JPPIPA (Jurnal Penelitian Pendidikan IPA)

Vol.7 No.1 2022

http://journal.unesa.ac.id/index.php/jppipa

A META-ANALYSIS STUDY OF IMPLEMENTING ACTIVE LEARNING STRATEGY TO IMPROVE STUDENTS' COGNITIVE LEARNING OUTCOMES IN JUNIOR AND SENIOR HIGH SCHOOL FOR BIOLOGY SUBJECT

Alni Isdayanti[1], *Nani Aprilia*[2]

[1,2]Biology Education Study Program, Faculty of Teacher Training and Education, Ahmad Dahlan University

Abstract

The quality of good education can be seen from the learning process which is carried out. A few phenomena occur in relation to learning problems which is caused by students' lack of interest and poor learning outcomes in Biology subject. This research aims to find out the improvement of students' learning outcomes in Junior and Senior High School Biology subject using active learning strategy through meta-analysis study. This research was a literature review study through meta-analysis research design with a proportion. The articles were found on the website of international journal, accredited national journal, and non-accredited national journal, proceedings, undergraduate thesis, and repository. Those articles were validated by adapting three criteria, which were up to date (last 10 years) and PTK with Minimum Completeness Score of 75. Therefore, 30 articles were obtained from two international journals, four national journals, 17 accredited journals, and three undergraduate theses. The data were analyzed using Cohen's effect size technique. The result of the meta-analysis research showed that an active learning strategy was able to improve students' cognitive learning outcomes in Biology subject with an effect size average of 0.857 in the big category. The learning model that had the highest effect size score was a team quiz possessing effect size score of 0.975 in the big category. The result of the Q test for homogeneity was 26.833 and the p-value was 0.001, meaning homogeneous. The Z test result was 78.540 and the p-value was 0.01 which showed significant analysis results. The florest plot result of students who completed was around 86% which showed that students who completed the KKM were more than 75%. The result of Eiger's Test p-value was 0.527, meaning that there was no bias on publication of the meta-analysis study which was conducted. The Fail-Safe N score was 65485 and p-value was 0.001, meaning that there was no bias on publication of meta-analysis study, so it could be scientifically justified.

Keywords: Meta-analysis, Active learning, Cognitive learning outcomes, Biology

[1]**Correspondence Address:**
Biology Education Study Program, Faculty of Teacher Training and Education, Ahmad Dahlan University, DI Yogyakarta, Indonesia
E-mail: alniisdynt@gmail.com

p-ISSN: 2527-7537
e-ISSN: 2549-2209

INTRODUCTION

Learning is essentially a process of organizing, organizing the environment around students to carry out a series of learning processes (Mulyasa, 2003). Learning aims to provide guidance or assistance to students as a whole, make students active, achieve learning goals effectively and take place in pleasant conditions (Risman, 2017). The number of main learning problems is that students do not concentrate in participating in learning activities so as to make students less concentrated in participating in learning activities. This has an impact on the value of students who do not reach the Minimum Completeness Criteria, which is 75. So an appropriate learning strategy is needed, namely an Active learning strategy (Kurniawan et al. 2017).

Biology learning is one of the subjects given starting from Primary School, Junior High School and Senior High School education levels, biology learning is called science learning. Science learning examines a series of events, facts and concepts about living things (Rahmah, 2016). Meanwhile, at the Senior High School level, it is called Biology. Learning biology has its own characteristics compared to other natural sciences, learning biology means an effort to recognize life processes in the environment.

Along with the many scientific studies that discuss the same topic with various characteristics or commonly referred to as a literature review. The purpose of the literature review is to obtain a theory that can support a thorough problem solving which is carried out by reviewing previous studies to obtain accurate conclusions. There are four types of literature review methods, namely Narrative review, Descriptive Review, Vote Counting and meta analysis. Of the four types of methods, meta-analysis is a method that focuses on a quantitative approach, namely effect size (King et al 2005).

Meta-analysis aims to answer questions concerning the problem of differences between the experimental group and the control group based on research results that will continue to grow from time to time. The main objective of the meta-analysis is to find the effect size. (Retnawati et al, 2020).

Based on this background, a study entitled " A Meta-Analysis Study of Implementation Active Learning Strategy to Improve Students' Cognitive Learning Outcomes In Junior High School and Senior High School For Biology Subject ".

