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DOI: <http://dx.doi.org/10.30998/formatif.v14i1>

Table of Contents

Artikel

The Correlation between Students' Insights and Academic Achievement in Science: A Predictor for STEM Career Path	PDF
10.30998/formatif.v14i1.17616 <i>Roger Reyes, Frank Angelo Abayog Pacala, Glamour Bengua, Ellen Entac</i>	
Project-Based Interactive Colloidal E-Module in Chemistry Learning to Improve Student's Science Process Skills and Understanding Concepts	UNTITLED PDF
10.30998/formatif.v14i1.17934 <i>Aiza Alya, Kusumawati Dwiningsih</i>	
Numeracy: How About Student of Junior High School Ability to Solve Problem Use Conten Uncertainty and Data with Personal Context?	PDF
10.30998/formatif.v14i1.19251	

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Focus and Scope

Peer-Review Process

Editorial Team

Reviewers Acknowledgement

Author Guidelines

Publication Ethics

Policies

Copyright

Publication Fees

Journal History

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Measuring Instrument for Self-Regulated Physics Learning at High School Level in Sungai Penuh	PDF
10.30998/formatif.v14i1.22310 <i>Nadia Alfia Netta, Desnita Desnita</i>	
Reading Comprehension Skills of Scientific Texts with Natural Sciences Content of Junior High School (SMP) Students in Magelang City	PDF
10.30998/formatif.v14i1.11915 <i>Kurnia Intan Sari, Siswanto Siswanto, Riva Ismawati, Ahmad Muhlisin</i>	
Science Teachers' Teaching Competency: Educational Background versus Teaching Experience	PDF
10.30998/formatif.v14i1.13080 <i>Weni Anissa Putri, Ari Widodo</i>	
Implementation of IBSC Learning Model with Podcast Media Blended Learning Media System to Train Critical Thinking and Communication	PDF
10.30998/formatif.v14i1.15638 <i>Peni Suharti, Chintya Catur Anggraini, Wiwi Wikanta</i>	
Correlation Study Between Scientific Literacy And Environmental Literacy Of Jambi City High School Students In The Subject Of Physics	PDF
10.30998/formatif.v14i1.22319 <i>Dhea Febriya, Desnita Desnita</i>	
Implementation Process of Research Based Learning (RBL) for Doctoral Education Program Students: An Exploratory Case Study	PDF
10.30998/formatif.v14i1.17959 <i>Fitri April Yanti, Aceng Ruyani, Yunitasari Yunitasari, M. Anas Thohir, Ayang Kinasih</i>	
Strategic Factors that Influence Critical Thinking Ability in Mathematics Learning in Elementary Schools	PDF
10.30998/formatif.v14i1.21427 <i>Prapti Octavia Ningsih, Harsono Harsono, Murfiah Dewi Wulandari</i>	
The Improvement of Students' Mathematical Critical Thinking Skills and Learning Motivation Through Contextual Teaching and Learning	PDF
10.30998/formatif.v14i1.21634	



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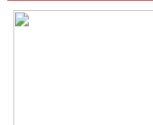
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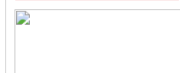
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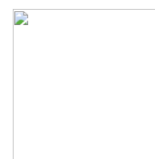


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Quality Of Algebra Questions to Measure Mathematical Literacy Ability Using Partial Credit Model 10.30998/formatif.v14i1.21984 <i>Akfi Hikmah Wahdana, Didik Sugeng Pambudi, Dian Kurniati, Arika Indah Kristiana, Ridho Alfarisi</i>	PDF
Application of Assemblr Edu Augmented Reality Media in IPAS Learning on Water Cycle Material at Wonosari 01 State Elementary School 10.30998/formatif.v14i1.22161 <i>Vera Amelia, Barokah Isdaryanti</i>	PDF
The Effect of Project Based Learning (PjBL) Model on Science Process Skills and Student Cognitive Learning Outcomes 10.30998/formatif.v14i1.22260 <i>Ida Ayu Putu Nova Warmadewi, I Wayan Subagia, I Wayan Suja</i>	PDF
Fire Safety Awareness and Practices of Science, Technology, Engineering, and Mathematics Students in a Philippine Public Secondary School 10.30998/formatif.v14i1.22350 <i>Michelle Delallarte, Joji Davila Linaugo, Dennis Villasor Madrigal</i>	PDF
Evaluation and Restructuring National Education Standards 10.30998/formatif.v14i1.22679 <i>Jafriansen Damanik, Leonard Leonard</i>	PDF
Is the Jigsaw Model Still Relevant for Improving Mathematical Ability? Meta-Analysis Studies 10.30998/formatif.v14i1.20436 <i>Joko Soebagyo, Samsul Maarif, Huri Suhendri, Leonard Leonard</i>	PDF
Analysis of Validity and Reliability Test of Self Efficacy Instrument in Learning Wave Material Physics at SMA Kota Padang 10.30998/formatif.v14i1.22321 <i>Riri Ayudia, Desnita Desnita</i>	PDF
Bibliometric and Network Analysis: Case Based Learning Model Based on Statistica Preneurship to Strengthen Data Analysis Ability and Resilience of Mathematics Students 10.30998/formatif.v14i1.20955 <i>Bunga Mardhotillah, Kamid Kamid, Nizel Huda, Zurweni Zurweni</i>	PDF

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KEYWORDS

Biology Learning Approaches, Scientific, Environmental Exploration, Local Wisdom and Cultural Cognitive conflict approach, critical thinking skills, conceptual understanding, E-Modules, Mathematics, EPUB3, SIGIL, Online Learning, Covid-19 Faculty-researchers Global warming concepts Learning mathematics, introduction of number, learning motivation, pre-school students, Mathematical Problem-solving Ability, High Mathematical Disposition, Medium Mathematical Disposition, Low Mathematical Disposition Mathematics Learning Media, Domino Math Game, ADDIE Modules Problem-Based Learning Research Culture SIM-based teaching STEM Education Science education, Character education, Students' attitudes toward science Strategic intervention material TPACK, science instruction, special education teacher ability, creative thinking, mathematical problems digital learning, covid-19 pandemic, primary education learning outcomes, snow cube throwing learning model, cooperative learning project based learning, understanding of concepts, retention, social attitudes teaching material, STEM, 21st century skills, character

CURRENT ISSUE

ATOM	3.0
DOI	3.0

10.30998/formatif.v14i1.22350 <i>Michelle Delallarte, Joji Davila Linaugo, Dennis Villasor Madrigal</i>	
Evaluation and Restructuring National Education Standards 10.30998/formatif.v14i1.22679 <i>Jafriansen Damanik, Leonard Leonard</i>	PDF
Is the Jigsaw Model Still Relevant for Improving Mathematical Ability? Meta-Analysis Studies 10.30998/formatif.v14i1.20436 <i>Joko Soebagyo, Samsul Maarif, Huri Suhendri, Leonard Leonard</i>	PDF
Analysis of Validity and Reliability Test of Self Efficacy Instrument in Learning Wave Material Physics at SMA Kota Padang 10.30998/formatif.v14i1.22321 <i>Riri Ayudia, Desnita Desnita</i>	PDF
Bibliometric and Network Analysis: Case Based Learning Model Based on Statistica Preneurship to Strengthen Data Analysis Ability and Resilience of Mathematics Students 10.30998/formatif.v14i1.20955 <i>Bunga Mardhotillah, Kamid Kamid, Nizel Huda, Zurweni Zurweni</i>	PDF
The Influence of Instructional Strategy and Motivation the Natural Science Subject Instructional Outcomes 10.30998/formatif.v14i1.17575 <i>Yayan Sudrajat, Ni Wayan Ayu Permata Sari, Nurdin Nurdin, Leonard Leonard</i>	PDF

concepts Learning mathematics, introduction of number, learning motivation, pre-school students, Mathematical Problem-solving Ability, High Mathematical Disposition, Medium Mathematical Disposition, Low Mathematical Disposition Mathematics Learning Media, Domino Math Game, ADDIE Modules Problem-Based Learning Research Culture SIM-based teaching STEM Education Science education, Character education, Students' attitudes toward science Strategic intervention material TPACK, science instruction, special education teacher ability, creative thinking, mathematical problems digital learning, covid-19 pandemic, primary education learning outcomes, snow cube throwing learning model, cooperative learning project based learning, understanding of concepts, retention, social attitudes teaching material, STEM, 21st century skills, character

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- [Focus and Scope](#)
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Authors	Joko Soebagyo, Samsul Maarif, Huri Suhendri, Leonard Leonard
Title	Is the Jigsaw Model Still Relevant for Improving Mathematical Ability? Meta-Analysis Studies
Original file	20436-56966-1-SM.DOCX 2023-09-15
Supp. files	None
Submitter	Joko Soebagyo
Date submitted	September 15, 2023 - 09:26 AM
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Editor	Ari Irawan, M.Pd
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#20436 Review

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Title

Is the Jigsaw Model Still Relevant for Improving Mathematical Ability? Meta-Analysis Studies

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We have reached a decision regarding your submission to **Formatif**: Jurnal Ilmiah Pendidikan MIPA, "Is the Jigsaw Method Still Relevant for Improving Mathematical Ability? Meta-Analysis Studies".

Our decision is to: Revision Required

Silakan direvisi sesuai dengan masukan reviewer dan kami tunggu paling lambat tanggal 7 Februari 2024. terima kasih

Ari Irawan, M.Pd

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Abstract

Based on the findings of research that has been done, learning the Jigsaw method also has an influence on the mathematical ability of students but some do not have a significant influence. As a result, meta-analysis research is required to provide thorough and in-depth conclusions about the Jigsaw method's applicability to students' mathematical abilities. Comprehensive Meta-Analysis is used to evaluate property values based on comparisons with similar properties in the same area. Data obtained from Publish or Perish with a year level from 2010 to 2023 there are a total of 501 articles with a Google Scholar data base. The total number of eligible journals and will be analyzed is 30 samples with a total of 1252 subjects. The moderator variables in this study consider the country, education level, sample size and publication source. According to the study's findings, the Jigsaw technique had a significant impact on arithmetic ability (P-value 0.05), with an effect size of 1.146 classed as extremely high based on a fixed effect and an error standard of 0.045. The results showed that the Jigsaw method is still relevant to improve students' mathematical skills, especially at the elementary school level. In contrast, The meta-analysis revealed that the Jigsaw method had no effect on pupils' mathematical abilities across country categories.

Keywords: Jigsaw methods, mathematical abilities, meta-analysis

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INTRODUCTION

Recognize mathematics as an abstract science that is the basis for achieving other sciences. Mathematics complements all existing sciences ranging from science, technology, art and many others (Kamarullah, 2017). The level of difficulty in mathematics is often used as a benchmark in achieving success. No wonder many of the nation's students are required to be proficient in mathematics. Sometimes the difficulty in solving abstract problems often makes interest in learning decrease so that you are lazy to learn, this is a trigger factor for problems in learning (Siswono, 2014). In mathematics, mathematical ability is not only measured on one ability. Mathematical abilities are grouped into five understandings ranging from mathematical understanding, problem solving, reasoning, connection and communication (Sumarmo, 2012). Mathematics learning must instill rational thinking processes with the laws of mathematical logic to develop thinking processes in solving mathematical problems (Maarif et al., 2018). In understanding logic, of course, requires motivation and good learning and teaching. Not all teaching provided is able to make some students interested in learning. Therefore, as a good teacher, there needs to be variety in providing learning models. This variant is used to ensure the learners grasp the topic and that objectives for learning are achieved. Currently, there are many learning models that are often found, ranging from Problem Based Learning (PBL), Project Based Learning (PJBL), Realistic Mathematics Education (RME), to Cooperative Learning

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2. recommendations for subsequent research related to similar research topics.

(CL). The development of technology, a lot of research related to learning. In fact, not a few studies that vary learning with other methods.

Cooperative learning was first studied in 1898 by Roger and Johnson in about 600 experiments. Cooperative learning is learning that creates interaction between group members and teachers try to condition it by motivating students to always develop a sense of mutual need in a team (Jaelani, 2015). Social behavior learning is specifically developed to assist students in collaborating while learning. Cooperative learning is a learning paradigm in which students participate and interact with one another in small groups of four to six persons (Saputra et al., 2017). There are various variations of models that can be used in cooperative learning, namely (1) STAD, (2) Group Investigation, (3) Jigsaw, (4) Think-Pair-Share, (5) Inside-Outside Circle, (6) Make a Match, (7) Listening Team, (8) The Power of Two, and (9) Bamboo Dancing.

Jigsaw is one of the models of cooperative learning. Jigsaw type learning is learning in a learning group where there is interaction between each group member and has responsibility for the material in the group and the ability to master and teach the topic to the other members of the group (Lubis & Harahap, 2016). The initial group and the expert group are displayed in the puzzle cooperative learning paradigm. The origin group, or parent group of students, consists of students from different racial, ethnic, and socioeconomic backgrounds. While the expert group consists of members of different origin groups and is tasked with researching and studying certain subjects while carrying out tasks that will be communicated to members of the origin group. A number of specialists from the initial group have been combined to form the expert group. Being interconnected with each other where each student is able to convey the information needed to their teammates so that the goal in solving problems can be achieved is the key to the success of Jigsaw (Werdiningsih & Mukhlisin, 2021). In this learning students work in a team and are assigned to read and study a subject. Random selection is made for each member of the group who is designated as an expert in a particular field. Furthermore, the experts reported to the group and met with other groups to discuss the material learned then returned to their group to teach the material to their teammates (Widyastuti, 2015). The characteristic of the Jigsaw type that distinguishes it from other types of cooperatives is that there are study groups and specialist groups (Hibattulloh & Sofyan, 2014).

One of the learning models that can promote student activity, involvement, and knowledge of the material is cooperative learning. The Jigsaw cooperative learning model is one example (Nurfutriyanti, 2017). This learning model is possible to be applied to young children, because this type of children is also divided into several heterogeneous groups according to ability and gender, so that group characters are formed into parallels (Poerwati et al., 2020). The Jigsaw cooperative paradigm is intended to improve students' problem-solving and critical thinking abilities because in discussion activities students are grouped into specialist groups and origin teams to solve mathematical problems (Handayani, 2020).

In understanding abstract science, the ability to train critical thinking needs to be taught to students (Sarman & Soebagyo, 2022). Critical thinking is the ability of human thinking that has systematic and logical steps (Saviraningrum & Soebagyo, 2022). Thinking logically means being precise, which is an important skill for life and work to work effectively in all areas of life. The advantage in critical thinking, we can assess the level of thoroughness or truth of the question and without any information it is not easy to express what we want to convey (Zuharni, 2022). In addition, mathematical creative thinking skills, namely the ability to think based on data and information, are available to find possible answers to such problems from different points of view on problems in each individual where it is more emphasized the suitability of answers and the versatility of answers (Yayuk et al., 2020). That is, creative thinking skills should belong to everyone (Florentina & Leonard, 2017). No less important, to find relationships from a

representation of concepts and procedures, to grasp between mathematical themes and apply mathematical concepts in other fields or daily life, the capacity to make mathematical connections is required (Widarti, 2013).

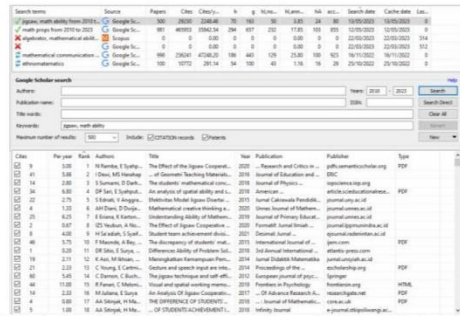
The Jigsaw method of learning, which is derived from research findings, assists students in understanding the findings they make (Sari & Fitriani, 2018). In other studies there is an influence on the mathematical ability of students but there are also those that do not have a significant influence. Of course, in various studies there are different kinds of conclusions even though the variables studied have similarities. Based on the existing problems, Meta-analysts can provide comprehensive and in-depth conclusions on certain variables or topics that want to be discussed. This study can answer how much influence the Jigsaw method has based on the desired category variables. One of the results of this study is a significant improvement in students' mathematical abilities after attending the Jigsaw method lecture with discussion assessment and based only on the findings of the preliminary and final tests (Edriati et al., 2015).

