



The Influence of the Jigsaw Model Based on Higher Order Thinking Skills on Students 21st Century Skills : Meta-Analysis

Everhard Markiano Solissa^{1*}, Kartini Marzuki², Arniati³, Dhini Mufti⁴, Tomi Apra Santosa⁵

¹ Dosen Pendidikan Bahasa dan Sastra, FKIP, Universitas Pattimura

² Dosen Ilmu Pendidikan, FIP, Universitas Negeri Makassar

³ Dosen Ekonomi Pembangunan, FEB, Universitas Muhammadiyah Makassar

⁴ Dosen Pendidikan PGSD, FKIP, Universitas Muhammadiyah Muaro Bungo

⁵ Dosen Teknik Sipil, Akademi Teknik Adikarya

* Corresponding Author. E-mail: eversolissa@yahoo.com

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Abstrak

Tujuan penelitian untuk mengetahui pengaruh model pembelajaran jigsaw berbasis Higher Order Thinking Skills terhadap keterampilan berpikir abad-21 siswa. Jenis penelitian ini adalah penelitian kuantitatif dengan pendekatan meta-analisis. Sumber data dalam penelitian ini berasal dari 10 jurnal nasional dan Internasional terbit tahun 2018-2023. Proses pencarian sumber data melalui database google scholar, Eric dan Wiley. Kriteria inklusi dalam penelitian ini adalah a) penelitian harus memiliki kelas eksperimen dan kontrol, b) penelitian berasal dari jurnal atau prosiding terindeks Scopus dan SINTA, c) penelitian memiliki keterkaitan dengan model pembelajaran jigsaw berbasis Higher Order Thinking Skills Terhadap keterampilan abad-21 siswa, d) penelitian harus terbitan 5 tahun terakhir rentang 2018-2023; e) artikel harus mempunyai nilai (t), (r), (f) ; f) ukuran sampel > 20 siswa. Analisis data dalam meta-analisis ini dengan bantuan aplikasi JSAP 0.8.5. Hasil analisis 10 penelitian menyimpulkan Dari meta-analisis ini dapat disimpulkan adanya pengaruh yang signifikan model pembelajaran jigsaw berbasis Higher Order Thinking Skills terhadap keterampilan berpikir abad-21 siswa ($Z = 1.431$; $p < 0.001$; CI 95% [0.612;0.942]. Pengaruh ini kriteria yang tinggi ($rRE = 0.845$). Temuan ini menjelaskan model pembelajaran model pembelajaran jigsaw berbasis Higher Order Thinking Skills memberikan pengaruh yang tinggi terhadap keterampilan berpikir abad-21 siswa.

Kata Kunci: Model Jigsaw, Efek Size, HOTS, Keterampilan abad-21, Meta-analisis

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Abstract

The purpose of the study was to determine the effect of jigsaw learning model based on Higher Order Thinking Skills on students' 21st century thinking skills. This type of research is quantitative research with a meta-analysis approach. The data sources in this study came from 10 national and international journals published in 2018-2023. The process of searching for data sources through google scholar, Eric and Wiley databases. The inclusion criteria in this study are a) research must have experimental and control classes, b) research comes from

Scopus and SINTA indexed journals or proceedings, c) research has a relationship with the Higher Order Thinking Skills-based jigsaw learning model towards students' 21st century skills, d) research must be published in the last 5 years range 2018-2023; e) articles must have a value (t), (r), (f); f) sample size > 20 students. Data analysis in this meta-analysis with the help of JSAP 0.8.5 application. From this meta-analysis, it can be concluded that there is a significant effect of jigsaw learning model based on Higher Order Thinking Skills on students' 21st century thinking skills ($Z = 1.431$; $p < 0.001$; 95% CI [0.612; 0.942]). This effect is criterion high ($rRE = 0.845$). This finding explains the learning model of jigsaw learning model based on Higher Order Thinking Skills provides a high influence on students' 21st century thinking skills.

