



Meta-analysis of the Effect of Jigsaw Model Based on Hybrid-Based Learning on Students' Critical Thinking Skills

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Abstrak

Tujuan penelitian ini untuk mengetahui pengaruh model pembelajaran jigsaw berbasis hybrid based learning terhadap keterampilan berpikir kritis siswa. Jenis penelitian ini adalah penelitian kuantitatif dengan pendekatan meta-analisis. Sumber data berasal dari analisis jurnal nasional dan internasional. Kriteria inklusi yaitu penelitian harus berasal dari jurnal atau prosiding terindeks Scopus dan SINTA; Penelusuran sumber data berasal dari Google scholar, ERIC, IEEE dan Wiley; Penelitian harus memiliki kelas eksperimen dan kelas kontrol; Penelitian harus terbit dari tahun 2017-2023; Penelitian memiliki keterkaitan dengan variabel penelitian dan penelitian memiliki nilai (t), (r) dan (f). Analisis data adalah analisis statistik kuantitatif dengan bantuan aplikasi JSAP. Hasil penelitian ini menyimpulkan nilai rata-rata summary effect size atau mean effect size dari keseluruhan studi (ES = 0.896 ; p < 0.001) dengan kriteria sangat tinggi. Temuan ini menjelaskan model pembelajaran jigsaw berbasis hybrid based learning memberikan pengaruh yang besar terhadap keterampilan berpikir kritis siswa.

Kata Kunci: Model Jigsaw, Pendidikan, Hybrid Based learning, Berpikir Kritis, Meta-analisis

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Abstract

The purpose of this study was to determine the effect of the jigsaw learning model based on hybrid learning on students' critical thinking skills. This type of research is quantitative research with a meta-analysis approach. Data sources come from analyzing national and international journals. Inclusion criteria are research must come from Scopus and SINTA-indexed journals or proceedings; Data source searches come from Google Scholar, ERIC, IEEE, and Wiley; Research must have experimental and control classes; Research must be published from 2017-2023; Research has a relationship with research variables and research has a value (t), (r) and (f). Data analysis is quantitative statistical analysis with the help of the JSAP application. The results of this study concluded that the average value of the summary effect size or mean effect size of the entire study (ES = 0.896; p < 0.001) with very high criteria. This finding explains that the jigsaw learning model based on hybridized learning has a great influence on students' critical thinking skills.

Keywords: *Jigsaw model, Education, Hybrid Based learning, Critical thinking, Meta-analysis*

Introduction

Critical thinking skills are a skill that students must have in facing the era of the industrial revolution 4.0 towards the revolution 5.0 society (Suryono et al., 2023; Zulyusri et al., 2022; Elfira et al., 2023; Rahman et al., 2023). Critical thinking skills are very important for students to solve problems in life (Mulyanto et al., 2020; Listiqowati et al., 2022; Zulkifli et al., 2022; Supriyadi et al., 2023). Ristanto et al., (2022) Critical thinking skills help students analyze, evaluate and provide ideas in solving a problem factually. Furthermore, critical thinking skills need to be developed in formal and non-formal education (Haris et al., 2015; Luciana et al., 2023; Fradila et al., 2021; Jamaludin et al., 2022).

But the fact is that students' critical thinking skills in Indonesia are still relatively low (Priadi et al., 2021). This can be seen from the results of the Trend in International Mathematics and Science Study (TIMSS) survey in 2015 Indonesian students only scored 397, 45th out of 47 member countries (Nurtamam et al., 2023; Ichsan et al., 2022; Rahman et al., 2023; Suharyat et al., 2022; Putra et al., 2023). The low critical thinking skills of students in Indonesia are influenced by many factors. The learning process does not involve students to be active so that students do not have critical thinking skills (Novayani & Nufida, 2015; Usman et al., 2022; Farizi et al., 2019). The teacher only involves students in memorizing and understanding the material (Mahmudah, 2020). Furthermore, the teacher-centered learning process makes it difficult for students to understand the subject matter (Farisi et al., 2017; Kurniahtunnisa et al., 2016; Suhaimi et al., 2022; Santosa et al., 2021). Therefore, teachers must provide solutions by implementing learning models that encourage students' critical thinking skills.

The jigsaw learning model is a learning model that can encourage students to think critically (Susanti, 2019; Leniati & Indarini, 2021). The jigsaw learning model helps students be more active and skilled in presenting their ideas in learning (Handayani, 2020; Wati & Anggraini, 2019). Research results (aputra et al., (2019) The jigsaw learning model encourages students to work together and think critically in learning. The jigsaw learning model helps students learn independently so that it can improve student learning outcomes (Kahar et al., 2020; Ramdani, 2016; Cashata et al., 2023; Widyaningrum & Harjono, 2019). Furthermore, the jigsaw learning model based on hybrid based learning provides one solution to improve students' critical thinking skills.

