	0.69[0.37,100]	Moderate effect
	31-60	21	358.277	0.928	94.316	0.93[0.65,1.20]	High Effect
	61-90	14	257.796	0.543	95.005	0.54[0.26,0.83]	Moderate effect
	More Than 91	6	245.568	0.529	98.108	0.59[0.05,1.13]	Moderate effect

At the publication years interval, mind mapping has the same effect on vocabulary learning because the estimates for 2012-2019 and 2020-2022 are the same as the estimate of 0,734 in the high category. Finally, in the category of a number of participants, mind mapping is very influential with the number of participants being more than 31 people with an estimate of 0.928.

CONCLUSION

Based on the results of this study, Mind Mapping is very influential on Vocabulary learning where the results show that 73% of the value of its influence on student learning outcomes is included in the High category. Then, it can be seen from the moderator table that the most influential on Mind Mapping media in vocabulary learning is at the high school level with an estimate of 1,039, the effect on student learning outcomes which is the very strong category. Meanwhile, at the College level, the effect is quite low the estimate is only 0.569 which is included in the low category. there is no difference in effect size or impact before or after Covid-19 it can be seen in the publication years with an RE model of 73%. And also the use of mind mapping

in Indonesia is very suitable for use because the estimate is 0.788, while outside Indonesia the estimate is 0.698. Furthermore, from the moderator table. Meanwhile, judging from the number of participants, 31-60 had the most influence on vocabulary. which has little influence found in participants with several More Than 91 with an estimate of 0.529.

From the above findings, it can be seen that high school has a very high impact therefore we suggest that future researchers examine the research focus 1. the implementation of mind mapping for teaching vocabulary at the high school level further 2. examine the shortcomings of mind mapping in teaching vocabulary at the college level because we found that the effect size in college is only 57%.

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