METHODS

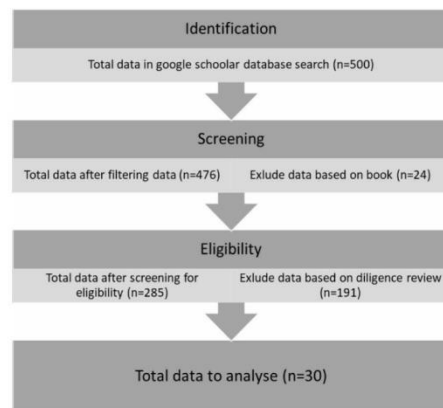
This study focuses on quantitative data research analysis based on Google Scholar database sources, specifically to investigate *Jigsaw models* with *math ability*. The purpose of this analysis was to identify the magnitude of the influence on the Jigsaw learning method and to investigate the impact of characteristics on mathematical ability in determining the variation in effect size of each available research. Analysis using a meta-analysis approach is used to achieve this purpose. Meta-analysis is used to compare primary study with other scientific advancements in the form of drawing statistical findings in the form of effect size on quantitative data studies based on relevant themes (Rosdiana, 2021). The steps in compiling the meta-analysis, starting from; (1) choose the criteria for the article to be researched, (2) look for literature sources related to relevant research to be used, (3) code the article to be used, (4) conduct analysis and classification, (5) interpret findings based on the article under study (Sukmawati, 2020).

Literary Search

This research uses the Google Scholar database as a location for document search. Furthermore, the use of Publish or Perish is applied as a reference in downloading studies related to the application of the Jigsaw method by combining keywords into Jigsaw, math ability (Eryanti & Soebagyo, 2021; Haniyah & Soebagyo, 2021; Sarman & Soebagyo, 2022). Seen in Figure 1, it is obtained that the search process for the application of the Jigsaw method on Google Scholar using the PoP application reaches 500 data.



The data screening in this investigation was done using the PRISMA protocols shown in Figure 2.



Coding

All studies that match the criteria are coded manually using a detailed coding scheme based on protocols. In this study, the instrument was carried out using the provision of codes (*categories*). Coding is done to separate individual data information into numerical data. A random sample of 5 valid studies was reproduced and divided among coders to determine reliability. The coder is given a copy of the article, as well as the coding form and protocol. To assess the reliability of these coders, the following formula is employed to calculate percent agreement (PA):

$$PA = \frac{N_A}{N_A + N_P} \times 100\%$$

In this scenario, N_A represents the total number of agreements, while N_P represents the entire number of disagreements.

Statistical Analysis

The data was evaluated with the CMA application, with special attention paid to the effect size, which is defined as the influence of the Jigsaw approach on students' mathematical skills. The Comprehensive Meta-Analysis is beneficial for adjusting the effect size of research, including the overall effect size, P-value, Q-statistic, and truth interval. In addition, the program creates research forest plots and funnel plots. The g Hedges measure was utilized in this analysis, and the size effect was classified as less than 0.2 (negligible), 0.2 to 0.5 (small effect), 0.5 to 0.8 (moderate effect), 0.8 to 1.3 (big effect), and more than 1.3 (very large effect) (Cohen et al., 2007). The random effect technique was chosen as the estimation method since there is no assumption that all research have the same effect. The randomized effect model in this study was selected after a successful heterogeneity test. The p value is used to perform this test. If the p-value is less than 0.05, all studies will be identical, and the null hypothesis and homogeneity will be rejected. The rejection of the null hypothesis suggests that population parameters may not be measured with the same effect size across studies or study groups (Retnawati et al., 2018). There is evidence that different study categories have different effects on study effect sizes.

To avoid misrepresentation of results, publication bias is checked. Publication bias is the likelihood that studies appearing in published literature are considered statistically significant to be published (Cooper et al., 2009). In anticipation, a bias analysis was carried out on the funnel plot to see if the research was free from bias. When the distribution of impact sizes on vertical lines was symmetrical, publication bias was judged strong in this study. However, if the size distribution of the effect is not perfectly symmetrical, it is necessary to use the trim and fill method. If the observed effects and virtual effects generated by randomized effects models are found to be similar, then the study is immune to publication bias.

RESULTS & DISCUSSION

Results

Literature Search Results

The goal of this study was to determine whether the magnitude of the effect created had an effect on learning the Jigsaw method and mathematical competence based on category variables. Therefore, researchers try to search literature using PoP (Publish or Perish) software by applying several criteria. The first criterion, researchers use vulnerable research time in 2010 – 2023. Furthermore, the second criterion of researchers used the keywords Jigsaw and Math ability, and the maximum number of results was limited to 500

data. From the topics used, 501 articles were collected, with 24 data coming from books and the rest coming from journals, citations and documents.

Literature Selection Results

After setting criteria for literature search, the researcher converts the data into excel and eliminates the data in the appropriate journal. First, researchers filter data that is included in journals or articles. Second, researchers use a quantitative approach to collect data that has an experimental class and a control class. Third, researchers collect statistical data such as the number of samples, average values and standard deviations. This statistical data aims to calculate the size of the effect to be studied. Furthermore, screening through the PRISMA method is carried out to ensure the accuracy of the data obtained. Not only that, but researchers must guarantee that the journal's title and theme are consistent with the criteria variables.

Results Criteria

The results of the criteria in this study focused on vulnerable years 2010 - 2023. The selection of criteria on this year's vulnerability was carried out to ensure that the available research is up-to-date. From the results of the criteria that have been filtered, researchers consider choosing research sourced from journals and proceedings. In addition, researchers also obtained various journals from various countries with the same topic, ranging from Asian to European countries. Furthermore, researchers consider the degree of education beginning with (pre-school, elementary, junior high, high school, and university). The many variations that have been studied at this level of education add to the accuracy of a study. Furthermore, researchers also looked at the number of sample sizes in a study and paid attention to whether each of these journals had a control class and an experimental class. The selected research is also equipped with post-test and pre-test data, average values and standard deviations to see the extent of the data spread and whether there are data deviations in the average value.

Statistical Analysis Results

The results of the study here aim to answer the research question. Figure 3 depicts the findings of a meta-analysis of 30 filtered and collected data from Google Scholar. Figure 3 contains the identification of the names of the studies. Furthermore, the magnitude of the effect is shown which contains the results of the intervention. It can be seen that there is 1 data that is less than 0 or under consideration, while the average confidence interval that stretches horizontally or is more than 0 is on the right. This means that the effects of the intervention are beneficial. In addition, figure 3 also shows the heterogeneity of a data to see discrepancies in the source of findings from the study.

According to Figure 3, there is an inconsistent response rate. It is clear that the research is likely to be diverse. As a result, it must be statistically examined such that the starting assumptions are consistent with the estimation approach.

Model	N	Hedge's	standard error	Test of null		Q	P	Decision
				Z-value	P-value			
Fixed-effects	30	1.146	0.045	25.583	0.000	447.062	0.000	Reject
Random-effects	30	1.095	0.177	6.189	0.000			

- 7 -

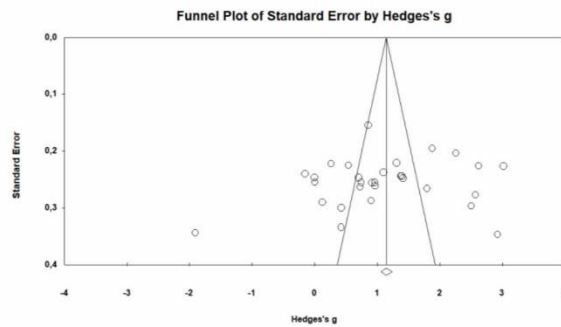


Figure 4. Funnel plot of 30 samples

Then, as shown in Figure 5, we will show a funnel plot with the research spread out and not symmetrical in the funnel, requiring trim and fill to check whether there is a difference with the influence of publication bias.

Duval and Tweedie's trim and fill

	Fixed Effects			Random Effects			Q Value
	Studies Trimmed	Point Estimate	Lower Limit	Upper Limit	Point Estimate	Lower Limit	Upper Limit
Observed values		1.14597	1.05817	1.23376	1.09469	0.74799	1.44139
Adjusted values	0	1.14597	1.05817	1.23376	1.09469	0.74799	1.44139

Figure 5. Trim and Fill

The findings of trim and fill indicate that there is no difference or opposite according to the fixed effect model, so no research or study is trimmed or added to this study.. The overall effect size is 1.14597 rounded up to 1.146 is a very high value for an effect size.

Furthermore, in addressing the following question, it is demonstrated that the estimation approach, as previously stated, matches the fixed effect model. This shows that the effect sizes of each study are varied, necessitating a detailed examination of the categorical factors influencing the association between the Jigsaw learning model and mathematical competence. As a result, Table 2 shows the summary results of the category variable analysis.

Table 2. Summary of Category Variable Analysis

No	Category Variable	Group	N	Combined Effect Size (Hedge's g)	Test of null (2-Tail)		Heterogeneity			Decision
					Z	P-value	Between-Classes Effect (Q-value)	Df (Q)	P-value	
1	Country	Indonesia	15	0.99	3.439	0.001	0.331	1	0.565	Reject H_0
		Overseas	15	1.199	5.412	0				Reject H_0
2	Educational level	University	4	1.172	3.797	0	32.466	4	0	Reject H_0
		High School	9	0.942	3.672	0				Reject H_0
		Primary School	15	1.09	3.702	0.000				Reject H_0
		Elementary	1	2.924	8.428	0.000				Reject H_0
		Pre School	1	0.429	1.429	0.153				Reject H_0
3	Sample Size	30 or less	7	0.114	0.361	0.000	12.005	1	0.001	Reject H_0
		31 or more	23	1.384	7.51	0.000				Reject H_0
4	Publication Source	Journal	29	0.178	5.919	0.000	19.84	1	0	Reject H_0
		Proceeding	1	2.26	11.07	0.000				Reject H_0

Country

The effect size in Indonesian study was 3,439, whereas the effect size in international research was 5,412. According to the heterogeneity of Q-value = 0.331 and $p > 0.05$, studies on the Jigsaw learning model conducted in Indonesia and abroad have no impact on students' mathematical abilities.

Education Level

According to Table 2, the sample size at the education level is as follows: Pre-school (0.429), Elementary (2,924), Junior High School (1.09), Senior High School (0.942), and University (1.172). Heterogeneity tests yielded Q-value = 32.466 and $p > 0.05$, indicating that the application of Jigsaw learning to mathematical abilities was influential at all stages of schooling, from pre-primary to university.

Sample Size

Based on Table 2. It was shown that a sample size with a group of 30 or less had an effect size of 0.114, while a sample size with a group of 31 or more had an effect size of 1.384. Based on the heterogeneity test, Q-value = 12.005 and $p < 0.05$. In this situation, it suggests that the sample size influences Jigsaw technique learning with students' mathematical skills.

Publication Source

According to the publication source, the effect size of journal research was 0.178, whereas the effect size of proceedings research was 2.26. Judging from the heterogeneity of Q-value = 19.84 and $p < 0.05$, the entire paper shows that Jigsaw learning affects students' mathematical abilities.

Discussion

Essentially, the purpose of this study is to determine whether the Jigsaw approach has a significant impact on students' mathematical abilities. Based on the analysis, an effect size of 1,146 was obtained, which shows that this study has a considerable influence. In accordance with the research that has been conducted, there is a possibility that students can contribute to solving problems in group discussions using the Jigsaw learning model, due to its significant influence (Tamur et al., 2021).

The number of subjects studied in this study was 1252 with an average of 69 people. In this case, the effect size of 1,146 shows that the Jigsaw method affects mathematical ability (Cohen et al., 2018). In line with other studies, learning using the Jigsaw method is more fun than ordinary learning because students can find information

from other groups (Wardani, 2015). Next, researchers conducted an analysis based on categorical variables. It can be seen that the amount of the influence in this study is clarified beginning with the level of education, country, sample size, and publication source.

Analysis of country categories found that research in Indonesia and abroad showed no influence between the Jigsaw learning model on mathematical ability. In this study, the number of samples from 30 papers is comparable. This means that in addition to Indonesia, abroad this research has been carried out a lot even not a few who use modifications to the variables studied with the main variable being Jigsaw learning. For example, research (Abed et al., 2020) that predicts Jigsaw-type learning strategies on students' mathematics learning achievement. Furthermore, other data show that the Jigsaw technique of learning geometric information is more effective than the lecture method (Timayi et al., 2015). Another study related to Jigsaw learning in Turkey states that there is an influence on students' abilities in natural science laboratory practice (Karacop, 2017).

Next, analyze category variables related to education level. Judging from the comparison of the magnitude of the effect size between Pre-School: Elementary: Junior High: High School: University (0.429: 2.924: 1.09: 0.942: 1.172) the results show that learning the Jigsaw method has a major effect on the elementary level. The findings also show that learning mathematics using the Jigsaw method is more effective at the elementary level than at other levels. According to research (Sulistiyowati & Astuti, 2020), the Jigsaw method of learning has a high level of cooperation as indicated by post-test and pre-test findings. Although this is a contradiction where learning mathematics using the Jigsaw method at the high school level affects students' mathematical communication skills (Yeubun et al., 2020).

Learning mathematics using the Jigsaw method, as shown in Table 2, also demonstrates that many research samples were collected at the secondary school level. This happens because the level of thinking has entered the formal stage. On the other hand, this learning triggers the psychology of students to be curious about their peers (Utami et al., 2021). In addition to their mathematical abilities, students' mathematical successes have beneficial consequences after the Jigsaw learning approach is implemented (Ribut, 2021). However, other studies on cooperative learning with the type of Think Pair Share aided by comics show that it is no better than not using comics to develop problem-solving skills (Turyanto et al., 2019). However, Pair Check cooperative learning has been shown to improve students' overall cooperative abilities (Wijayanti & Kusdiyanta, 2019).

In this study, sample size was also applied to categorical variables to clarify the size of the effect on the study. The findings showed that (31 or more) had a greater influence than other categories. This study also conducted an analysis of publication sources on categorical variables. Based on the findings, 1 literature was obtained from proceedings and 29 other literature was obtained from journals. These data imply that the study was free of publication bias, which is supported by trim and fill.

Many studies are not taken or do not fall into the required category while examining this research. Such research conducted by (Budiawan & Arsani, 2013) using the same variables but carried out on sports subjects. In addition, there are also some unqualified studies where there is a lack of pretest data as a control study. Of the 500 data collected, only about 30 studies were included in the requirements after several screenings. And obviously, it does not end there; this study needs to be researched further to determine its effectiveness.

CONCLUSION

This research was conducted by taking articles from proceedings and international journals in the range of 2010 – 2023. A meta-analysis research with 30 samples revealed a fixed effect with an effect size of 1,146, indicating that mastering the Jigsaw technique had a significant impact on students' mathematical abilities. This means that Jigsaw learning is still relevant to improve students' mathematical skills. Furthermore, this study was conducted analysis based on category variables divided into four variables. Based on the analysis of education levels, it was discovered that the degree of the influence varied depending on the study. However, learning using the Jigsaw method is more influential at the elementary level than other levels. In addition, the number of samples in 31 or more has a higher effectiveness and also publication sources based on journals have more significant influence, while analysis in countries does not have an influence on both research from Indonesia and abroad.