Keywords: Jigsaw model, Effect size, HOTS, 21st century skills, Meta-analysis

Introduction

21st century thinking skills are skills that students must have to face the era of globalisation (Kuloğlu & Karabekmez, 2022; Chehimi & Alameddine, 2022; Elfira et al., 2023; Supriyadi et al., 2023). The 21st century thinking skills are known as the 4Cs which consist of critical thinking & problem solving, creative, communicative and collaborative (Warrick & Woodward, 2021; Rahman et al., 2023). 21st century thinking skills help students in solving symptoms or phenomena that occur in life (Sarigöz, 2023; Thiel & Marx, 2019). Furthermore, 21st century thinking skills develop higher order thinking skills in the learning process (Zulkifli et al., 2022; Suryono et al., 2023; Nurtamam et al., 2023). Students have 21st century thinking skills are more critical, active and innovative in learning (Laar et al., 2017).

But in reality, the 21st century thinking skills of Indonesian students are still relatively low (Vari, 2022; Oktarina et al., 2021). This result can be seen from the Trends in International Mathematics and Science Study (TIMSS) survey of students' critical thinking skills in the field of science is low, only obtaining a score of 397 from an international average score of 500 (Putra et al., 2023; Zulyusri et al., 2023; Suhaimi et al., 2022; Rahman, 2023). The low level of 21st-century thinking skills in students is influenced by various factors. According to (Aulia et al., 2023) The low level of students' 21st-century

thinking skills is due to the learning process that does not involve students learning more actively. The learning process is teacher-centered, making it difficult for students to understand the subject matter (Şahin, 2021; Luciana et al., 2023; Fradila et al., 2021). In addition, the selection of learning methods and models that do not encourage students' 21st century thinking skills.

The Jigsaw learning model is a learning model that can encourage students' 21st century thinking skills (Saputra et al., 2019; Zainil et al., 2023). The jigsaw learning model is a learning model that designs origin group and expert group patterns to encourage students to take responsibility in the learning process (Abed et al., 2019; Cashata et al., 2023). This jigsaw learning model can train students to be more active and creative in learning (Usman et al., 2022; Septiani et al., 2020; Azmin, 2015). Hasil penelitian (Susanti, 2019) jigsaw learning model can train students to be skilled in collaboration. Furthermore, the jigsaw learning model is able to grow students' high self-esteem in learning (Aydin & Biyikli, 2017; Dat, 2016). Not only that, the jigsaw learning model helps students more easily understand learning concepts (Saputri, 2020).

Furthermore, the jigsaw learning model based on higher order thinking skills is one of the solutions in improving students' 21st century thinking skills. Higher order thinking skills is a high-level thinking ability that is needed by students in analysing a problem that occurs (Obeidat & Saleh, 2022; Razak et

al., 2021). Learning based on higher order thinking skills students have high thinking and analysing power in learning (Zain et al., 2022; Zhou, 2020).

Research results Widyaningrum & Harjono (2019) jigsaw learning model can improve student learning outcomes. Research by (Ade Wilda Pebrina&, 2019) The jigsaw model can have a positive influence on students' critical thinking skills. Furthermore, the research results Karacop (2017) The jigsaw learning model has a significant effect on students' science process skills. But in fact, many studies on the jigsaw learning model have not found research on the effect size of the jigsaw model based on higher order thinking skills on students' 21st century thinking skills. based on the above problems, this study aims to determine the effect of the jigsaw learning model based on Higher Order Thinking Skills on students' 21st century thinking skills.

Methods

This research is a type of meta-analysis research. Meta-analysis research is a type of research that analyses previous studies that can be analysed quantitatively (Sayyah et al., 2022; Suharyat et al., 202; Suparman et al., 2020; Karim et al., 2023; Santosa et al., 2021; Balemen, 201; lchsan et al., 2022). According to Borenstein et al.,(2010) The steps of meta-analysis research consist of 1) inclusion criteria; 2) literature collection; 3) literature screening; 4) Coding; 5) Data analysis.

Inclusion Criteria

The inclusion criteria in this meta-analysis study are a) research must have experimental and control classes, b) research comes from Scopus and SINTA indexed journals or proceedings, c) research has a relationship with the Higher Order Thinking Skills-based jigsaw learning model towards students' 21st century skills, d) research must be published in the last 5 years in the range

2018-2023; e) articles must have a value (t), (r), (f); f) sample size > 20 students; f) research must be accessed from the google scholar, Eric, Wiley and Proquest databases.

Data Collection and Screening

The data collection process in this meta-analysis is through google scholar, ERIC, Wiley and ProQuest databases. The keywords for searching data sources were "jigsaw learning model", "higher order thinking skills", and "21st century thinking skills". The method of selecting data sources through the PRISMA method. Furthermore, the data screening process goes through the stages of identification, screening, eligibility and inclusion. From the data screening process, 10 national and international journals were obtained for meta-analysis.