Hybrid based learning is a learning model that can be done online through the internet (Kumaş, 2022; Cheerapakorn & Chatwattana, 2023). Hybrid based learning helps students be more creative and innovative in learning (Rukayah et al., 2022). Furthermore, hybrid-based learning makes it easier for students to understand and access learning information (Essa, 2023). So, through the jigsaw learning model based on hybrid based learning can support the quality of student learning.

Previous research results (Harefa et al., 2022) stated that the application of the jigsaw learning model can improve students' understanding of learning concepts. Wahyuni & Rahmiati (2022) jigsaw learning model has a significant effect on improving student learning outcomes. Research results Cashata et al., (2023) The application of the jigsaw model in encouraging students' problem solving skills. But in reality, many studies on the jigsaw learning model are still few studies describing the effect size of the hybrid-based learning model on students' critical

thinking skills. Based on the above problems, this study aims to determine the effect of jigsaw learning model based on hybrid based learning on students' critical thinking skills.

Methods

This research is a meta-analysis study. Meta-analysis is a type of research that analyzes previous research that can be analyzed statistically (Razak et al., 2021; Ichsan et al., 2023; Santosa et al., 2021; Nastiti et al., 2021). The steps in meta-analysis research are determining inclusion criteria; data search and coding process; data analysis and interpretation (Aisyah & Usdiyana et al., 2022; Firman et al., 2019).

Literature Search

The process of searching for data sources in this meta-analysis through google scholar database; ERIC; ScienceDirect and Wiley. Literature search keywords for research data are jigsaw learning model, hybrid-based learning-based jigsaw model; and jigsaw model on critical thinking skills. The source selection process with the Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) method consisting of 1) identification; 2) screening; 3) eligibility; and 4) Included.

Inclusion Criteria

The inclusion criteria in the study are 1) research must be from SINTA or Scopus indexed journals or proceedings; 2) research must be published in 2018-2023; 3) research must have an experimental class of the jigsaw learning model and a control class; 4) research must be in Indonesian and English; and 5) research has complete data on (t), (r) and (f) values and sample size ≥ 20 .

Data Analysis

Data analysis in the meta-analysis with the help of JSAP application. Data analysis only calculates: 1) the effect value of each study that has met the inclusion criteria and summary effect size; 2) conduct a heterogeneity test and determine the estimation model; 3) check for publication bias and 4) calculate the p-value to test the research hypothesis (Cohen et al., 2007; Borenstein & Hedges, 2009). The effect size criteria in this study can be seen in table 1.

Table 1. Effect Size Value Criteria

Effect Size	Criteria
$0.00 \leq ES \leq 0.20$	Ignored Effect Size
$0.20 \leq ES \leq 0.50$	Low Effect Size
$0.50 \leq ES \leq 0.80$	Moderate Effect Size
$0.80 \leq ES \leq 1.30$	High Effect Size
≥ 1.30	Very High Effect Size

Source : Cohen's in (Aisyah & Usdiyana, 2013; Rahman et al., 2023; Karim et al., 2023; Suharyat et al., 2022)

Result and Discussion

Result

Based on the search for data sources through the google scholar database, ScienceDirect, Wiley, ERIC and Plos ONE, 9 studies were obtained that met the inclusion criteria. Research that meets the inclusion criteria is calculated the effect size value which can be seen in table 2.

Table 2. Effect Size of Studies Meeting Inclusion Criteria

N	Author	Index	N	Effect Size	Criteria
1	Wati & Anggraini, (2019)	Sinta	49	0.75	Moderate
2	Handayani, (2020)	Sinta	50	0.83	Moderate
3	Tamur et al., (2021)	Sinta	62	1.03	High
4	Muliawan (2023)	Sinta	76	0.80	Moderate
5	Silva & Dominguez (2023)	Scopus	106	0.97	High
6	Purwaningsih &	Sinta	74	1.26	Very High

	Harjono, (2023)				
7	Leniati & Indarin (2021)	Sinta	12	0.43	Low
8	Nurmala & Corebima, (2015)	Sinta	28	0.94	High
9	Wayan et al., (2020)	Sinta	90	0.89	High

Table 2. explains from the overall effect size analysis, there are 3 studies that have an effect size value range of 0.73 - 0.83 with moderate criteria, 4 studies have an effect size value range of 0.89 - 0.97 with high criteria, 1 study has an effect size value of 1.26 very high criteria and 1 study has an effect size value of 0.43 low criteria. Furthermore, testing the heterogeneity of the entire study can be seen in table 3.

Table 3. Heterogeneity Test Results

Model	n	Hedge's	SE	95% CI	Q	P	Decision
Fixed	9	0.769	0.016	[0.670 ; 0.984]	34.15	0.000	Reject H ₀
Random	9	0.896	0.178	[0.456 ; 1.319]			

Based on table 3. The value of the heterogeneity test (Q = 34.15; P = 0.00 < 0.05) then the overall effect size is heterogeneously distributed and the meta-analysis model used in this study is random effect size. Furthermore, the average effect size value is 0.896 with high criteria. This result explains that the jigsaw learning model based on hybrid based learning has a high effect on students' critical thinking skills. Furthermore, checking the publication bias with funnel plot. The results of checking publication bias can be seen in Figure 1.