In the world of education, the application of the Jigsaw method is quite effective, as evidenced by the findings of several studies, particularly at the elementary level, where students enjoy playing and learning in groups, exchanging information, and working together to find information. This research has limitations because the sample in this study was obtained from Google Scholar using PoP software which means there are still many other research samples that were not carried out because of access or paid constraints. Further research requires good collaboration to review more deeply about this research.

CONFLICT OF INTEREST

ACKNOWLEDGEMENT

REFERENCES

- Abed, A. Z., Sameer, S. A., Kasim, M. A., & Othman, A. T. (2020). Predicting Effect Implementing the Jigsaw Strategy on the Academic Achievement of Students in Mathematics Classes. *International Electronic Journal of Mathematics Education*, 15(1), 1–7. <https://doi.org/10.29333/iejme/5940>
- Budiawan, M., & Arsani, N. L. K. A. (2013). Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw dan Motivasi Belajar Terhadap Prestasi Belajar Ilmu Fisiologi Olahraga. *Pendidikan Indonesia*, 2(1), 138–144. <https://doi.org/10.3102/0013189X18785613>
- Cohen, L., Manion, L., & Morrison, K. (2007). Book Reviews Research Methods in Education. *The Austr Alian Educational Researcher*, 2, 147–156.
- Cohen, L., Manion, L., & Morrison, K. (2018). Research Methods in Education. In *Jurnal Penelitian Pendidikan Guru Sekolah Dasar* (Vol. 6, Issue August).
- Cooper, H., Hedges, L. V., & Valentine, J. C. (2009). Handbook of Research Synthesis and Meta-Analysis 2nd Edition. In *The Lancet* (Vol. 389, Issue 10082).
- Edriati, S., Anggraini, V., & Siska, M. (2015). Efektivitas Model Jigsaw Disertai Penilaian Diskusi Untuk Meningkatkan Kemampuan Matematis Mahasiswa. *Jurnal Cakrawala Pendidikan*, 2(2), 288–295. <https://doi.org/10.21831/cp.v2i2.4833>
- Eryanti, I., & Soebagyo, J. (2021). Bibliometric Analysis of Blended learning Mathematics in Scientific Publications Indexed by Scopus. *Numerical: Jurnal Matematika Dan Pendidikan Matematika*, 91–102.
- Florentina, N., & Leonard, L. (2017). Pengaruh Model Pembelajaran Kooperatif Terhadap Kemampuan Berpikir Kreatif Matematis Siswa. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 7(2), 96–106. <https://doi.org/10.30998/formatif.v7i2.1877>
- Handayani, H. (2020). Pengaruh Implementasi Pembelajaran Kooperatif Tipe Jigsaw

- Terhadap Kemampuan Berpikir Kritis Matematis Siswa Sekolah Dasar. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, 5(1), 50–60. <https://doi.org/10.23969/jp.v5i1.1944>
- Haniyah, D., & Soebagyo, J. (2021). Analisis Bibliometrik Terhadap Kemampuan Komunikasi Matematis Dalam Pembelajaran Matematika Berdasarkan Perbedaan Gender berbasis VOSViewer. *Buana Matematika: Jurnal Ilmiah Matematika Dan Pendidikan Matematika*, 11(2), 121–136.
- Hibattulloh, N., & Sofyan, D. (2014). Perbandingan Kemampuan Komunikasi Matematis Siswa Antara Yang Menggunakan Model Pembelajaran Kooperatif Tipe Jigsaw Dengan Konvensional (Studi Quasi Eksperimen di Kelas VII SMP Negeri 2 Bayongbong). *Jurnal Pendidikan Matematika*, 3(3), 169–178.
- Jaelani, A. (2015). Pembelajaran Kooperatif, Sebagai Salah Satu Model Pembelajaran Di Madrasah Ibtidaiyya (MI). *Al Ibtida: Jurnal Pendidikan Guru MI*, 2(1), 1–16. <https://doi.org/10.24235/al.ibtida.snj.v2i1.189>
- Kamarullah, K. (2017). Pendidikan Matematika Di Sekolah Kita. *Al Khawarizmi: Jurnal Pendidikan Dan Pembelajaran Matematika*, 1(1), 21. <https://doi.org/http://dx.doi.org/10.22373/jppm.v1i1.1729>
- Karacop, A. (2017). The Effects of Using Jigsaw Method Based on Cooperative Learning Model in the Undergraduate Science Laboratory Practices. *Universal Journal of Educational Research*, 5(3), 420–434. <https://doi.org/10.13189/ujer.2017.050314>
- Lubis, N. A., & Harahap, H. (2016). Pembelajaran Kooperatif Tipe Jigsaw. *Jurnal As-Salam*, 1(1), 96–102.
- Maarif, S., Wahyudin, W., Noto, M. S., Hidayat, W., & Mulyono, H. (2018). Geometry Exploration Activities Assisted With Dynamic Geometry Software (Dgs) in a Teacher Education Classroom. *Infinity Journal*, 7(2), 133. <https://doi.org/10.22460/infinity.v7i2.p133-146>
- Musna, R. R., Juandi, D., & Jupri, A. (2021). A meta-analysis study of the effect of Problem-Based Learning model on students' mathematical problem solving skills. *Journal of Physics: Conference Series*, 1882(1), 2–8. <https://doi.org/10.1088/1742-6596/1882/1/012090>
- Nurfitriyanti, M. (2017). Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw Terhadap Hasil Belajar Matematika Ditinjau Dari Kecerdasan Emosional Maya. *Jurnal Formatif*, 7(2), 153–162. <https://doi.org/10.31949/jcp.v8i4.2941>
- Poerwati, C. E., Suryaningsih, N. M. A., & Cahaya, I. M. E. (2020). Model Pembelajaran Kooperatif Tipe Jigsaw II dalam Meningkatkan Kemampuan Matematika Anak. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, 5(1), 281. <https://doi.org/10.31004/obsesi.v5i1.496>
- Retnawati, H., Apino, E., Kartianom, Djidu, H., & Anazifa, R. D. (2018). *Pengantar Analisis Meta* (Issue July).
- Ribut, O. Y. P. (2021). Model Pembelajaran Kooperatif Jigsaw Pada Prestasi Matematika Siswa Sekolah Menengah Pertama. *Jurnal Jendela Pendidikan*, 1(02), 61–65. <https://doi.org/10.57008/jjp.v1i02.9>
- Rosdiana, R. (2021). *Studi Meta - Analisis Penggunaan Model Pembelajaran Kooperatif Terhadap Kemampuan Komunikasi Matematis Siswa*.
- Saputra, G. A. A., Agung, A. A. G., & Suwatra, I. W. (2017). Pengembangan Multimedia Interaktif Sebagai Suplemen Pembelajaran Kooperatif Tipe Stad Pada Mata Pelajaran Ips Kelas Viii Smp. *Jurnal Edutech Undiksha*, 05(1), 121–131.
- Sari, S. R., & Fitriani, D. (2018). Meningkatkan Komunikasi Matematis Melalui Model Pembelajaran Kooperatif Tipe Jigsaw. *Journal for Research in Mathematics Learning*, 1(1), 183–188. <https://doi.org/10.30605/pedagogy.v7i1.1801>
- Sarman, S. N., & Soebagyo, J. (2022). Analisis Bibliometrik terhadap Kemampuan Berpikir Kritis Matematika Berdasarkan Pemecahan Masalah Berbasis VOS Viewer.

- Vygotsky: *Jurnal Pendidikan Matematika Dan Matematika*, 4(2), 117–128.
- Saviraningrum, W., & Soebagyo, J. (2022). Analisis Bibliometrik dengan Kata Kunci Mathematical Critical Thinking Student Independent Menggunakan VOSviewer. *JKPM (Jurnal Kajian Pendidikan Matematika)*, 8(1), 1. <https://doi.org/10.30998/jkpm.v8i1.13529>
- Siswono, T. Y. E. (2014). Permasalahan Pembelajaran Matematika dan Upaya Mengatasinya. *FMIPA UNESA*, 1–9.
- Sukmawati, A. (2020). Meta Analisis Model Problem Based Learning Dalam Meningkatkan Kemampuan Berpikir Kritis Pada Pembelajaran Matematika. *Thinking Skills and Creativity Journal*, 3(2), 63–68. <https://doi.org/10.23887/tscj.v3i2.30211>
- Sulistiyowati, D. P., & Astuti, S. (2020). Efektivitas Model Pembelajaran Kooperatif Tipe Jigsaw Dan Student Teams Achievement Divisions (STAD) Ditinjau Dari Keterampilan Kerjasama Pada Mata Pelajaran Matematika Siswa Kelas 5 SD. *Jurnal Karya Pendidikan Matematika*, 7(1), 92. <https://doi.org/10.26714/jkpm.7.1.2020.92-103>
- Sumarmo, U. (2012). Pendidikan Karakter serta Pengembangan Berfikir dan Disposisi Matematik dalam Pembelajaran Matematika. *Seminar Pendidikan Matematika*, 1–26.
- Tamur, M., Subaryo, S., Ramda, A. H., Nurjaman, A., Fedi, S., & Hamu, A. (2021). Pengaruh Pembelajaran Kooperatif Tipe Jigsaw Terhadap Kemampuan Berpikir Kritis Siswa SMP. *Journal of Honai Math*, 4(2), 173–182. <https://doi.org/10.30862/jhm.v4i2.201>
- Timayi, J. M., Bolaji, C., & Kajuru, Y. K. (2015). Effects of Jigsaw IV Cooperative Learning Strategy (J4CLS) on Academic Performance of Secondary School Students in Geometry. *International Journal of Mathematics Trends and Technology*, 28(1), 12–18. <https://doi.org/10.14445/22315373/ijmtt-v28p504>
- Turyanto, T., Agustito, D., & Widodo, S. A. (2019). Think Pair Share With Comic For Mathematical Problem Solving Skills. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 9(3), 181–190. <https://doi.org/10.30998/formatif.v9i3.3773>
- Utami, P., Kadir, & Herlanti, Y. (2021). Meta-Analisis Pembelajaran Kooperatif di Indonesia. *Jurnal Inovasi Pendidikan IPA*, 7(1), 106–115. <https://doi.org/10.21831/jipi.v7i1.39574>
- Wardani, D. T. (2015). Pengaruh Pembelajaran Kooperatif Tipe STAD (Student Teams Achievement Divisions) Dan Jigsaw Terhadap Prestasi Belajar Ekonomi Ditinjau Dari Motivasi Belajar Siswa Tahun Ajaran 2014/2015. *EQUILIBRIUM: Jurnal Ilmiah Ekonomi Dan Pembelajarannya*, 3(2), 105–111. <https://doi.org/10.25273/equilibrium.v3i2.657>
- Werdiningsih, E., & Mukhlisshin, M. I. (2021). Penerapan Model Pembelajaran Kooperatif Tipe Jigsaw di Kelas. *Jurnal Pendidikan Berkarakter*, 4(2), 60–65.
- Widarti, A. (2013). “Kemampuan Koneksi Matematis Dalam Menyelesaikan Masalah Kontekstual Ditinjau dari Kemampuan Matematis Siswa” (jurnal STKIP jombang, 2012). *Jurnal Pendidikan Matematika*, 1(003), 1–2.
- Widyastuti, E. (2015). Peningkatan Kemampuan Pemahaman Konsep Dan Komunikasi Matematis Siswa Dengan Menggunakan Pembelajaran Kooperatif Jigsaw. *Journal of Mathematics Education*, 1(1), 1–14.
- Wijayanti, A., & Kusdiyanta, A. (2019). Cooperative Skills Improvement Through Mind Mapping Assisted Pair Check Peningkatan Keterampilan Kooperatif Melalui Pair Check Berbantuan Mind Mapping. *Jurnal Ilmiah Pendidikan MIPA*, 9(3), 257–266. <https://doi.org/10.30998/formatif.v9i3.2927>
- Yayuk, E., Purwanto, As’Ari, A. R., & Subanji. (2020). Primary School Students’ Creative Thinking Skills in Mathematics Problem Solving. *European Journal of Educational Research*, 9(3), 1281–1295. <https://doi.org/10.12973/eu-jer.9.3.1281>

- Yeubun, I. Z. S., Noornia, A., & Ambarwati, L. (2020). The Effect of Jigsaw Cooperative Learning Methods on Mathematical Communication Ability Viewed Based on Student Personality. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 9(4), 333–338. <https://doi.org/10.30998/formatif.v9i4.4132>
- Zuhasni, N. (2022). *Penerapan Model Jigsaw untuk Meningkatkan Kemampuan Berpikir Kritis dan Hasil Belajar Siswa Kelas V SDN 2 Celala Aceh Tengah*.

Is the Jigsaw Method Still Relevant for Improving Mathematical Ability? Meta-Analysis Studies

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Abstract
Based on the findings of research that has been done, learning the Jigsaw method also has an influence on the mathematical ability of students but some do not have a significant influence. As a result, meta-analysis research is required to provide thorough and in-depth conclusions about the Jigsaw method's applicability to students' mathematical abilities. Comprehensive Meta-Analysis is used to evaluate property values based on comparisons with similar properties in the same area. Data obtained from Publish or Perish with a year level from 2010 to 2023 there are a total of 501 articles with a Google Scholar data base. The total number of eligible journals and will be analyzed is 30 samples with a total of 1252 subjects. The moderator variables in this study consider the country, education level, sample size and publication source. According to the study's findings, the Jigsaw technique had a significant impact on arithmetic ability (P-value 0.05), with an effect size of 1.146 classed as extremely high based on a fixed effect and an error standard of 0.045. The results showed that the Jigsaw method is still relevant to improve students' mathematical skills, especially at the elementary school level. In contrast, The meta-analysis revealed that the Jigsaw method had no effect on pupils' mathematical abilities across country categories.

Keywords: Jigsaw methods, mathematical abilities, meta-analysis

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INTRODUCTION

Recognize mathematics as an abstract science that is the basis for achieving other sciences. Mathematics complements all existing sciences ranging from science, technology, art and many others (Kamarullah, 2017). The level of difficulty in mathematics is often used as a benchmark in achieving success. No wonder many of the nation's students are required to be proficient in mathematics. Sometimes the difficulty in solving abstract problems often makes interest in learning decrease so that you are lazy to learn, this is a trigger factor for problems in learning (Siswono, 2014). In mathematics, mathematical ability is not only measured on one ability. Mathematical abilities are grouped into five understandings ranging from mathematical understanding, problem solving, reasoning, connection and communication (Sumarmo, 2012). Mathematics learning must instill rational thinking processes with the laws of mathematical logic to develop thinking processes in solving mathematical problems (Maarif et al., 2018). In understanding logic, of course, requires motivation and good learning and teaching. Not all teaching provided is able to make some students interested in learning. Therefore, as a good teacher, there needs to be variety in providing learning models. This variant is used to ensure the learners grasp the topic and that objectives for learning are achieved. Currently, there are many learning models that are often found, ranging from Problem Based Learning (PBL), Project Based Learning (PjBL), Realistic Mathematics Education (RME), to Cooperative Learning

Commented [A1]: Apakah benar? Cek kembali.

Commented [A2]: database

Commented [A3]: Maksudnya apa?

Commented [A4]: Misinterpretasi

Commented [A5]: j

(CL). The development of technology, a lot of research related to learning. In fact, not a few studies that vary learning with other methods.