METHOD

The type of research used is Literature Review by looking for relevant references in accordance with research on the implementation of Active learning strategies to improve students' cognitive learning outcomes in biology subjects. The research design used in the literature review is a meta-analysis of the type of proportion. Research data collection is carried out by researchers by browsing articles that can be accessed online.

The keywords in article search are "Learning Outcomes", "Active Learning", "Biology" obtained 60 articles then there are 30 articles that meet 3 criteria, namely up to date in the last 10 years, CAR and KKM 75. So articles from 2 international journals, 4 national journals, 17 accredited journals and 3 theses.

In meta-analysis research, there are 5 sequences carried out to arrive at the research results, namely: first, formulating the problem, by arranging the questions to be answered, the construct to be studied, and the research population. Second, look for literature that fits the research objectives. Third, evaluate the research by reading various literature and making conclusions. Fourth, analyze and interpret the literature. Fifth, present the results in written form.

RESULTS AND DISCUSSION

The results of collecting research data that will be carried out in meta-analysis obtained 30 appropriate articles related to active learning strategies in improving students' cognitive learning outcomes in biology subjects. The 30 articles came from journals, proceedings, theses and dissertations. Data from table 1 is a data preparation table

Table 1. The results of the data preparation table

Study	p	N	SE	w	w.ES	LB	UB	$w.ES^2$
Data 1	0.90	20	0.0671	222.22	200.00	0.62	0.88	180
Data 2	0.85	34	0.0607	271.06	231.20	0.63	0.87	197.2
Data 3	0.78	36	0.0693	208.29	162.00	0.63	0.9	126
Data 4	0.88	26	0.0627	254.72	225.33	0.65	0.9	199.3
Data 5	0.82	38	0.0629	252.87	206.29	0.66	0.91	168.28
Data 6	0.94	32	0.0428	546.13	512.00	0.72	0.89	480
Data 7	0.84	32	0.0642	242.73	204.80	0.69	0.94	172.8
Data 8	0.85	26	0.0708	199.73	169.00	0.68	0.96	143
Data 9	0.86	28	0.0661	228.67	196.00	0.69	0,95	168
Data 10	0.84	32	0.0642	242.73	204.80	0.71	0.96	172.8
Data 11	0.86	21	0.0764	171.50	147.00	0.69	0.99	126
Data 12	0.75	40	0.0685	213.33	160.00	0.71	0.98	120
Data 13	0.77	26	0.0826	146.47	112.67	0.68	100	86.66
Data 14	0.83	30	0.0680	216.00	180.00	0.71	0.98	150

Study	p	N	SE	w	w.ES	LB	UB	w.ES^2
Data 15	0.92	26	0.0523	366.17	338.00	0.75	0.95	312
Data 16	0.94	16	0.0605	273.07	256.00	0.74	0.98	240
Data 17	0.94	34	0.0404	614.13	578.00	0.78	0.94	544
Data 18	0.92	26	0.0523	366.17	338.00	0.76	0.96	312
Data 19	0.86	21	0.0764	171.50	147.00	0.7	1.01	126
Data 20	0.75	24	0.0884	128.00	96.00	0.71	1.06	72
Data 21	0.96	23	0.0425	553.05	529.00	0.82	0.98	506
Data 22	0.78	37	0.0677	218.33	171.13	0.77	1.04	134.125
Data 23	0.91	34	0.0486	422.62	385.33	0.82	1.01	351.33
Data 24	0.92	25	0.0543	339.67	312.50	0.81	1.03	287.5
Data 25	0.86	35	0.0591	285.83	245.00	0.81	1.04	210
Data 26	0.84	31	0.0661	229.16	192.20	0.79	1.05	161.2
Data 27	0.90	42	0.0453	487.42	441.00	0.85	1.03	399
Data 28	0.82	17	0.0925	116.98	96.33	0.76	1.12	79.333
Data 29	0.81	31	0.0710	198.61	160.17	0.80	1.08	129.1667
Data 30	0.90	32	0.053	355.56	320.00	0.80	1.00	288
TOTAL				**8542.69**				**6641.744**

Based on Table 1. The above contains 30 data that meet the criteria, divided into 17 articles at the SMA/MA education level and 13 articles at the SMP/MTs education level. So that the Effect Size (SE) and Standard Error (SE) are obtained in table 2.