Coding data

The coding in this meta-analysis consists of researchers, publication year, journal index, (r), (t) and (f) values and journal type. the results of data coding can be seen in table 1.

Table 1. Meta-analysis Data Coding

Journal Code	Index jurnal	r	t	f	Journal Type
A1	Scopus	1.10			International
A2	Sinta		2.30		Nasional
A3	Sinta		1.09		Nasional
A4	Sinta	0.92			Nasional
A5	Scopus	0.58			International
A6	Sinta	1.30			Nasional
A7	Sinta	0.82		2.60	Nasional
A8	Sinta		3..11		Nasional
A9	Scopus		2.82		International
A10	Sinta	0.75			Nasional

Data Analysis

Data analysis in the meta-analysis used the JSAP application. According to Borenstein et al., (2010) Data analysis steps in meta-analysis research consist of 1) calculating the effect value of the entire study, 2) conducting heterogeneity tests and calculating the overall

effect size value, 3) analysing moderator variables and 4) calculating publication bias. Furthermore, the effect size value criteria for research can be seen in table 2.

Table 2. Effect Size Value Categories

Effect Size	Category
0.0 < ES ≤ 0.20	Low
0.20 < ES ≤ 0.80	Medium
ES ≥ 0.80	High

Source : Cohen in (Ramdhayani et al., 2019) ;Rahman et al., 2023; Santosa et al., 2023; Suharyat et al., 2023)

Result and Discussion

From the analysis of 119 studies on the effect of jigsaw learning model based on higher order thinking skills on students' 21st century thinking skills, there were only 10 studies that met the inclusion criteria. Furthermore, studies that have met the criteria are tested for heterogeneity. The results of the heterogeneity test can be seen in table 3.

Table 3. Heterogeneity Test Results

	Q	df	p
Omnibus test of Model Coefficients	62.372	1	< 0.001
Test of Residual Heterogeneity	510.812	9	< 0.001

Note. *p* value are approximate

Tabel 4. The Residual Heterogeneity Test Result

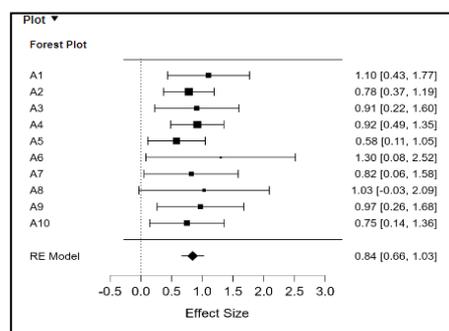
	Estimates	Lower bound	Upper Bound
τ^2	0.3110	0.2864	0.7621
τ	0.6415	0.4184	0.8203
I ² (%)	96.761	94.227	97.890
H ²	39.758	23.6612	51.976

Based on tables 3 and 4, it explains that the 8 studies are heterogeneously distributed. This can be seen from the p value < 0.001; Q = 62.372; τ^2 or $t > 0$ and I² (%) = 96.761 close to 100%. The next step is to calculate the summary effect value or mean effect size of the entire research sample. The results of the summary effect size test or mean effect size can be seen in Table 5.

Table5. Hajji uji Summary Effect Size atau Mean Effect Size

	Estimates	Standard Error	z	p	Lower bound	Upper bound
Interept	0.845	0.292	7.913	< 0.001	0.612	0.942

Based on Table 5. explains that the value of z = 7.913; p < 0.001. This result shows that the application of inquiry learning model based on mobile learning has an effect on students' creative thinking skills. Furthermore, the results can be categorised as a large effect based on the estimated standard error value of 0.845 (0.612; 0.942). In addition, the summary effect size analysis test can be illustrated by the forest plot in Figure 2.



Gambar 1. Forest Plot

Based on Figure 1. explains that the overall effect size of the study has a significant effect. Furthermore, knowing the publication bias of each study. In this meta-analysis research, publication bias can be known by using funnel plot. Funnel plot effect size of the entire study can be seen in Figure 3.