Cooperative learning was first studied in 1898 by Roger and Johnson in about 600 experiments. Cooperative learning is learning that creates interaction between group members and teachers try to condition it by motivating students to always develop a sense of mutual need in a team (Jaelani, 2015). Social behavior learning is specifically developed to assist students in collaborating while learning. Cooperative learning is a learning paradigm in which students participate and interact with one another in small groups of four to six persons (Saputra et al., 2017). There are various variations of models that can be used in cooperative learning, namely (1) STAD, (2) Group Investigation, (3) Jigsaw, (4) Think-Pair-Share, (5) Inside-Outside Circle, (6) Make a Match, (7) Listening Team, (8) The Power of Two, and (9) Bamboo Dancing.

Jigsaw is one of the models of cooperative learning. Jigsaw type learning is learning in a learning group where there is interaction between each group member and has responsibility for the material in the group and the ability to master and teach the topic to the other members of the group (Lubis & Harahap, 2016). The initial group and the expert group are displayed in the puzzle cooperative learning paradigm. The origin group, or parent group of students, consists of students from different racial, ethnic, and socioeconomic backgrounds. While the expert group consists of members of different origin groups and is tasked with researching and studying certain subjects while carrying out tasks that will be communicated to members of the origin group. A number of specialists from the initial group have been combined to form the expert group. Being interconnected with each other where each student is able to convey the information needed to their teammates so that the goal in solving problems can be achieved is the key to the success of Jigsaw (Werdiningsih & Mukhlisin, 2021). In this learning students work in a team and are assigned to read and study a subject. Random selection is made for each member of the group who is designated as an expert in a particular field. Furthermore, the experts reported to the group and met with other groups to discuss the material learned then returned to their group to teach the material to their teammates (Widyastuti, 2015). The characteristic of the Jigsaw type that distinguishes it from other types of cooperatives is that there are study groups and specialist groups (Hibattulloh & Sofyan, 2014).

One of the learning models that can promote student activity, involvement, and knowledge of the material is cooperative learning. The Jigsaw cooperative learning model is one example (Nurfitriyanti, 2017). This learning model is possible to be applied to young children, because this type of children is also divided into several heterogeneous groups according to ability and gender, so that group characters are formed into parallels (Poerwati et al., 2020). The Jigsaw cooperative paradigm is intended to improve students' problem-solving and critical thinking abilities because in discussion activities students are grouped into specialist groups and origin teams to solve mathematical problems (Handayani, 2020).

In understanding abstract science, the ability to train critical thinking needs to be taught to students (Sarman & Soebagyo, 2022). Critical thinking is the ability of human thinking that has systematic and logical steps (Saviraningrum & Soebagyo, 2022). Thinking logically means being precise, which is an important skill for life and work to work effectively in all areas of life. The advantage in critical thinking, we can assess the level of thoroughness or truth of the question and without any information it is not easy to express what we want to convey (Zuharni, 2022). In addition, mathematical creative thinking skills, namely the ability to think based on data and information, are available to find possible answers to such problems from different points of view on problems in each individual where it is more emphasized the suitability of answers and the versatility of answers (Yayuk et al., 2020). That is, creative thinking skills should belong to everyone (Florentina & Leonard, 2017). No less important, to find relationships from a

Commented [A6]: cek komentar selanjutnya tentang konsistensi penulisan

Commented [A7]: akronim ini sebaiknya dijelaskan dahulu sebelum digunakan selanjutnya.

Commented [A8]: Mengapa dipilih model pembelajaran Jigsaw, bukan lainnya?

representation of concepts and procedures, to grasp between mathematical themes and apply mathematical concepts in other fields or daily life, the capacity to make mathematical connections is required (Widarti, 2013).

The Jigsaw method of learning, which is derived from research findings, assists students in understanding the findings they make (Sari & Fitriani, 2018). In other studies there is an influence on the mathematical ability of students but there are also those that do not have a significant influence. Of course, in various studies there are different kinds of conclusions even though the variables studied have similarities. Based on the existing problems, Meta-analysts can provide comprehensive and in-depth conclusions on certain variables or topics that want to be discussed. This study can answer how much influence the Jigsaw method has based on the desired category variables. One of the results of this study is a significant improvement in students' mathematical abilities after attending the Jigsaw method lecture with discussion assessment and based only on the findings of the preliminary and final tests (Edriati et al., 2015).

METHODS

This study focuses on quantitative data research analysis based on Google Scholar database sources, specifically to investigate *Jigsaw models* with *math ability*. The purpose of this analysis was to identify the magnitude of the influence on the Jigsaw learning method and to investigate the impact of characteristics on mathematical ability in determining the variation in effect size of each available research. Analysis using a meta-analysis approach is used to achieve this purpose. Meta-analysis is used to compare primary study with other scientific advancements in the form of drawing statistical findings in the form of effect size on quantitative data studies based on relevant themes (Rosdiana, 2021). The steps in compiling the meta-analysis, starting from; (1) choose the criteria for the article to be researched, (2) look for literature sources related to relevant research to be used, (3) code the article to be used, (4) conduct analysis and classification, (5) interpret findings based on the article under study (Sukmawati, 2020).

Literary Search

This research uses the Google Scholar database as a location for document search. Furthermore, the use of Publish or Perish is applied as a reference in downloading studies related to the application of the Jigsaw method by combining keywords into Jigsaw, math ability (Eryanti & Soebagyo, 2021; Haniyah & Soebagyo, 2021; Sarman & Soebagyo, 2022). Seen in Figure 1, it is obtained that the search process for the application of the Jigsaw method on Google Scholar using the PoP application reaches 500 data.

Commented [A9]: Metode atau model pembelajaran?
Sebutkan secara konsisten.

Commented [A10]: Cek penulisan

Commented [A11]: Kalimat ini ambigu, penelitian ini yang dimaksud apakah penelitian ini atau penelitian Edriati? Apakah meta-analisis pada model pembelajaran jigsaw belum pernah dilakukan sebelumnya? Jika ada sebutkan, dan letak perbedaan dengan penelitian ini dimana?

Commented [A12]: Cek komentar sebelumnya

Commented [A13]: Tambahkan kata hubung antara dua kata kunci yang digunakan dalam pencarian.

Commented [A14]: Jelaskan dahulu akronim ini, sebelum digunakan selanjutnya.

The screenshot shows the Google Scholar search interface. At the top, there's a search bar with the query 'Jigsaw, math ability'. Below it, a table displays search results. The table has columns for 'Cited by', 'Year', 'Author', 'Title', 'Journal', 'Publisher', and 'Type'. The first few results are:

Cited by	Year	Author	Title	Journal	Publisher	Type
9	2020	M. R. H. H. H.	The Effect of the Jigsaw Cooperative ...	Journal of Education and ...	gajournal.uns.ac.id	PDF
41	2020	C. D. H. H.	The Effect of the Jigsaw Cooperative ...	Journal of Education and ...	gajournal.uns.ac.id	PDF
14	2020	C. D. H. H.	The Effect of the Jigsaw Cooperative ...	Journal of Education and ...	gajournal.uns.ac.id	PDF

Figure 1. Google Scholar database search results (Jigsaw, Math ability)

Literary Inclusion Criteria

Throughout the present investigation, the research that was successfully found using the PoP software was then collated based on the requirements listed following: (1) write keywords using English settings, then retrieve the Google Scholar database at a vulnerable time between 2010-2023, (2) statistical information is used to obtain the effect size value. And journals or study criteria that do not match will be removed from the analysis data, and (3) learning to use a quantitative approach where in quantitative data there must be control groups and experiments. Journals or papers with just a single sample and a qualitative approach will be excluded from the data analysis.

The data screening in this investigation was done using the PRISMA protocols shown in Figure 2.

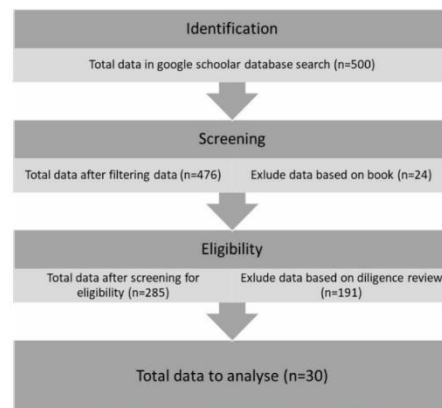


Figure 2. Filter data using PRISMA

Commented [A15]: Mengapa dipilih rentang tahun ini?

Commented [A16]: Jelaskan akronim ini terlebih dahulu, sebelum digunakan selanjutnya.

Commented [A17]: 1 paragraf sebaiknya lebih dari 1 kalimat.

Commented [A18]: Identifikasi sesuatu yang ada di hasil. Jelaskan tahap screening sesuai dengan penjelasan pada hasil khususnya "Literature Selection Results".

Coding

All studies that match the criteria are coded manually using a detailed coding scheme based on protocols. In this study, the instrument was carried out using the provision of codes (*categories*). Coding is done to separate individual data information into numerical data. A random sample of 5 valid studies was reproduced and divided among coders to determine reliability. The coder is given a copy of the article, as well as the coding form and protocol. To assess the reliability of these coders, the following formula is employed to calculate percent agreement (PA):

$$PA = \frac{N_A}{N_A + N_P} \times 100\%$$

In this scenario, N_A represents the total number of agreements, while N_P represents the entire number of disagreements.

Statistical Analysis

The data was evaluated with the CMA application, with special attention paid to the effect size, which is defined as the influence of the Jigsaw approach on students' mathematical skills. The Comprehensive Meta-Analysis is beneficial for adjusting the effect size of research, including the overall effect size, P-value, Q-statistic, and truth interval. In addition, the program creates research forest plots and funnel plots. The g Hedges measure was utilized in this analysis, and the size effect was classified as less than 0.2 (negligible), 0.2 to 0.5 (small effect), 0.5 to 0.8 (moderate effect), 0.8 to 1.3 (big effect), and more than 1.3 (very large effect) (Cohen et al., 2007). The random effect technique was chosen as the estimation method since there is no assumption that all research have the same effect. The randomized effect model in this study was selected after a successful heterogeneity test. The p value is used to perform this test. If the p-value is less than 0.05, all studies will be identical, and the null hypothesis and homogeneity will be rejected. The rejection of the null hypothesis suggests that population parameters may not be measured with the same effect size across studies or study groups (Retnawati et al., 2018). There is evidence that different study categories have different effects on study effect sizes.

To avoid misrepresentation of results, publication bias is checked. Publication bias is the likelihood that studies appearing in published literature are considered statistically significant to be published (Cooper et al., 2009). In anticipation, a bias analysis was carried out on the funnel plot to see if the research was free from bias. When the distribution of impact sizes on vertical lines was symmetrical, publication bias was judged strong in this study. However, if the size distribution of the effect is not perfectly symmetrical, it is necessary to use the trim and fill method. If the observed effects and virtual effects generated by randomized effects models are found to be similar, then the study is immune to publication bias.

RESULTS & DISCUSSION

Results

Literature Search Results

The goal of this study was to determine whether the magnitude of the effect created had an effect on learning the Jigsaw method and mathematical competence based on category variables. Therefore, researchers try to search literature using [PoP (Publish or Perish)] software by applying several criteria. The first criterion, researchers use vulnerable research time in 2010 – 2023. Furthermore, the second criterion of researchers used the keywords Jigsaw and Math ability, and the maximum number of results was limited to 500

Commented [A19]: Maksud kalimat ini apa?

Commented [A20]: Siapa pengodanya? Berapa orang pengode? Hal ini akan berpengaruh pada penggunaan kata tunggal atau jamak.

Bagaimana cara kerja pengode? Jelaskan juga hubungan antar pengode, independent atau dependen?

Commented [A21]: percentage

Commented [A22]: 1 paragraf sebaiknya lebih dari 1 kalimat.

Commented [A23]: Sebutkan penjelasan akronim ini dulu, sebelum akronim digunakan lebih lanjut.

Commented [A24]: Gunakan istilah yang baku, misal confidence interval

Commented [A25]: Overlapping dalam pengategorian. Sebaiknya gunakan interval berupa notasi matematika.

Commented [A26]: Cek komentar sebelumnya

Commented [A27]: Penjelasan ini sebaiknya disebutkan di bagian awal artikel yang menyebutkan hal ini. Selanjutnya cukup menggunakan akronim saja.

Commented [A28]: Dibatasi 500 dokumen

data. From the topics used, 501 articles were collected, with 24 data coming from books and the rest coming from journals, citations and documents.

Literature Selection Results

After setting criteria for literature search, the researcher converts the data into excel and eliminates the data in the appropriate journal. First, researchers filter data that is included in journals or articles. Second, researchers use a quantitative approach to collect data that has an experimental class and a control class. Third, researchers collect statistical data such as the number of samples, average values and standard deviations. This statistical data aims to calculate the size of the effect to be studied. Furthermore, screening through the PRISMA method is carried out to ensure the accuracy of the data obtained. Not only that, but researchers must guarantee that the journal's title and theme are consistent with the criteria variables.

Results Criteria

The results of the criteria in this study focused on vulnerable years 2010 - 2023. The selection of criteria on this year's vulnerability was carried out to ensure that the available research is up-to-date. From the results of the criteria that have been filtered, researchers consider choosing research sourced from journals and proceedings. In addition, researchers also obtained various journals from various countries with the same topic, ranging from Asian to European countries. Furthermore, researchers consider the degree of education beginning with (pre-school, elementary, junior high, high school, and university). The many variations that have been studied at this level of education add to the accuracy of a study. Furthermore, researchers also looked at the number of sample sizes in a study and paid attention to whether each of these journals had a control class and an experimental class. The selected research is also equipped with post-test and pre-test data, average values and standard deviations to see the extent of the data spread and whether there are data deviations in the average value.

Statistical Analysis Results

The results of the study here aim to answer the research question. Figure 3 depicts the findings of a meta-analysis of 30 filtered and collected data from Google Scholar. Figure 3 contains the identification of the names of the studies. Furthermore, the magnitude of the effect is shown which contains the results of the intervention. It can be seen that there is 1 data that is less than 0 or under consideration, while the average confidence interval that stretches horizontally or is more than 0 is on the right. This means that the effects of the intervention are beneficial. In addition, figure 3 also shows the heterogeneity of a data to see discrepancies in the source of findings from the study.

Commented [A29]: Tapi mengapa diperoleh 501?

Commented [A30]: Sebarannya bagaimana?

Commented [A31]: Journal atau prosiding conference?

Commented [A32]: Gunakan istilah yang tepat, misal sample size

Commented [A33]: Gunakan istilah yang tepat, misal mean. Kata value dihapus saja. Kemudian di antara mean dan standard deviations diberi tanda pemisah koma (,).

Commented [A34]: mean

Commented [A35]: hapus

Commented [A36]: mean

Commented [A37]: hapus

Commented [A38]: Figure

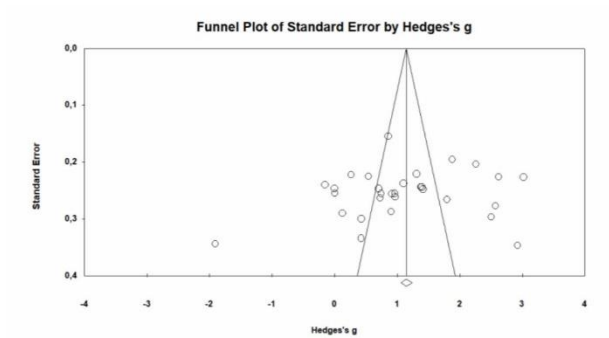


Figure 4. Funnel plot of 30 samples

Commented [A43]: Semua gambar diujuk dalam naskah.

Then, as shown in Figure 5, we will show a funnel plot with the research spread out and not symmetrical in the funnel, requiring trim and fill to check whether there is a difference with the influence of publication bias.

Commented [A44]: Cek penomoran gambar, sepertinya salah. 1 paragraf sebaiknya lebih dari 1 kalimat.