Table 2. *Effect Size* (SE) dan *Standard Error* (SE)

Study Name	Writer's Name	Effect Size (ES)	Standar Eror (SE)
Data 12	Nasution (2017)	0.750	0.067
Data20	Astuti (2016)	0.750	0.061
Data 13	Carroline *et al*. (2018)	0.769	0.069
Data 3	Kurniawan *et al*. (2015)	0.778	0.063
Data 22	Supiana (2017)	0.784	0.063
Data 29	Wahdah *et al*. (2018)	0.806	0.043
Data 5	Widodo *et al*. (2011)	0.816	0.071
Data 28	Afkalorin *et al*. (2019)	0.824	0.066
Data 14	Radjabessy (2019)	0.833	0.064
Data 26	Fatmawati *et al*. (2017)	0.839	0.076
Data 7	Indrawati (2019)	0.844	0.069
Data 10	Rachyuni (2016)	0.844	0.083
Data 8	Astuti (2020)	0.846	0.068
Data 2	Rohmah *et al*. (2016)	0.853	0.052
Data 9	Kurniawan (2019)	0.857	0.061
Data 11	Mansur (2019)	0.857	0.040
Data 19	Mardiana *et al* (2020)	0.857	0.052
Data 25	Akmaliya *et al* (2016)	0.857	0.076
Data 4	Julyanti (2019)	0.885	0.088
Data 1	Annabila *et al* (2018)	0.900	0.043
Data 30	Wirdanti *et al*. (2020)	0.900	0.053
Data 27	Haya (2019)	0.905	0.068
Data 23	Sunaryo *et al*. (2020)	0.912	0.049
Data 24	Waluyo (2015)	0.920	0.054
Data 15	Jumat (2017)	0.923	0.059
Data 18	Mulyono *et al*.(2017)	0.923	0.066

Study Name	Writer's Name	Effect Size (ES)	Standar Eror (SE)
Data 6	Aisyiyah *et al*. (2012)	0.938	0.045
Data 16	Utami *et al*. (2016)	0.938	0.093
Data 17	Sugio (2014)	0.941	0.071
Data 21	Parnahayati (2020)	0.957	0.069

Before determining the model to be used, we need to test the homogeneity of all Effect Sizes from the research collected as follows:

a. Homogenity Test

Test is used to determine the appropriate model to analyze the effect of Active learning strategy on students' cognitive learning outcomes on biology material. The hypothesis on the heterogeneity test is as follows:

H_0 : *Fixed Effect Model*

H_a *: Random-Effect Model*

Model The decision making criteria for the heterogeneity test at a significant level of 5% are as follows:

a) If p value < 0.05 then the hypothesis H0 is rejected or the hypothesis Ha accepted means that the appropriate model for analyzing is the Random-Effect Model

b) If p value > 0.05 then the hypothesis H_0 is accepted or the hypothesis H_a is rejected, meaning that the appropriate model for analyzing is the fixed effect model. Homogeneity test results can be seen in table 3.

Tabel 3. Table of Homogeneity Test Results for

Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	6329.825	1	< .001
Test of Residual Heterogeneity	26.805	29	0.582

Note. *p* -values are approximate.

Table 5 shows that the Q value is 26,805 and the p-value is 0.001. These results indicate that the p-value < 0.05 is 0.001 < 0.05.

The decision-making criteria for the Z-test at a significant level of 5% are carried out in the following way:

a) If the p value <0.05 then the hypothesis H0 is rejected or the hypothesis Ha is accepted, meaning that there is a significant effect

b) The active learning strategy on student biology learning outcomes. If the p value > 0.05 then the hypothesis H0 is accepted or the hypothesis Ha is rejected, meaning that there is no significant effect between active learning on students' biology learning outcomes. The following is a Random Effect model based on the Z test which can be seen in the table below:

Tabel. 4 Test Result Z

Coefficients

					95% Confidence Interval	
	Estimate	Standard Error	z	p	Lower	Upper
intercept	0.863	0.011	79.560	< .001	0.841	0.884

Note. Wald test.