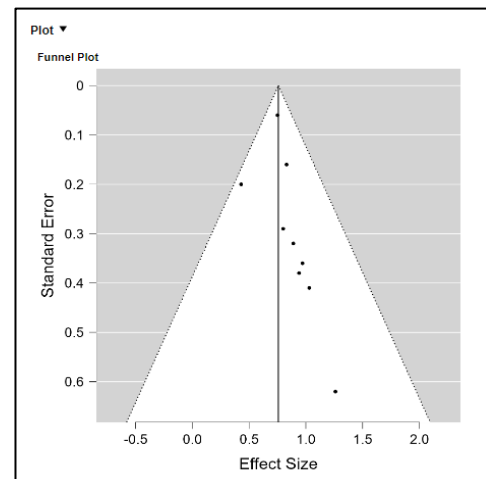


Figure 1. Funnel Plot Standar Error

Furthermore, checking for publication bias with the funnel plot in Figure 1. shows that the effect size data is symmetrical on a vertical curve which has a small risk of publication bias. Furthermore, it is necessary to conduct the Rosenthal Fail safe N (FSN) test to determine the possibility of publication bias. The results of the Rosenthal fail safe N (FSN) test can be seen in table 4.

Table 4. Rosenthal Fail Safe Test Results N

Classic Fail Safe N	
Z-Value for observed studies	14.906
The P-value for observed studies	0.001
Alpha	0.050
Tails	2.000
Z for alpha	1.342
Number of observed studies	9.000
Number of missing studies that would bring p-value to > alpha	447.000

Based on table 4. shows the value (Z = 14.906; P < 0.05) so that 447 / (5.9 + 10) = 8.12 > 1 means that in this meta-analysis study there is no publication bias. Next, calculate the p-value to test the hypothesis. This aims to determine the effect of the jigsaw learning model on the overall research based on random effect size. The p-value test results can be seen in table 5.

Table 5. Results of Overall Research Analysis Based on Random Effect Model

Estimation model	n	Z	P	Effect Size	Standard error	95% CI
Random Effect Model	9	4.17	0.00	0.89	0.167	[0.456; 1.319]

Based on table 5. Explaining the overall analysis of the effect size of 0.895 with high criteria. Furthermore, the value ($Z = 4.178$; $P < 0.001$) then the application of the jigsaw learning model based on hybrid based learning effectively improves students' critical thinking skills compared to conventional learning models.

Discussion

Based on table 5. Explaining the overall analysis of the effect size of 0.895 with high criteria. Furthermore, the value ($Z = 4.178$; $P < 0.001$) then the application of the jigsaw learning model based on hybrid based learning effectively improves students' critical thinking skills compared to conventional learning models (Saputra et al., 2019; Usman et al., 2022). Not only that, the jigsaw learning model can encourage students' cognitive development so as to encourage students to think critically (Cunqueiro, 2016 ; Herawati et al., 2019). Research results Gusta & Christina (2020) the application of the jigsaw learning model can improve student independence and learning outcomes.

Furthermore, checking for publication bias plays an important role in meta-analysis research (Balemen, 2018; Öztürk et al., 2022). In this study, the overall effect size of each researcher is resistant to publication bias. This result can be seen in the funnel plot and the results of the fail safe N test. The funnel plot shows that the overall effect size is symmetrical on the vertical curve and the results of the fail safe n test are as follows (447.00 ; $8.12 > 1$) then the study is resistant to publication bias. Publication bias has an influence on the p-

value test in the research hypothesis test (Yıldırım, 2022; Yusuf, 2023; Aspiranti et al., 2021). Thus, the entire hybrid-based learning model jigsaw study was valid in this meta-analysis.

The jigsaw learning model based on hybrid-based learning is effective for improving students' critical thinking skills. The results can be seen from the p-value test in table 5. Where the value ($Z = 4.178$; $P < 0.001$) means that the jigsaw model based on hybrid based learning is effective in encouraging critical thinking skills compared to conventional learning models. Research results (Sari et al., 2019) the application of the jigsaw learning model effectively improves students' critical thinking skills. thinking skills provide an important role for students in solving a problem in the learning process (Sutoyo et al., 2023; Kizilhan, 2022; Rahman et al., 2023). Furthermore, the jigsaw learning model based on hybrid based learning can be carried out by teachers and students through the internet network (Rukayah et al., 2022; Mart et al., 2021). Therefore, the jigsaw model based on hybrid-based learning really needs to be applied by teachers to encourage students' critical thinking skills at school.

Conclusion

From this study it can be concluded that the average value of the summary effect size or mean effect size of the entire study ($ES = 0.896$; $p < 0.001$) with very high criteria. This finding explains that the jigsaw learning model based on hybrid based learning has a great influence on students' critical thinking skills. The jigsaw learning model based on hybrid based learning can encourage students' critical thinking skills.

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