Duval and Tweedie's trim and fill

	Fixed Effects			Random Effects			Q Value
	Studies Trimmed	Point Estimate	Lower Limit	Upper Limit	Point Estimate	Lower Limit	Upper Limit
Observed values		1.14597	1.05817	1.23376	1.09469	0.74799	1.44139
Adjusted values	0	1.14597	1.05817	1.23376	1.09469	0.74799	1.44139

Figure 5. Trim and Fill

The findings of trim and fill indicate that there is no difference or opposite according to the fixed effect model, so no research or study is trimmed or added to this study. The overall effect size is 1.14597 rounded up to 1.146 is a very high value for an effect size.

Commented [A45]: Rujuk gambarnya.

Commented [A46]: hapus

Furthermore, in addressing the following question, it is demonstrated that the estimation approach, as previously stated, matches the fixed effect model. This shows that the effect sizes of each study are varied, necessitating a detailed examination of the categorical factors influencing the association between the Jigsaw learning model and mathematical competence. As a result, Table 2 shows the summary results of the category variable analysis.

Commented [A47]: research question

Table 2. Summary of Category Variable Analysis

No	Category Variable	Group	N	Combined Effect Size (Hedge's g)	Test of null (2-Tail)		Heterogeneity		Decision
					Z	P-value	Between-Classes Effect (Q-value)	Df (Q)	
1	Country	Indonesia	15	0.99	3.439	0.001	0.331	1	0.565
		Overseas	15	1.199	5.412	0			Reject H_0
2	Educational level	University	4	1.172	3.797	0	32.466	4	0
		High School	9	0.942	3.672	0			Reject H_0
		Primary School	15	1.09	3.702	0.000			
		Elementary	1	2.924	8.428	0.000			
		Pre School	1	0.429	1.429	0.153			
3	Sample Size	30 or less	7	0.114	0.361	0.000	12.005	1	0.001
		31 or more	23	1.384	7.51	0.000			Reject H_0
4	Publication Source	Journal	29	0.178	5.919	0.000	19.84	1	0
		Proceeding	1	2.26	11.07	0.000			Reject H_0

Country

The effect size in Indonesian study was 3.439, whereas the effect size in international research was 5.412. According to the heterogeneity of Q-value = 0.331 and $p > 0.05$, studies on the Jigsaw learning model conducted in Indonesia and abroad have no impact on students' mathematical abilities.

Education Level

According to Table 2, the sample size at the education level is as follows: Pre-school (0.429), Elementary (2.924), Junior High School (1.09), Senior High School (0.942), and University (1.172). Heterogeneity tests yielded Q-value = 32.466 and $p < 0.05$, indicating that the application of Jigsaw learning to mathematical abilities was influential at all stages of schooling, from pre-primary to university.

Sample Size

Based on Table 2. It was shown that a sample size with a group of 30 or less had an effect size of 0.114, while a sample size with a group of 31 or more had an effect size of 1.384. Based on the heterogeneity test, Q-value = 12.005 and $p < 0.05$. In this situation, it suggests that the sample size influences Jigsaw technique learning with students' mathematical skills.

Publication Source

According to the publication source, the effect size of journal research was 0.178, whereas the effect size of proceedings research was 2.26. Judging from the heterogeneity of Q-value = 19.84 and $p < 0.05$, the entire paper shows that Jigsaw learning affects students' mathematical abilities.

Discussion

Essentially, the purpose of this study is to determine whether the Jigsaw approach has a significant impact on students' mathematical abilities. Based on the analysis, an effect size of 1.146 was obtained, which shows that this study has a considerable influence. In accordance with the research that has been conducted, there is a possibility that students can contribute to solving problems in group discussions using the Jigsaw learning model, due to its significant influence (Tamur et al., 2021).

The number of subjects studied in this study was 1252 with an average of 69 people. In this case, the effect size of 1.146 shows that the Jigsaw method affects mathematical ability (Cohen et al., 2018). In line with other studies, learning using the Jigsaw method is more fun than ordinary learning because students can find information

Commented [A48]: Decision 1, menggunakan istilah yang tidak wajar. Dalam statistika yang diuji adalah H_0 , jadi yang diterima atau ditolak adalah H_0 . Dalam berbagai referensi digunakan istilah "not reject H_0 ".

Variabel terahir terjadi kesalahan penulisan.

Sebaiknya bagian ini masuk dalam kategori gambar, karena tidak bisa diedit, kecuali penulis menggantinya dalam format tabel.

Penulisan desimal juga harus konsisten, misal tiga angka di belakang koma.

Commented [A49]: Gunakan simbol titik (.) untuk menunjukkan desimal

Commented [A50]: Gunakan simbol titik (.) untuk menunjukkan desimal

Commented [A51]: Simpulan ini terlihat misinterpretasi. Jelas bahwa penelitian di Indonesia memberikan efek yang signifikan, begitupula penelitian luar negeri. Pengujian selanjutnya terlihat bahwa penelitian di Indonesia dan luar negeri memiliki efek yang tidak berbeda secara signifikan. Artinya, hasil penelitian Indonesia dan luar negeri identik.

Commented [A52]: Bagian ini menarik dan perlu diuraikan lebih mendalam, karena dari berbagai tingkat pendidikan, pembelajaran jigsaw di PAUD memiliki efek yang kecil dan tidak signifikan.

Commented [A53]: Sisipkan simbol penghubung antara p dan 0.05

Commented [A54]: cek

Commented [A55]: abilities atau skills? Gunakan istilah yang konsisten

Commented [A56]: publication type

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Commented [A58]: Gunakan simbol titik (.) untuk menunjukkan desimal

Commented [A59]: Darimana nilai ini? Apa yang dimaksud subyek dan orang? Apakah penulis atau bagaimana? Jelaskan!

Commented [A60]: Gunakan simbol titik (.) untuk menunjukkan desimal

from other groups (Wardani, 2015). Next, researchers conducted an analysis based on categorical variables. It can be seen that the amount of the influence in this study is clarified beginning with the level of education, country, sample size, and publication source.

Analysis of country categories found that research in Indonesia and abroad showed no influence between the Jigsaw learning model on mathematical ability. In this study, the number of samples from 30 papers is comparable. This means that in addition to Indonesia, abroad this research has been carried out a lot even not a few who use modifications to the variables studied with the main variable being Jigsaw learning. For example, research (Abed et al., 2020) that predicts Jigsaw-type learning strategies on students' mathematics learning achievement. Furthermore, other data show that the Jigsaw technique of learning geometric information is more effective than the lecture method (Timayi et al., 2015). Another study related to Jigsaw learning in Turkey states that there is an influence on students' abilities in natural science laboratory practice (Karacop, 2017).

Next, analyze category variables related to education level. Judging from the comparison of the magnitude of the effect size between Pre-School: Elementary: Junior High: High School: University (0.429: 2.924: 1.09: 0.942: 1.172) the results show that learning the Jigsaw method has a major effect on the elementary level. The findings also show that learning mathematics using the Jigsaw method is more effective at the elementary level than at other levels. According to research (Sulistiyowati & Astuti, 2020), the Jigsaw method of learning has a high level of cooperation as indicated by post-test and pre-test findings. Although this is a contradiction where learning mathematics using the Jigsaw method at the high school level affects students' mathematical communication skills (Yeubun et al., 2020).

Learning mathematics using the Jigsaw method, as shown in Table 2, also demonstrates that many research samples were collected at the secondary school level. This happens because the level of thinking has entered the formal stage. On the other hand, this learning triggers the psychology of students to be curious about their peers (Utami et al., 2021). In addition to their mathematical abilities, students' mathematical successes have beneficial consequences after the Jigsaw learning approach is implemented (Ribut, 2021). However, other studies on cooperative learning with the type of Think Pair Share aided by comics show that it is no better than not using comics to develop problem-solving skills (Turyanto et al., 2019). However, Pair Check cooperative learning has been shown to improve students' overall cooperative abilities (Wijayanti & Kusdiyanta, 2019).

In this study, sample size was also applied to categorical variables to clarify the size of the effect on the study. The findings showed that (31 or more) had a greater influence than other categories. This study also conducted an analysis of publication sources on categorical variables. Based on the findings, 1 literature was obtained from proceedings and 29 other literature was obtained from journals. These data imply that the study was free of publication bias, which is supported by trim and fill.

Many studies are not taken or do not fall into the required category while examining this research. Such research conducted by (Budiawan & Arsani, 2013) using the same variables but carried out on sports subjects. In addition, there are also some unqualified studies where there is a lack of pretest data as a control study. Of the 500 data collected, only about 30 studies were included in the requirements after several screenings. And obviously, it does not end there; this study needs to be researched further to determine its effectiveness.

CONCLUSION

Commented [A61]: Misinterpretasi

Commented [A62]: Cek signifikansi untuk kelompok ini.

Commented [A63]: Tunjukkan berbagai referensi yang menguatkan temuan ini.

Commented [A64]: Sesuaikan dengan hasil penelitian yang telah direvisi sesuai saran yang diberikan.

This research was conducted by taking articles from proceedings and international journals in the range of 2010 – 2023. A meta-analysis research with 30 samples revealed a fixed effect with an effect size of $|1,146$, indicating that mastering the Jigsaw technique had a significant impact on students' mathematical abilities. This means that Jigsaw learning is still relevant to improve students' mathematical skills. Furthermore, this study was conducted analysis based on category variables divided into four variables. Based on the analysis of education levels, it was discovered that the degree of the influence varied depending on the study. However, learning using the Jigsaw method is more influential at the elementary level than other levels. In addition, the number of samples in 31 or more has a higher effectiveness and also publication sources based on journals have more significant influence, while analysis in countries does not have an influence on both research from Indonesia and abroad.

In the world of education, the application of the Jigsaw method is quite effective, as evidenced by the findings of several studies, particularly at the elementary level, where students enjoy playing and learning in groups, exchanging information, and working together to find information. This research has limitations because the sample in this study was obtained from Google Scholar using PoP software which means there are still many other research samples that were not carried out because of access or paid constraints. Further research requires good collaboration to review more deeply about this research.

CONFLICT OF INTEREST

ACKNOWLEDGEMENT

REFERENCES

- Abed, A. Z., Sameer, S. A., Kasim, M. A., & Othman, A. T. (2020). Predicting Effect Implementing the Jigsaw Strategy on the Academic Achievement of Students in Mathematics Classes. *International Electronic Journal of Mathematics Education*, 15(1), 1–7. <https://doi.org/10.29333/iejme/5940>
- Budiawan, M., & Arsani, N. L. K. A. (2013). Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw dan Motivasi Belajar Terhadap Prestasi Belajar Ilmu Fisiologi Olahraga. *Pendidikan Indonesia*, 2(1), 138–144. <https://doi.org/10.3102/0013189X18785613>
- Cohen, L., Manion, L., & Morrison, K. (2007). Book Reviews Research Methods in Education. *The Austr Alian Educational Researcher*, 2, 147–156.
- Cohen, L., Manion, L., & Morrison, K. (2018). Research Methods in Education. In *Jurnal Penelitian Pendidikan Guru Sekolah Dasar* (Vol. 6, Issue August).
- Cooper, H., Hedges, L. V., & Valentine, J. C. (2009). Handbook of Research Synthesis and Meta-Analysis 2nd Edition. In *The Lancet* (Vol. 389, Issue 10082).
- Edriati, S., Anggraini, V., & Siska, M. (2015). Efektivitas Model Jigsaw Disertai Penilaian Diskusi Untuk Meningkatkan Kemampuan Matematis Mahasiswa. *Jurnal Cakrawala Pendidikan*, 2(2), 288–295. <https://doi.org/10.21831/cp.v2i2.4833>
- Eryanti, I., & Soebagyo, J. (2021). Bibliometric Analysis of Blended learning Mathematics in Scientific Publications Indexed by Scopus. *Numerical: Jurnal Matematika Dan Pendidikan Matematika*, 91–102.
- Florentina, N., & Leonard, L. (2017). Pengaruh Model Pembelajaran Kooperatif Terhadap Kemampuan Berpikir Kreatif Matematis Siswa. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 7(2), 96–106. <https://doi.org/10.30998/formatif.v7i2.1877>
- Handayani, H. (2020). Pengaruh Implementasi Pembelajaran Kooperatif Tipe Jigsaw

Commented [A65]: Gunakan symbol titik (.) untuk menunjukkan desimal

Commented [A66]: misinterpretasi

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- Terhadap Kemampuan Berpikir Kritis Matematis Siswa Sekolah Dasar. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, 5(1), 50–60. <https://doi.org/10.23969/jp.v5i1.1944>
- Haniyah, D., & Soebagyo, J. (2021). Analisis Bibliometrik Terhadap Kemampuan Komunikasi Matematis Dalam Pembelajaran Matematika Berdasarkan Perbedaan Gender berbasis VOSViewer. *Buana Matematika: Jurnal Ilmiah Matematika Dan Pendidikan Matematika*, 11(2), 121–136.
- Hibattulloh, N., & Sofyan, D. (2014). Perbandingan Kemampuan Komunikasi Matematis Siswa Antara Yang Menggunakan Model Pembelajaran Kooperatif Tipe Jigsaw Dengan Konvensional (Studi Quasi Eksperimen di Kelas VII SMP Negeri 2 Bayongbong). *Jurnal Pendidikan Matematika*, 3(3), 169–178.
- Jaelani, A. (2015). Pembelajaran Kooperatif, Sebagai Salah Satu Model Pembelajaran Di Madrasah Ibtidaiyya (MI). *Al Ibtida: Jurnal Pendidikan Guru MI*, 2(1), 1–16. <https://doi.org/10.24235/al.ibtida.snj.v2i1.189>
- Kamarullah, K. (2017). Pendidikan Matematika Di Sekolah Kita. *Al Khawarizmi: Jurnal Pendidikan Dan Pembelajaran Matematika*, 1(1), 21. <https://doi.org/http://dx.doi.org/10.22373/jppm.v1i1.1729>
- Karacop, A. (2017). The Effects of Using Jigsaw Method Based on Cooperative Learning Model in the Undergraduate Science Laboratory Practices. *Universal Journal of Educational Research*, 5(3), 420–434. <https://doi.org/10.13189/ujer.2017.050314>
- Lubis, N. A., & Harahap, H. (2016). Pembelajaran Kooperatif Tipe Jigsaw. *Jurnal As-Salam*, 1(1), 96–102.
- Maarif, S., Wahyudin, W., Noto, M. S., Hidayat, W., & Mulyono, H. (2018). Geometry Exploration Activities Assisted With Dynamic Geometry Software (Dgs) in a Teacher Education Classroom. *Infinity Journal*, 7(2), 133. <https://doi.org/10.22460/infinity.v7i2.p133-146>
- Musna, R. R., Juandi, D., & Jupri, A. (2021). A meta-analysis study of the effect of Problem-Based Learning model on students' mathematical problem solving skills. *Journal of Physics: Conference Series*, 1882(1), 2–8. <https://doi.org/10.1088/1742-6596/1882/1/012090>
- Nurfitriyanti, M. (2017). Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw Terhadap Hasil Belajar Matematika Ditinjau Dari Kecerdasan Emosional Maya. *Jurnal Formatif*, 7(2), 153–162. <https://doi.org/10.31949/jcp.v8i4.2941>
- Poerwati, C. E., Suryaningsih, N. M. A., & Cahaya, I. M. E. (2020). Model Pembelajaran Kooperatif Tipe Jigsaw II dalam Meningkatkan Kemampuan Matematika Anak. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 5(1), 281. <https://doi.org/10.31004/obsesi.v5i1.496>
- Retnawati, H., Apino, E., Kartianom, Djidu, H., & Anazifa, R. D. (2018). *Pengantar Analisis Meta* (Issue July).
- Ribut, O. Y. P. (2021). Model Pembelajaran Kooperatif Jigsaw Pada Prestasi Matematika Siswa Sekolah Menengah Pertama. *Jurnal Jendela Pendidikan*, 1(02), 61–65. <https://doi.org/10.57008/jjp.v1i02.9>
- Rosdiana, R. (2021). *Studi Meta - Analisis Penggunaan Model Pembelajaran Kooperatif Terhadap Kemampuan Komunikasi Matematis Siswa*.
- Saputra, G. A. A., Agung, A. A. G., & Suwatra, I. W. (2017). Pengembangan Multimedia Interaktif Sebagai Suplemen Pembelajaran Kooperatif Tipe Stad Pada Mata Pelajaran Ips Kelas Viii Smp. *Jurnal Edutech Undiksha*, 05(1), 121–131.
- Sari, S. R., & Fitriani, D. (2018). Meningkatkan Komunikasi Matematis Melalui Model Pembelajaran Kooperatif Tipe Jigsaw. *Journal for Research in Mathematics Learning*, 1(1), 183–188. <https://doi.org/10.30605/pedagogy.v7i1.1801>
- Sarman, S. N., & Soebagyo, J. (2022). Analisis Bibliometrik terhadap Kemampuan Berpikir Kritis Matematika Berdasarkan Pemecahan Masalah Berbasis VOS Viewer.