Tabel 4.4 shows that the Random-Effect Model shows that there is a positive and significant

relationship between Active learning strategy on students' cognitive learning outcomes with a z-value of 79,560 and a p-value of 0.01. These results can be seen from the Florest Plot which can be seen in Figure 1.

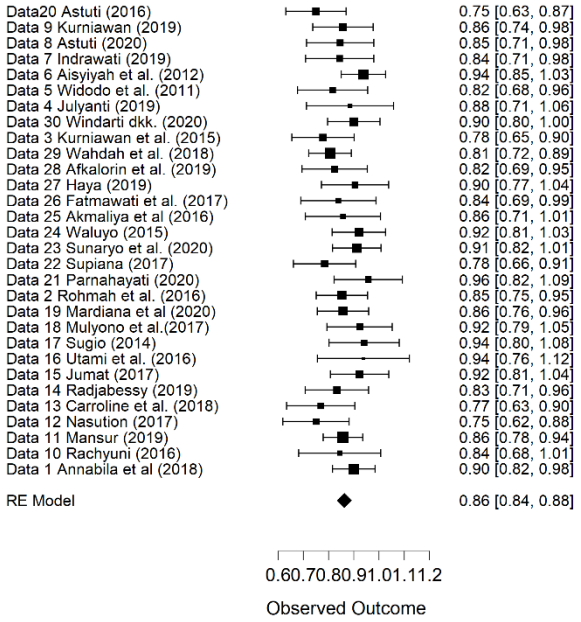

Figure 1. Florest Plot

These results indicate that the average student learning outcomes that have been completed after the implementation of the Active Learning Strategy have increased by about 86% and this result is much better than the student's aggregate learning mastery with criteria of 75. From the 30 articles used as meta-analysis, the lower limit of the effect size was 0.63 and the upper limit of the effect size is 0.87.

b. Publication Bias

The publication bias test is to find out whether the data that has been collected can be used as a positive sample from the population (Mansurah et al, 2021). Publication bias indicates the possibility of finding research results that only accept the null hypothesis (Ho) or research that only publishes results that are as expected (Kesuma, 2020). The publication bias test can be seen from the Eiger's Test and Fail Safe N scores. The decision making criteria based on the Eiger's Test scores are as follows:

a. If the p-value > 0.05 then there is no publication bias in the meta-analysis study.

b. If the p-value < 0.05 then there is publication bias in meta analysis study

The following is a publication bias test based on the Eiger's Test value which can be seen in table 5.

Tabel 5. Nilai Eiger's Test

Regression test for Funnel plot asymmetry ("Egger's test")

	z	p
sei	-0.644	0.520

Source: Output JASP

Table 5 shows that the p-value is 0.520. This shows that the p-value > 0.005 is 0.520 > 0.05.

The publication bias test can also be seen based on the Fail Safe N value. The decision making criteria based on the Fail Safe N are as follows:

a. If the p value < 0.05 and the value 5K+10, then there is no publication bias in the meta analysis

b. If p value > 0.05 dan nilai 5K + 10 > Fail Safe N, then there is publication bias in the meta analysis.

The following is a publication bias test based on Fail Safe N which can be seen in table 6 bellow :

Table 6. Fail-Safe N

File Drawer Analysis

	Fail-safe N	Target Significance	Observed Significance
Rosenthal	66823.000	0.050	< .001

Sumber : Output JASP

Tabel 4.8 shows that the Fail Safe N value is 65485 and the p-value is 0.001. This shows that the Fail Safe N value > 5K + 10 is 66823 > 5.30 + 10 = 160 and the p-value < 0.05 is 0.001 < 0.05.

DISCUSSION

This study aims to determine the increase in students' cognitive learning outcomes on biology material through a meta-analysis study and to find out whether there is a publication bias towards the application of Active Learning Strategy in improving students' cognitive learning outcomes on biology material.

Effect size is a quantitative index used to summarize study results in a meta-analysis. That is, the effect size reflects the magnitude of the relationship between variables in each study. The choice of effect size index depends on the type of data used in the study (Retnawati et al, 2018). Of the 60 articles collected, there are 30 articles that are appropriate and are summarized in the form of a data preparation table. The calculation of the effect size is carried out on the raw data contained in the statistical data of journal articles, dissertations, proceedings and theses.