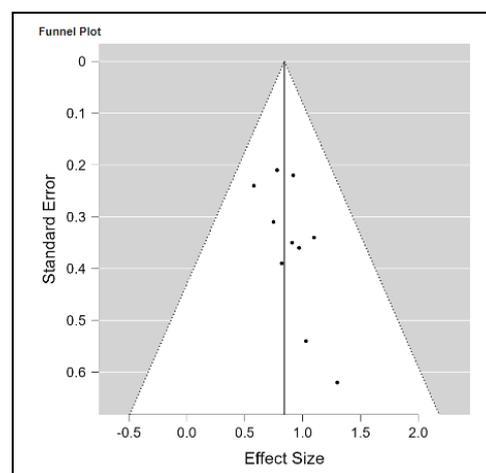


Figure 2. Funnel Plot Standard Error

Based on Figure 2. Explains that the points of the study that are extended domina are in the middle of the curve. This shows the effect size but it is difficult to determine whether this meta-analysis is symmetrical or asymmetrical so it is necessary to do the Egger test. The results of the Egger test can be seen in Table 6.

Table 6. Egger Test Results

	z	p
sei	1.431	1.568

Table 6. Explaining the value of Z = 1.431; p-value > 0.05, the funnel plot distribution is symmetrical. The funnel plot shows that there is no publication bias in this study. Furthermore, to increase the validity of publication bias, it is necessary to conduct the Fail Safe N (FSN) test. The results of the fail safe N test can be seen in Table 7.

Table 7. Fail Safe Test Results N

	Fail safe N	Target Significance	Observed significance
Rosenthal	472	0.050	< 0.001

Based on table 7. The value of fail safe N (FSN) is 472. Furthermore, the value of fail safe N is compared with the value of $k = (5.10) + 10 = 60$. Therefore, the value of fail safe N $472 / 60 = 7.8 > 1$ means that this meta-analysis study is resistant to publication bias.

Discussion

The meta-analysis of 10 studies on jigsaw learning model based on higher order thinking skills showed a positive influence on students' 21st century thinking skills. This result can be seen from the summary effect size value or mean effect size of ($Z = 7.913$; $P < 0.001$). Furthermore, the jigsaw learning model has a high effect on students' 21st century thinking skills ($rRE = 1.045$; $SE = 0.292$). This result is in line with Hulinggi et al., (2023) The jigsaw learning model has a significant effect on students' collaborative and critical thinking skills. The jigsaw learning model helps students be more active and creative in the learning process (Affandi et al., 2022; Jermstittiparsert et al., 2021). Furthermore, the jigsaw learning model based on higher order thinking skills can train students to communicate better and critically (Akkuş &

Doymuş, 2022; Saputra et al., 2019; Mukrimaa et al., 2016).

Research results Tamur et al., (2021) The jigsaw teaching model helps students play an active role in achieving learning objectives so that it can encourage students to have 21st century thinking skills. 21st century skills help students be more critical, creative, communicative and collaborative in solving a problem (Bell, 2010; Icela, 2022). Students' 21st century thinking skills are needed to face the industrial revolution 4.0. Research Indrawan et al., (2021) jigsaw learning model based on higher order thinking skills increases students' sense of courage in expressing opinions in a group.

Furthermore, in a meta-analysis it is necessary to calculate publication bias before conducting research hypotheses (Yusuf et al., 2022). Calculation of publication bias in meta-analysis of jigsaw learning model based on higher order thinking skills through funnel plot. In the funnel plot analysis, the effect size curve is in a vertical line but does not know whether it is symmetrical or asymmetrical. Therefore, it is necessary to do the Eggers test to determine whether the funnel plot is symmetrical or asymmetrical. The results of the Eggers test obtained a value ($z = 1.431$; $p > 0.05$) meaning that the meta-analysis curve is symmetrical. In addition, to determine the objectivity of research in meta-analysis, it is necessary to fail safe N. The results of the fail safe N test obtained ($k = 7.8 > 1$) can be concluded in this meta-analysis there is no publication bias. So, the jigsaw learning model based on higher order thinking skills is very well applied by teachers to encourage students' 21st century thinking skills.

Conclusion

From this meta-analysis, it can be concluded that there is a significant effect of jigsaw learning model based on Higher Order Thinking Skills on students' 21st century thinking skills ($Z = 1.431$; $p < 0.001$; 95% CI [0.612;0.942]). This effect is criterion high ($rRE = 1.045$). This finding explains the Higher Order Thinking Skills-based jigsaw learning model provides a high influence on students' 21st century thinking skills. Higher order thinking skills-based jigsaw learning model is

very necessary to help students in developing students' 21st century skills.

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