- Vygotsky: *Jurnal Pendidikan Matematika Dan Matematika*, 4(2), 117–128.
- Saviraningrum, W., & Soebagyo, J. (2022). Analisis Bibliometrik dengan Kata Kunci Mathematical Critical Thinking Student Independent Menggunakan VOSviewer. *JKPM (Jurnal Kajian Pendidikan Matematika)*, 8(1), 1. <https://doi.org/10.30998/jkpm.v8i1.13529>
- Siswono, T. Y. E. (2014). Permasalahan Pembelajaran Matematika dan Upaya Mengatasinya. *FMIPA UNESA*, 1–9.
- Sukmawati, A. (2020). Meta Analisis Model Problem Based Learning Dalam Meningkatkan Kemampuan Berpikir Kritis Pada Pembelajaran Matematika. *Thinking Skills and Creativity Journal*, 3(2), 63–68. <https://doi.org/10.23887/tscj.v3i2.30211>
- Sulistiyowati, D. P., & Astuti, S. (2020). Efektivitas Model Pembelajaran Kooperatif Tipe Jigsaw Dan Student Teams Achievement Divisions (STAD) Ditinjau Dari Keterampilan Kerjasama Pada Mata Pelajaran Matematika Siswa Kelas 5 SD. *Jurnal Karya Pendidikan Matematika*, 7(1), 92. <https://doi.org/10.26714/jkpm.7.1.2020.92-103>
- Sumarmo, U. (2012). Pendidikan Karakter serta Pengembangan Berfikir dan Disposisi Matematik dalam Pembelajaran Matematika. *Seminar Pendidikan Matematika*, 1–26.
- Tamur, M., Subaryo, S., Ramda, A. H., Nurjaman, A., Fedi, S., & Hamu, A. (2021). Pengaruh Pembelajaran Kooperatif Tipe Jigsaw Terhadap Kemampuan Berpikir Kritis Siswa SMP. *Journal of Honai Math*, 4(2), 173–182. <https://doi.org/10.30862/jhm.v4i2.201>
- Timayi, J. M., Bolaji, C., & Kajuru, Y. K. (2015). Effects of Jigsaw IV Cooperative Learning Strategy (J4CLS) on Academic Performance of Secondary School Students in Geometry. *International Journal of Mathematics Trends and Technology*, 28(1), 12–18. <https://doi.org/10.14445/22315373/ijmtt-v28p504>
- Turyanto, T., Agustito, D., & Widodo, S. A. (2019). Think Pair Share With Comic For Mathematical Problem Solving Skills. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 9(3), 181–190. <https://doi.org/10.30998/formatif.v9i3.3773>
- Utami, P., Kadir, & Herlanti, Y. (2021). Meta-Analisis Pembelajaran Kooperatif di Indonesia. *Jurnal Inovasi Pendidikan IPA*, 7(1), 106–115. <https://doi.org/10.21831/jipi.v7i1.39574>
- Wardani, D. T. (2015). Pengaruh Pembelajaran Kooperatif Tipe STAD (Student Teams Achievement Divisions) Dan Jigsaw Terhadap Prestasi Belajar Ekonomi Ditinjau Dari Motivasi Belajar Siswa Tahun Ajaran 2014/2015. *EQUILIBRIUM: Jurnal Ilmiah Ekonomi Dan Pembelajarannya*, 3(2), 105–111. <https://doi.org/10.25273/equilibrium.v3i2.657>
- Werdiningsih, E., & Mukhlisin, M. I. (2021). Penerapan Model Pembelajaran Kooperatif Tipe Jigsaw di Kelas. *Jurnal Pendidikan Berkarakter*, 4(2), 60–65.
- Widarti, A. (2013). “Kemampuan Koneksi Matematis Dalam Menyelesaikan Masalah Kontekstual Ditinjau dari Kemampuan Matematis Siswa” (jurnal STKIP jombang, 2012). *Jurnal Pendidikan Matematika*, 1(003), 1–2.
- Widyastuti, E. (2015). Peningkatan Kemampuan Pemahaman Konsep Dan Komunikasi Matematis Siswa Dengan Menggunakan Pembelajaran Kooperatif Jigsaw. *Journal of Mathematics Education*, 1(1), 1–14.
- Wijayanti, A., & Kusdiyanta, A. (2019). Cooperative Skills Improvement Through Mind Mapping Assisted Pair Check Peningkatan Keterampilan Kooperatif Melalui Pair Check Berbantuan Mind Mapping. *Jurnal Ilmiah Pendidikan MIPA*, 9(3), 257–266. <https://doi.org/10.30998/formatif.v9i3.2927>
- Yayuk, E., Purwanto, As’Ari, A. R., & Subanji. (2020). Primary School Students’ Creative Thinking Skills in Mathematics Problem Solving. *European Journal of Educational Research*, 9(3), 1281–1295. <https://doi.org/10.12973/eu-jer.9.3.1281>

Author. / Formatif: Jurnal Ilmiah Pendidikan MIPA 10(1), 1-6

- Yeubun, I. Z. S., Noormia, A., & Ambarwati, L. (2020). The Effect of Jigsaw Cooperative Learning Methods on Mathematical Communication Ability Viewed Based on Student Personality. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 9(4), 333–338. <https://doi.org/10.30998/formatif.v9i4.4132>
- Zuhasni, N. (2022). *Penerapan Model Jigsaw untuk Meningkatkan Kemampuan Berpikir Kritis dan Hasil Belajar Siswa Kelas V SDN 2 Celala Aceh Tengah*.



Is the Jigsaw Model Still Relevant for Improving Mathematical Ability? Meta-Analysis Studies

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Abstract

The Jigsaw learning model focuses on student activities in learning in general and also has an influence on students' mathematical abilities, but there are also some that do not have a significant influence. This research attempts to answer how much influence the Jigsaw model has based on the desired categorical variables. Therefore, meta-analysis research is needed to provide comprehensive and in-depth conclusions about the application of the Jigsaw model to students' mathematical abilities. Comprehensive Meta-Analysis (CMA) is used to evaluate a property's value based on comparisons to similar properties in the same area. Data was obtained from Publish or Perish (PoP) with a total of 500 articles from 2010 to 2023 with the Google Scholar database. The number of journals that meet the requirements and will be analyzed is 30 sample articles with a total of 1252 students. The moderator variables in this study consider country, education level, sample size and publication source. Based on research findings, the Jigsaw model has a significant influence on numeracy skills (P-value 0.05), with an effect size of 1.146 which is classified as very high based on fixed effects and a standard error of 0.045. The research results show that the Jigsaw model is still relevant for improving students' mathematical abilities, especially at the elementary school level. This meta-analysis study reveals that there is no difference in the results of implementing the Jigsaw model on students' mathematical abilities in all country categories.

Keywords: Jigsaw model, mathematical abilities, meta-analysis

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INTRODUCTION

Recognize mathematics as an abstract science that is the basis for achieving other sciences. Mathematics complements all existing sciences ranging from science, technology, art and many others (Kamarullah, 2017). The level of difficulty in mathematics is often used as a benchmark in achieving success. No wonder many of the nation's students are required to be proficient in mathematics. Sometimes the difficulty in solving abstract problems often makes interest in learning decrease so that you are lazy to learn, this is a trigger factor for problems in learning (Siswono, 2014). In mathematics, mathematical ability is not only measured on one ability. Mathematical abilities are grouped into five understandings ranging from mathematical understanding, problem solving, reasoning, connection and communication (Sumarmo, 2012). Mathematics learning must instill rational thinking processes with the laws of mathematical logic to develop thinking processes in solving mathematical problems (Maarif et al., 2018). In understanding logic, of course, requires motivation and good learning and teaching. Not all teaching provided is able to make some students interested in learning. Therefore, as a good teacher, there needs to be variety in providing learning models. This variant is used to ensure the learners grasp the topic and that objectives for learning are achieved. Currently, there are many learning models that are often found, ranging from Problem Based Learning (PBL), Project

Based Learning (PBjL), Realistic Mathematics Education (RME), to Cooperative Learning (CL). The development of technology, a lot of research related to learning. In fact, not a few studies that vary learning with other methods.

Cooperative learning was first studied in 1898 by Roger and Johnson in about 600 experiments. Cooperative learning is learning that creates interaction between group members and teachers try to condition it by motivating students to always develop a sense of mutual need in a team (Jaelani, 2015). Social behavior learning is specifically developed to assist students in collaborating while learning. Cooperative learning is a learning paradigm in which students participate and interact with one another in small groups of four to six persons (Saputra et al., 2017). There are various variations of models that can be used in cooperative learning, namely (1) Student Team Achievement Division (STAD), (2) Group Investigation, (3) Jigsaw, (4) Think-Pair-Share, (5) Inside-Outside Circle, (6) Make a Match, (7) Listening Team, (8) The Power of Two, and (9) Bamboo Dancing.

Jigsaw is one of the models of cooperative learning. One of the reasons why the Jigsaw model was chosen to be researched through meta-analysis is because there are not many similar studies that specifically examine it in mathematics learning. Jigsaw type learning is learning in a learning group where there is interaction between each group member and has responsibility for the material in the group and the ability to master and teach the topic to the other members of the group (Lubis & Harahap, 2016). The initial group and the expert group are displayed in the puzzle cooperative learning paradigm. The origin group, or parent group of students, consists of students from different racial, ethnic, and socioeconomic backgrounds. While the expert group consists of members of different origin groups and is tasked with researching and studying certain subjects while carrying out tasks that will be communicated to members of the origin group. A number of specialists from the initial group have been combined to form the expert group. Being interconnected with each other where each student is able to convey the information needed to their teammates so that the goal in solving problems can be achieved is the key to the success of Jigsaw (Werdiningsih & Mukhlisin, 2021). In this learning students work in a team and are assigned to read and study a subject. Random selection is made for each member of the group who is designated as an expert in a particular field. Furthermore, the experts reported to the group and met with other groups to discuss the material learned then returned to their group to teach the material to their teammates (Widyastuti, 2015). The characteristic of the Jigsaw type that distinguishes it from other types of cooperatives is that there are study groups and specialist groups (Hibattulloh & Sofyan, 2014).

One of the learning models that can promote student activity, involvement, and knowledge of the material is cooperative learning. The Jigsaw cooperative learning model is one example (Nurfitriyanti, 2017). This learning model is possible to be applied to young children, because this type of children is also divided into several heterogeneous groups according to ability and gender, so that group characters are formed into parallels (Poerwati et al., 2020). The Jigsaw cooperative paradigm is intended to improve students' problem-solving and critical thinking abilities because in discussion activities students are grouped into specialist groups and origin teams to solve mathematical problems (Handayani, 2020).

In understanding abstract science, the ability to train critical thinking needs to be taught to students (Sarman & Soebagyo, 2022). Critical thinking is the ability of human thinking that has systematic and logical steps (Saviraningrum & Soebagyo, 2022). Thinking logically means being precise, which is an important skill for life and work to work effectively in all areas of life. The advantage in critical thinking, we can assess the level of thoroughness or truth of the question and without any information it is not easy to express what we want to convey (Zuhasni, 2022). In addition, mathematical creative thinking skills, namely the ability to think based on data and information, are available to find possible answers to such problems from different points of view on problems in each

individual where it is more emphasized the suitability of answers and the versatility of answers (Yayuk et al., 2020). That is, creative thinking skills should belong to everyone (Florentina & Leonard, 2017). No less important, to find relationships from a representation of concepts and procedures, to grasp between mathematical themes and apply mathematical concepts in other fields or daily life, the capacity to make mathematical connections is required (Widarti, 2013).

The Jigsaw model, which is derived from research findings, assists students in understanding the findings they make (Sari & Fitriani, 2018). In other studies there is an influence on the mathematical ability of students but there are also those that do not have a significant influence. Of course, in various studies there are different kinds of conclusions even though the variables studied have similarities. Based on the existing problems, Meta-analysis can provide comprehensive and in-depth conclusions on certain variables or topics that want to be discussed. This study can answer how much influence the Jigsaw model has based on the desired category variables. One of the research results showed that there was a significant increase in students' mathematical abilities after attending Jigsaw model lectures with discussion assessments and based only on the findings of the initial and final tests (Edriati et al., 2015).

METHODS

This study focuses on quantitative data research analysis based on Google Scholar database sources, specifically to investigate *Jigsaw models* with *math ability*. The purpose of this analysis was to identify the magnitude of the influence on the Jigsaw model and to investigate the impact of characteristics on mathematical ability in determining the variation in effect size of each available research. Analysis using a meta-analysis approach is used to achieve this purpose. Meta-analysis is used to compare primary study with other scientific advancements in the form of drawing statistical findings in the form of effect size on quantitative data studies based on relevant themes (Rosdiana, 2021). The steps in compiling the meta-analysis, starting from; (1) choose the criteria for the article to be researched, (2) look for literature sources related to relevant research to be used, (3) code the article to be used, (4) conduct analysis and classification, (5) interpret findings based on the article under study (Sukmawati, 2020).

Literary Search

This research uses the Google Scholar database as a location for document search. Furthermore, the use of Publish or Perish is applied as a reference in downloading studies related to the application of the Jigsaw model by combining keywords into Jigsaw and math ability (Eryanti & Soebagyo, 2021; Haniyah & Soebagyo, 2021; Sarman & Soebagyo, 2022). Seen in Figure 1, it is obtained that the search process for the application of the Jigsaw model on Google Scholar using the PoP application reaches 500 data.