Homogenity Test

Test was conducted to determine the Summary Effect model to be used in the analysis. The results of the homogeneity test analysis are interpreted in table 4.3. The results of the analysis obtained a Q value of 26,805 and a p-value of 0.001 that is 0.001 < 0.05. These results mean that the 30 study effect sizes used for analysis are homogeneous. This means that the data is homogeneous so that the model that is suitable for analyzing the average effect size is the Random-Effect Model. The results of this analysis support the results of previous research conducted by Tamur et al, (2021) that if the p-value < 0.05 means a heterogeneous effect size distribution, the estimation model is in accordance with the Random-Effect Model. The proof is strengthened by using the homogeneity test. Meanwhile, to classify effect size, it is necessary to pay attention to the following criteria: 1) small means that the effect size is around 0.20; 2) medium means the effect size is around 0.50 and 3) large means the effect size is around 0.80 (Cohen in Faisol, 2021).

The homogeneity test was also used to see whether there was an effect of Active Learning Strategy on cognitive learning outcomes in students' biology material using the Random-Effect Model (Subarkah et al, 2018). Hypothesis testing is based on the value of the Z test, the Z test is one of the statistical tests used to see if the population used has an appropriate average or not on student learning outcomes. Because the p-value < 0.05, i.e. 0.001 < 0.05, the hypothesis H0 is rejected and the hypothesis Ha is accepted. These results indicate that the learning outcomes of biology after the application of Active Learning Strategy become more than 75. The results of this study are in line with research conducted by Faisol (2021) that student learning outcomes obtained 79.60 and p-value <0.05 that is 0.001 <0.005, this means that Ha is accepted and H0 is rejected. These results explain that the PAI learning outcomes of students after the application of teaching methods are more than 75. So it can be said that there is a significant influence between Active Learning Strategy on students' cognitive learning outcomes on biology material. In addition, Active Learning Strategy contributes to students' cognitive learning outcomes of 0.860.

Florest Plot

Student learning outcomes show that the average student learning outcomes that are completed after the implementation of the Active Learning Strategy increase by 86% and this result is much better than the students' aggregate learning completeness with the criteria of 75%, this is in accordance with the statement of Retnawati et al, (2018) which states that the aggregate of students who completed the meta-analysis of the proportions should not be less than 75%.

Publication Bias

The publication bias test is to find out whether the data that has been collected can be used as a positive sample from the population (Mansurah et al, 2021). publication bias in the meta-analysis of bias indicates inaccurate research information or results because the published articles do not represent the research conducted. This publication of bias will also indicate the possibility of finding research results that only accept the null hypothesis (Ho) or research that only publishes results that are as expected (Kesuma, 2020). The publication bias test is used to see if there is no publication bias problem. The publication bias is used to see

whether there is publication bias or not. The publication bias test can be seen from the value of Eiger's Test and Fail Safe N. The decision making criteria is based on the value of the Eiger's Test. Table 4.7 shows that the p-value is 0.520. This shows that the p-value > 0.005 is 0.520 > 0.005. So it can be said that there is no publication bias in the meta-analysis studies in the meta-analytical studies that have been carried out. The results of this analysis support the research that has been done previously by Subarkah et al, (2018) which states that when compared with the value of = 0.05, if the p-value = 0.05 then there is no indication of publication bias.

The publication bias test can also be seen based on the Fail Safe-N value. Fail Safe-N is an approach suggested by Roshental in Retnawati et al, (2018) which aims to overcome the problem of publication bias. The results in table 4.8 show that the Fail Safe N value is 66823 and the p-value is 0.001. This shows that the Fail Safe N value > 5K + 10 is 66823 > 5.30 + 10 = 160 and the p-value < 0.05 is 0.001 < 0.05. So it can be said that there is no publication bias problem in the meta-analysis study. Because the meta-analysis study does not have a publication bias problem, this research is considered accurate and scientifically justifiable (Roshental in Retnawati et al, 2018). The results in this study are in line with the research of Mansurah et al, (2021) which states that to test for publication bias, it can be done with the condition that the Fail Safe-N value > 5K + 10. Obtained 21,912 > 5.45 + 10 21,912 > 235. So, the sample used in this study indicated that there was no publication bias.