Search terms	Source	Papers	Cites	Cites/y...	h	g	h-index	h-index...	h-index...	Search date	Cache date	Let...
✓ jigsaw, math ability from 2010 to 2023	Google Sc...	500	29230	2248.46	70	163	50	3.45	24	13/05/2023	13/05/2023	0
✓ math props from 2010 to 2023	Google Sc...	981	463553	15842.54	294	657	232	17.85	103	12/05/2023	12/05/2023	0
✗ jigsaw, mathematical ability	Google Sc...	0	0	0.00	0	0	0	0.00	0	22/05/2023	22/05/2023	514
✗ mathematical communication ...	Google Sc...	998	236241	47248.20	186	443	129	25.80	100	16/11/2022	16/11/2022	0
✗ ethnomathematics	Google Sc...	100	10772	295.14	34	100	43	1.16	16	23/10/2022	23/10/2022	0

Cites	Per year	Rank	Authors	Title	Year	Publication	Publisher	Type
41	5.86	2	I Dwi, M Sinarup...	The Effect of the Jigsaw Cooperative...	2020	Journal of Education and ...	ERIC	
14	2.80	3	S Sumarni, D Darh...	The student's mathematical conc...	2018	Journal of Physics ...	logscience.iap.org	
34	6.80	4	DP Sari, E Syahput...	An analysis of spatial ability and t...	2018	American ...	article.sciencedirect.com	PDF
22	2.75	5	S Edwar, V Anggr...	Electronics Model Jigsaw Disoriet...	2015	Jurnal Cakrawala Pendidik...	journal.uns.ac.id	
4	1.33	6	Adi Dians, D Drij...	Mathematical creative thinking a...	2020	Unnes Journal of Mathem...	journal.unnes.ac.id	
23	6.25	7	E Eriana, K Kartan...	Understanding Ability of Mathem...	2019	Journal of Primary Educat...	journal.unnes.ac.id	
2	0.67	8	DS Yekson, A Nio...	The Effect of Jigsaw Cooperative ...	2020	Forum: Jurnal Ilmiah ...	journal.ippmunvita.ac.id	
8	4.00	9	H Gafalah, S Spat...	Student team achievement divisi...	2021	Desimal: Jurnal ...	ejournal.desimal.uns.ac.id	
46	5.75	10	F Maende, A Bey...	The discrepancy of students' mat...	2015	International Journal of ...	ijem.com	PDF
1	0.20	11	DR Sitis, E Surya...	Differences Ability of Problem Sol...	2018	3rd Annual International ...	atlantispress.com	
19	2.11	12	K Sari, M Idris...	Minimizing Kemampuan Pem...	2014	Jurnal Didakta Matematika	jurnal.uns.ac.id	
21	2.33	13	C Young, E Carlin...	Gesture and speech input are inte...	2014	Proceedings of the ...	scholarship.org	PDF
60	5.45	14	C Dennen, C Buch...	The jigsaw technique and self-eff...	2012	European journal of phys...	Springer	
44	11.00	15	R Ferman, C Melon...	Visual and spatial working memori...	2019	Frontiers in Psychology	frontiersin.org	HTML
14	2.33	16	M Juliana, E Surya	An Analysis Of Jigsaw Cooperative...	2017	Of Advance Research A...	researchgate.net	PDF
4	0.80	17	AA Sitoraj, H Ma...	THE DIFFERENCE OF STUDENTS' ...	2018	Journal of Mathematic...	core.ac.uk	PDF
5	1.00	18	AA Sitoraj, H Ma...	... OF STUDENTS' ACHIEVEMENT L...	2018	Infinity Journal	ejournal.digiliving.ac...	

Figure 1. Google Scholar database search results (Jigsaw, Math ability)

Literary Inclusion Criteria

Throughout the present investigation, the research that was successfully found using the PoP software was then collated based on the requirements listed following: (1) write keywords using English settings, then retrieve the Google Scholar database at a vulnerable time between 2010-2023 due to the novelty and dynamics of research, (2) statistical information is used to obtain the effect size value. And journals or study criteria that do not match will be removed from the analysis data, and (3) learning to use a quantitative approach where in quantitative data there must be control groups and experiments. Journals or papers with just a single sample and a qualitative approach will be excluded from the data analysis. The data screening in this investigation was done using the PRISMA protocols shown in Figure 2.

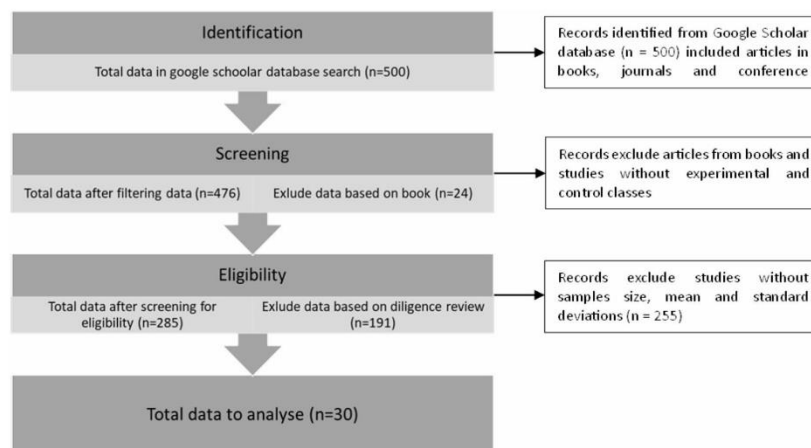


Figure 2. Filter data using PRISMA

Coding

All studies that match the criteria are coded manually using a detailed coding scheme based on protocols. In this study, the criteria was carried out using the provision of

codes (*categories*). Coding is carried out to separate individual data information into numerical data. Random samples from 5 valid studies were reproduced and divided among 3 coders from one research group to determine reliability. Three coders were provided with a copy of the article, as well as the coding form and protocol. To assess the reliability of this coder, the following formula was used to calculate the percentage agreement (PA). In this scenario, N_A represents the total number of agreements, while N_P represents the entire number of disagreements.

$$PA = \frac{N_A}{N_A + N_P} \times 100\%$$

Statistical Analysis

The data was evaluated with the CMA application, with special attention paid to the effect size, which is defined as the influence of the Jigsaw approach on students' mathematical skills. The Comprehensive Meta-Analysis is beneficial for adjusting the effect size of research, including the overall effect size, P-value, Q-statistic, and confidence interval. In addition, the program creates research forest plots and funnel plots. The g Hedges measure was utilized in this analysis, and the size effect (δ) was classified as $\delta < 0.2$ (negligible), $0.2 \leq \delta < 0.5$ (small effect), $0.5 \leq \delta < 0.8$ (moderate effect), $0.8 \leq \delta < 1.3$ (big effect), and $1.3 \leq \delta$ (very large effect) (Cohen et al., 2007). The random effect technique was chosen as the estimation method since there is no assumption that all research have the same effect. The randomized effect model in this study was selected after a successful heterogeneity test. The p value is used to perform this test. If the p-value is less than 0.05, all studies will be identical, and the null hypothesis and homogeneity will be rejected. The rejection of the null hypothesis suggests that population parameters may not be measured with the same effect size across studies or study groups (Retnawati et al., 2018). There is evidence that different study categories have different effects on study effect sizes.

To avoid misrepresentation of results, publication bias is checked. Publication bias is the likelihood that studies appearing in published literature are considered statistically significant to be published (Cooper et al., 2009). In anticipation, a bias analysis was carried out on the funnel plot to see if the research was free from bias. When the distribution of impact sizes on vertical lines was symmetrical, publication bias was judged strong in this study. However, if the size distribution of the effect is not perfectly symmetrical, it is necessary to use the trim and fill method. If the observed effects and virtual effects generated by randomized effects models are found to be similar, then the study is immune to publication bias.

RESULTS & DISCUSSION

Results

Literature Search Results

The goal of this study was to determine whether the magnitude of the effect created had an effect on learning the Jigsaw model and mathematical competence based on category variables. Therefore, researchers try to search literature using PoP software by applying several criteria. The first criterion, researchers use vulnerable research time in 2010 – 2023. Furthermore, the second criterion of researchers used the keywords Jigsaw and Math ability, and the maximum number of results was limited to 500 document. From the topics used, 500 articles were collected with 24 data coming from books and the rest comes from a combination of journals and conference proceedings.

Literature Selection Results

After setting criteria for literature search, the researcher converts the data into excel and eliminates the data in the appropriate journal. First, researchers filter data that is included in journals and conference proceedings. Second, researchers use a quantitative approach to collect data that has an experimental class and a control class. Third, researchers collect statistical data such as the samples size, mean and standard deviations. This statistical data aims to calculate the size of the effect to be studied. Furthermore, screening through the PRISMA method is carried out to ensure the accuracy of the data obtained. Not only that, but researchers must guarantee that the journal's title and theme are consistent with the criteria variables.

Results Criteria

The results of the criteria in this study focused on vulnerable years 2010 - 2023. The selection of criteria on this year's vulnerability was carried out to ensure that the available research is up-to-date. From the results of the criteria that have been filtered, researchers consider choosing research sourced from journals and proceedings. In addition, researchers also obtained various journals from various countries with the same topic, ranging from Asian to European countries. Furthermore, researchers consider the degree of education beginning with (pre-school, elementary, junior high, high school, and university). The many variations that have been studied at this level of education add to the accuracy of a study. Furthermore, researchers also looked at the number of sample sizes in a study and paid attention to whether each of these journals had a control class and an experimental class. The selected research is also equipped with post-test and pre-test data, mean and standard deviations to see the extent of the data spread and whether there are data deviations in the mean.

Statistical Analysis Results

The results of the study here aim to answer the research question. Figure 3 depicts the findings of a meta-analysis of 30 filtered and collected data from Google Scholar. Figure 3 contains the identification of the names of the studies. Furthermore, the magnitude of the effect is shown which contains the results of the intervention. It can be seen that there is 1 data that is less than 0 or under consideration, while the average confidence interval that stretches horizontally or is more than 0 is on the right. This means that the effects of the intervention are beneficial. In addition, Figure 3 also shows the heterogeneity of a data to see discrepancies in the source of findings from the study.

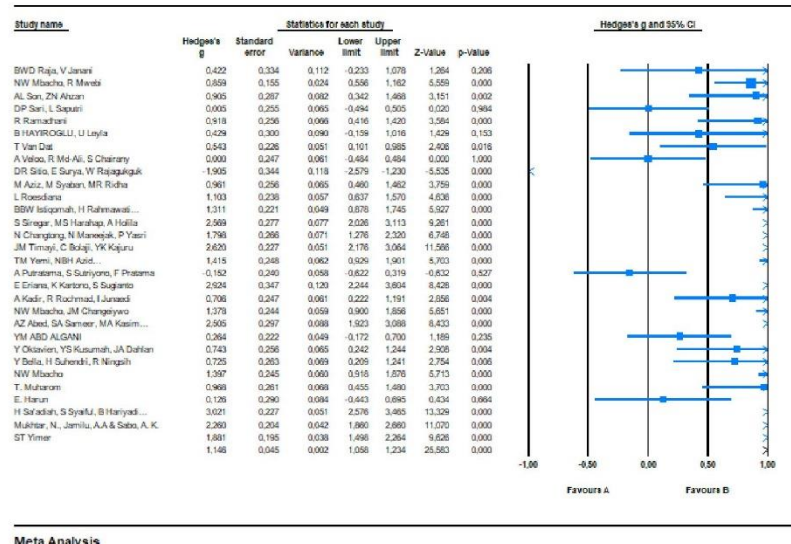


Figure 3. Research Forest Plot

According to Figure 3, there is an inconsistent response rate. It is clear that the research is likely to be diverse. As a result, it must be statistically examined such that the starting assumptions are consistent with the estimation approach.

Model	N	Hedge's	Standard error	Test of null		Q	P	Decision
				Z-value	P-value			
Fixed-effects	30	1.146	0.045	25.583	0.000	447.062	0.000	Reject
Random-effects	30	1.095	0.177	6.189	0.000			

Figure 4. Meta Results - Analysis according to the Estimation method

Figure 4 displays the findings of a meta-analysis of 30 articles from international conference proceedings and journals. Several examples of international conference and journal proceedings can be seen in Figure 1. Figure 4 shows that the P value is 0.05, indicating that each study has a diverse effect size. Therefore, a fixed effect model with a very high effect size of 1.146 was used. Using a null test obtained P less than 0.05 with a fixed effects model. In addition, a z value of 25,583 was obtained indicating that the research results were significant for $P < 0.05$ (Musna et al., 2021). To put it another way, the Jigsaw-type learning model has a big impact on mathematical ability.

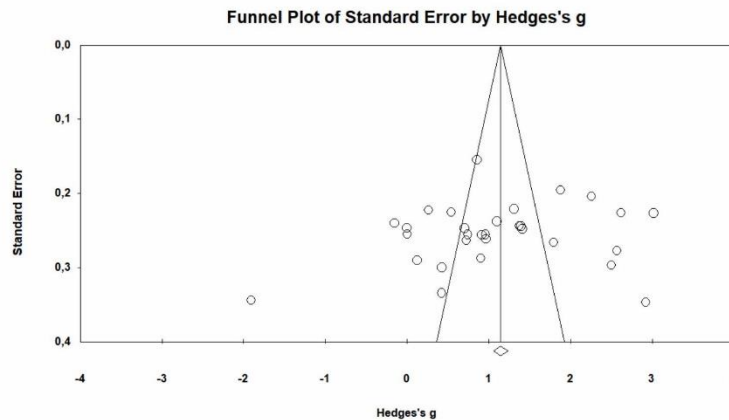


Figure 5. Funnel plot of 30 samples

Then, as shown in Figure 4, we will show a funnel plot with the research spread out and not symmetrical in the funnel, requiring trim and fill to check whether there is a difference with the influence of publication bias. In addition, trim and fill was performed to estimate potentially missing studies due to publication bias.

Duval and Tweedie's trim and fill

	Fixed Effects			Random Effects			Q Value
	Studies Trimmed	Point Estimate	Lower Limit	Upper Limit	Point Estimate	Lower Limit	Upper Limit
Observed values		1,14597	1,05817	1,23376	1,09469	0,74799	1,44139
Adjusted values	0	1,14597	1,05817	1,23376	1,09469	0,74799	1,44139

Figure 6. Trim and Fill

The findings of trim and fill in Figure 5 indicate that there is no difference or opposite according to the fixed effect model, so no research or study is trimmed or added to this study. The overall effect size is 1.14597 rounded up to 1.146 is a very high value for an effect size.

Furthermore, in addressing the research question, it is demonstrated that the estimation approach, as previously stated, matches the fixed effect model. This shows that the effect sizes of each study are varied, necessitating a detailed examination of the categorical factors influencing the association between the Jigsaw learning model and mathematical competence. As a result, Figure 6 shows the summary results of the category variable analysis.

No	Variabel Moderator	Group	N	Combined Effect Size (Hedge's g)	Test of null (2-Tail)		Heterogeneity			Decision
					Z	P-value	Between-Classes Effect (Q-value)	Df (Q)	P-value	
1	Country	Indonesia	15	0.99	3.439	0.001	0.331	1	0.565	Accept H_0
		Overseas	15	1.199	5.412	0				
2	Educational Level	University	4	1.172	3.797	0	32.466	4	0	Reject H_0
		High School	9	0.942	3.672	0				
		Primary School	15	1.09	3.702	0.000				
		Elementary	1	2.924	8.428	0.000				
		Pre School	1	0.429	1.429	0.153				
3	Sample Size	30 or less	7	0.114	0.361	0.000	12.005	1	0.001	Reject H_0
		31 or more	23	1.384	7.51	0.000				
4	Publication Source	Journal	29	0.178	5.919	0.000	19.84	1	0	Reject H_0
		Proceeding	1	2.26	11.07	0.000				

Figure 7. Summary of Category Variable Analysis

Country

The effect size in Indonesian study was 3.439, whereas the effect size in international research was 5.412. According to the heterogeneity of Q-value = 0.331 and $p > 0.05$, it is clear that research in Indonesia has a significant effect, as does research abroad. Further testing shows that research in Indonesia and abroad has effects that are not significantly different. This means that the results of Indonesian and foreign research are identical.

Education Level

According to Figure 6, the effect size at the education level is as follows: Pre-school (0.429), Elementary (2.924), Junior High School (1.09), Senior High School (0.942), and University (1.172). Heterogeneity tests yielded Q-value = 32.466 and $p < 0.05$, indicating that the application of Jigsaw learning to mathematical abilities was influential at all stages of schooling, from pre-primary to university.