CONCLUSION

Based on the results of the research and discussion, conclusions can be drawn from the meta-analysis study of the implementation of Active Learning Strategy on students' cognitive learning outcomes in junior high and high school biology material as follows:

1. Overall Active Learning Strategy can improve cognitive learning outcomes in students' biology material by the effect size is 0.860 in the high category which indicates that Active Learning Strategy can improve students' biology learning outcomes
2. The value of the Eiger's Test obtained a p-value of 0.520. This shows that the p-value > 0.005 is 0.520 > 0.005. so that in the meta-analysis studies conducted there is no publication bias. In the Fail Safe N value, the value is 66823 and the p-value is 0.001. This indicates that the Fail Safe N value > 5K +10 is 66823 > 5.30 + 10 = 160 and the p-value < 0.05 is 0.001 < 0.05. So that in the meta-analysis study there is no publication bias problem, this research is considered accurate.

REFERENCES

Candra, & Retnawati, H. (2020). A Meta-Analysis of Constructivism Learning Implementation Towards The Learning Outcomes on Civic Education Lesson. *International Journal of Instruction*, *13*(2), 835–846. https://doi.org/10.29333/iji.2020.13256a

Faisol, M. A. (2021). Efektivitas Metode Pengajaran Dalam Meningkatkan Hasil Belahar PAI Siswa SD: Meta-Analisis. *Paper Knowledge . Toward a Media History of Documents*, *15*(1), 1–14. https://doi.org/DOI: 10.30957/cendekia.v15i1.650.

Kesuma, A. T. (2020). Hubungan Ketrampilan Self-Regulated Learning dengan Hasil Belajar Siswa (Studi Meta Analisis). *Madaris: Jurnal Guru Inovatif*, 1–30. http://jurnalmadaris.org/index.php/md/article/view/189

King, W. R. ., & He, J. (2005). Understanding the Role and Methods of Meta-Analysis in IS Research. *Communications of the Association for Information Systems*, *16*(October). https://doi.org/10.17705/1cais.01632

Kurniawan, M. K., Keliat, N. R., Krave, A. S., & Hutagaol, D. R. (2017). Penerapan Pembelajaran Aktif Berbasis Tugas Proyek untuk Meningkatkan Hasil Belajar IPA Siswa Kelas VII B SMP Kristen 2 Salatiga Tahun Pelajaran 2016 / 2017 Active Learning Application Based on Project Assignment in Improving Science Learning Results of S. *Bioedukasi*, *10*(1).

Mansurah, R., Wahyuningsih, S., Insani, N., & Syaharuddin. (2021). Meta-Analisis: Model Kooperatif Two Stay Two Stray Terhadap Hasil Belajar. *Elementary*, *4*(2), 97–102. http://journal.ummat.ac.id/index.php/elementry

Mulyasa, E. (2003). *Kurikulum Berbasis Kompetensi : Konsep, Karakteristik dan Implementasi* (Edisi 1). Bandung : Remaja Rosdakarya.

Rahmah, I. M. (2016). Program Studi Pendidikan Guru Madrasah Ibtidaiyah. *Jurnal Pendidikan*, *3*, 1–130.

Retnawati, H., Apino, E., Kartianom, K., Djidu, H., & Anazifa, R. D. (2018). *Pengantar Analisis Meta* (Issue July).

Risman, Z. (2017). Pengaruh Model Pembelajaran Kolaboratif Terhadap Hasil Belajar IPA Peserta Didik Kelas V MIS DDI Bosalia Kabupater Jeneponti. In *UIN Alaudin*

Makassar (Vol. 4). UIN Alaudin Makassar.

Subarkah, I., & Retnawati, H. (2018). *Studi Meta Analisis Pengaruh Scientific Approach dalam Meningkatkan Hasil Belajar Pendidikan Agama Islam*. *2*(2), 42–56.

Tamur, M., Jehadus, E., Negara, H. R. P., Siagian, M. D., Marzuki, M., & Sulastri, R. (2021). Pembelajaran Selama Krisis COVID - 19 : Meta - Analisis dari Sudut Hasil Belajar yang Diukur. *Jurnal Riset Teknologi Dan Inovasi Pendidikan (JARTIKA)*, *4*(1), 1–9. https://doi.org/10.36765/jartika.v4i1.413