Sample Size

Based on Table 2. It was shown that a sample size with a group of 30 or less had an effect size of 0.114, while a sample size with a group of 31 or more had an effect size of 1.384. Based on the heterogeneity test, Q-value = 12.005 and $p < 0.05$. In this situation, it suggests that the sample size influences Jigsaw model with students' mathematical abilities.

Publication Source

According to the publication source, the effect size of journal research was 0.178, whereas the effect size of proceedings research was 2.26. Judging from the heterogeneity of Q-value = 19.84 and $p < 0.05$, publication type shows that Jigsaw learning affects students' mathematical abilities.

Discussion

Essentially, the purpose of this study is to determine whether the Jigsaw approach has a significant impact on students' mathematical abilities. Based on the analysis, an effect size of 1.146 was obtained, which shows that this study has a considerable influence. In accordance with the research that has been conducted, there is a possibility that students can contribute to solving problems in group discussions using the Jigsaw learning model, due to its significant influence (Tamur et al., 2021).

The number of subjects studied in this study was 1252 with an average of 69 students. In this case, the effect size of 1.146 shows that the Jigsaw model affects

mathematical ability (Cohen et al., 2018). In line with other studies, learning using the Jigsaw model is more fun than ordinary learning because students can find information from other groups (Wardani, 2015). Next, researchers conducted an analysis based on categorical variables. It can be seen that the amount of the influence in this study is clarified beginning with the level of education, country, sample size, and publication source.

Analysis of country categories found that research in Indonesia and abroad showed that research in Indonesia and abroad has effects that are not significantly different. This means that the results of Indonesian and foreign research are identical. In this study, the number of samples from 30 papers is comparable. This means that in addition to Indonesia, abroad this research has been carried out a lot even not a few who use modifications to the variables studied with the main variable being Jigsaw learning. For example, research (Abed et al., 2020) that predicts Jigsaw-type learning strategies on students' mathematics learning achievement. Furthermore, other data show that the Jigsaw model of learning geometric information is more effective than the lecture method (Timayi et al., 2015). Another study related to Jigsaw learning in Turkey states that there is an influence on students' abilities in natural science laboratory practice (Karacop, 2017).

Next, analyze category variables related to education level. Judging from the comparison of the magnitude of the effect size between Pre-School: Elementary: Junior High: High School: University (0.429: 2.924: 1.09: 0.942: 1.172), the research results show that the Jigsaw model of learning has a big influence from elementary to tertiary level, but not at the pre-school level. The effect size of the implementation of the Jigsaw model at the pre-school level is in the small effect category because the model only influences the choice of learning goals in young children and encourages children to change their learning goals while doing the task (Leclercq et al., 2022). On the other hand, one of the research results showed a decrease in the average score during the four treatments using the Jigsaw model in social learning, although there was an average increase between the pre-test and post-test of 5% (Karta et al., 2021).

The findings also show that learning mathematics using the Jigsaw model is more effective at the elementary level than at other levels. According to research (Sulistyowati & Astuti, 2020), the Jigsaw model of learning has a high level of cooperation as indicated by post-test and pre-test findings. This finding is in line with other research which states that the jigsaw model is an active learning model that has a higher level of social connectedness when Jigsaw type cooperative learning is used (Costouros, 2020). Other findings show that the Jigsaw model influences students' motivation in learning mathematics (Amin et al., 2020), mathematical representation abilities (Rambe et al., 2020), retention (Baken et al., 2020), collaboration abilities (Chang & Benson, 2020), and communication skills (Namaziandost et al., 2020). Although this is a contradiction where learning mathematics using the Jigsaw model at the high school level affects students' mathematical communication skills (Yeubun et al., 2020).

Learning mathematics using the Jigsaw model, as shown in Figure 6, also demonstrates that many research samples were collected at the secondary school level. This happens because the level of thinking has entered the formal stage. On the other hand, this learning triggers the psychology of students to be curious about their peers (Utami et al., 2021). In addition to their mathematical abilities, students' mathematical successes have beneficial consequences after the Jigsaw learning approach is implemented (Ribut, 2021). However, other studies on cooperative learning with the type of Think Pair Share aided by comics show that it is no better than not using comics to develop problem-solving skills (Turyanto et al., 2019). However, Pair Check cooperative learning has been shown to improve students' overall cooperative abilities (Wijayanti & Kusdiyanta, 2019).

In this study, sample size was also applied to categorical variables to clarify the size of the effect on the study. The findings showed that (31 or more) had a greater influence

than other categories. This study also conducted an analysis of publication sources on categorical variables. Based on the findings, one literature was obtained from proceedings and 29 other literature was obtained from journals. These data imply that the study was free of publication bias, which is supported by trim and fill.

Many studies are not taken or do not fall into the required category while examining this research. Such research conducted by (Budiawan & Arsani, 2013) using the same variables but carried out on sports subjects. In addition, there are also some unqualified studies where there is a lack of pretest data as a control study. Of the 500 data collected, only about 30 studies were included in the requirements after several screenings. And obviously, it does not end there; this study needs to be researched further to determine its effectiveness.

CONCLUSION

This research was conducted by taking articles from proceedings and international journals in the range of 2010 – 2023. A meta-analysis research with 30 samples revealed a fixed effect with an effect size of 1.146, indicating that mastering the Jigsaw technique had a significant impact on students' mathematical abilities. This means that Jigsaw learning is still relevant to improve students' mathematical skills. Furthermore, this study was conducted analysis based on category variables divided into four variables. Based on the analysis of education levels, it was discovered that the degree of the influence varied depending on the study. However, learning using the Jigsaw model is more influential at the elementary level than other levels. In addition, the number of samples in 31 or more has a higher effectiveness and also publication sources based on journals have more significant influence, meanwhile, analysis of country categories shows that there are no differences in the results of implementing the Jigsaw model for research in Indonesia or abroad.

In the world of education, the application of the Jigsaw model is quite effective, as proven by the findings of several studies, especially at the elementary school level, where students enjoy playing and studying in groups, exchanging information, and working together to find information. This research has limitations because the samples in this research were obtained from Google Scholar using PoP software, which means that there are still many other research samples that were not carried out due to access or payment constraints. Recommendations for further research are to re-examine the same themes using the Scopus database, and compare the implementation of the Jigsaw model in mathematics learning with other models.

CONFLICT OF INTEREST

There is no conflict of interest

ACKNOWLEDGEMENT

REFERENCES

- Abed, A. Z., Sameer, S. A., Kasim, M. A., & Othman, A. T. (2020). Predicting Effect Implementing the Jigsaw Strategy on the Academic Achievement of Students in Mathematics Classes. *International Electronic Journal of Mathematics Education*, 15(1), 1–7. <https://doi.org/10.29333/iejme/5940>
- Amin, M., Nur, F., Diah, M., Damayanti, E., & Harti, S. (2020). The Influence of Jigsaw-

- type Cooperative Learning Model on Students' Mathematics Learning Outcomes and Motivation. *Desimal: Jurnal Matematika*, 3(3), 235–246. <https://doi.org/10.24042/djm.v3i3.6831>
- Baken, E. K., Adams, D. C., & Rentz, M. S. (2020). Jigsaw method improves learning and retention for observation-based undergraduate biology laboratory activities ABSTRACT. *Journal of Biological Education*, 00(00), 1–6. <https://doi.org/10.1080/00219266.2020.1796757>
- Budiawan, M., & Arsani, N. L. K. A. (2013). Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw dan Motivasi Belajar Terhadap Prestasi Belajar Ilmu Fisiologi Olahraga. *Pendidikan Indonesia*, 2(1), 138–144. <https://doi.org/10.3102/0013189X18785613>
- Chang, W. L., & Benson, V. (2020). Jigsaw teaching method for collaboration on cloud platforms. *Innovations in Education and Teaching International*, 00(00), 1–13. <https://doi.org/10.1080/14703297.2020.1792332>
- Cohen, L., Manion, L., & Morrison, K. (2007). Book Reviews Research Methods in Education. *The Austr Alian Educational Researcher*, 2, 147–156.
- Cohen, L., Manion, L., & Morrison, K. (2018). Research Methods in Education. In *Jurnal Penelitian Pendidikan Guru Sekolah Dasar* (Vol. 6, Issue August).
- Cooper, H., Hedges, L. V., & Valentine, J. C. (2009). Handbook of Research Synthesis and Meta-Analysis 2nd Edition. In *The Lancet* (Vol. 389, Issue 10082).
- Costouros, T. (2020). Jigsaw Cooperative Learning Versus Traditional Lectures : Impact on Student Grades and Learning Experience. *Teaching & Learning Inquiry*, 8(1), 154–172.
- Edriati, S., Anggraini, V., & Siska, M. (2015). Efektivitas Model Jigsaw Disertai Penilaian Diskusi Untuk Meningkatkan Kemampuan Matematis Mahasiswa. *Jurnal Cakrawala Pendidikan*, 2(2), 288–295. <https://doi.org/10.21831/cp.v2i2.4833>
- Eryanti, I., & Soebagyo, J. (2021). Bibliometric Analysis of Blended learning Mathematics in Scientific Publications Indexed by Scopus. *Numerical: Jurnal Matematika Dan Pendidikan Matematika*, 91–102.
- Florentina, N., & Leonard, L. (2017). Pengaruh Model Pembelajaran Kooperatif Terhadap Kemampuan Berpikir Kreatif Matematis Siswa. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 7(2), 96–106. <https://doi.org/10.30998/formatif.v7i2.1877>
- Handayani, H. (2020). Pengaruh Implementasi Pembelajaran Kooperatif Tipe Jigsaw Terhadap Kemampuan Berpikir Kritis Matematis Siswa Sekolah Dasar. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, 5(1), 50–60. <https://doi.org/10.23969/jp.v5i1.1944>
- Haniyah, D., & Soebagyo, J. (2021). Analisis Bibliometrik Terhadap Kemampuan Komunikasi Matematis Dalam Pembelajaran Matematika Berdasarkan Perbedaan Gender berbasis VOSViewer. *Buana Matematika: Jurnal Ilmiah Matematika Dan Pendidikan Matematika*, 11(2), 121–136.
- Hibattulloh, N., & Sofyan, D. (2014). Perbandingan Kemampuan Komunikasi Matematis Siswa Antara Yang Menggunakan Model Pembelajaran Kooperatif Tipe Jigsaw Dengan Konvensional (Studi Quasi Eksperimen di Kelas VII SMP Negeri 2 Bayongbong). *Jurnal Pendidikan Matematika*, 3(3), 169–178.
- Jaelani, A. (2015). Pembelajaran Kooperatif, Sebagai Salah Satu Model Pembelajaran Di Madrasah Ibtidaiyya (MI). *Al Ibtida: Jurnal Pendidikan Guru MI*, 2(1), 1–16. <https://doi.org/10.24235/al.ibtida.snj.v2i1.189>
- Kamarullah, K. (2017). Pendidikan Matematika Di Sekolah Kita. *Al Khawarizmi: Jurnal Pendidikan Dan Pembelajaran Matematika*, 1(1), 21. <https://doi.org/http://dx.doi.org/10.22373/jppm.v1i1.1729>
- Karacop, A. (2017). The Effects of Using Jigsaw Method Based on Cooperative Learning Model in the Undergraduate Science Laboratory Practices. *Universal Journal of Educational Research*, 5(3), 420–434. <https://doi.org/10.13189/ujer.2017.050314>

- Karta, I. W., Rachmayani, I., & Rasmini, N. W. (2021). The Influence of Cooperative Learning Through Authentic Assessment-Based Jigsaw on Social Development of Early Childhood. *JPI (Jurnal Pendidikan Indonesia)*, 10(4), 633–642. <https://doi.org/10.23887/jpi-undiksha.v10i4.34353>
- Leclercq, M., Gimenes, G., Maintenant, C., & Clerc, J. (2022). Goal choice in preschoolers is influenced by context, cognitive flexibility, and metacognition. *Frontiers in Psychology*, 13(February), 1–19. <https://doi.org/10.3389/fpsyg.2022.1063566>
- Lubis, N. A., & Harahap, H. (2016). Pembelajaran Kooperatif Tipe Jigsaw. *Jurnal As-Salam*, 1(1), 96–102.
- Maarif, S., Wahyudin, W., Noto, M. S., Hidayat, W., & Mulyono, H. (2018). Geometry Exploration Activities Assisted With Dynamic Geometry Software (Dgs) in a Teacher Education Classroom. *Infinity Journal*, 7(2), 133. <https://doi.org/10.22460/infinity.v7i2.p133-146>
- Musna, R. R., Juandi, D., & Jupri, A. (2021). A meta-analysis study of the effect of Problem-Based Learning model on students' mathematical problem solving skills. *Journal of Physics: Conference Series*, 1882(1), 2–8. <https://doi.org/10.1088/1742-6596/1882/1/012090>
- Namaziandost, E., Gilakjani, A. P., & Hidayatullah. (2020). Enhancing pre-intermediate EFL learners' reading comprehension through the use of Jigsaw technique. *Cogent Arts and Humanities*, 7(1). <https://doi.org/10.1080/23311983.2020.1738833>
- Nurfitriyanti, M. (2017). Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw Terhadap Hasil Belajar Matematika Ditinjau Dari Kecerdasan Emosional Maya. *Jurnal Formatif*, 7(2), 153–162. <https://doi.org/10.31949/jcp.v8i4.2941>
- Poerwati, C. E., Suryaningsih, N. M. A., & Cahaya, I. M. E. (2020). Model Pembelajaran Kooperatif Tipe Jigsaw II dalam Meningkatkan Kemampuan Matematika Anak. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 5(1), 281. <https://doi.org/10.31004/obsesi.v5i1.496>
- Rambe, N., Syahputra, E., & Elvis, E. (2020). The Effect of the Jigsaw Cooperative Learning Model and the Student's Initial Mathematical Abilities and Its Effect on the Mathematical Representation Ability and Learning Motivation of Students in the PAB 10 Sampali Private Elementary School. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, 3(3), 1591–1599. <https://doi.org/10.33258/birle.v3i3.1249>
- Retnawati, H., Apino, E., Kartianom, Djidu, H., & Anazifa, R. D. (2018). *Pengantar Analisis Meta* (Issue July).
- Ribut, O. Y. P. (2021). Model Pembelajaran Kooperatif Jigsaw Pada Prestasi Matematika Siswa Sekolah Menengah Pertama. *Jurnal Jendela Pendidikan*, 1(02), 61–65. <https://doi.org/10.57008/jjp.v1i02.9>
- Rosdiana, R. (2021). *Studi Meta - Analisis Penggunaan Model Pembelajaran Kooperatif Terhadap Kemampuan Komunikasi Matematis Siswa*.
- Saputra, G. A. A., Agung, A. A. G., & Suwatra, I. W. (2017). Pengembangan Multimedia Interaktif Sebagai Suplemen Pembelajaran Kooperatif Tipe Stad Pada Mata Pelajaran Ips Kelas Viii Smp. *Jurnal Edutech Undiksha*, 05(1), 121–131.
- Sari, S. R., & Fitriani, D. (2018). Meningkatkan Komunikasi Matematis Melalui Model Pembelajaran Kooperatif Tipe Jigsaw. *Journal for Research in Mathematics Learning*, 1(1), 183–188. <https://doi.org/10.30605/pedagogy.v7i1.1801>
- Sarman, S. N., & Soebagyo, J. (2022). Analisis Bibliometrik terhadap Kemampuan Berpikir Kritis Matematika Berdasarkan Pemecahan Masalah Berbasis VOS Viewer. *Vygotsky: Jurnal Pendidikan Matematika Dan Matematika*, 4(2), 117–128.
- Saviraningrum, W., & Soebagyo, J. (2022). Analisis Bibliometrik dengan Kata Kunci Mathematical Critical Thinking Student Independent Menggunakan VOSviewer.

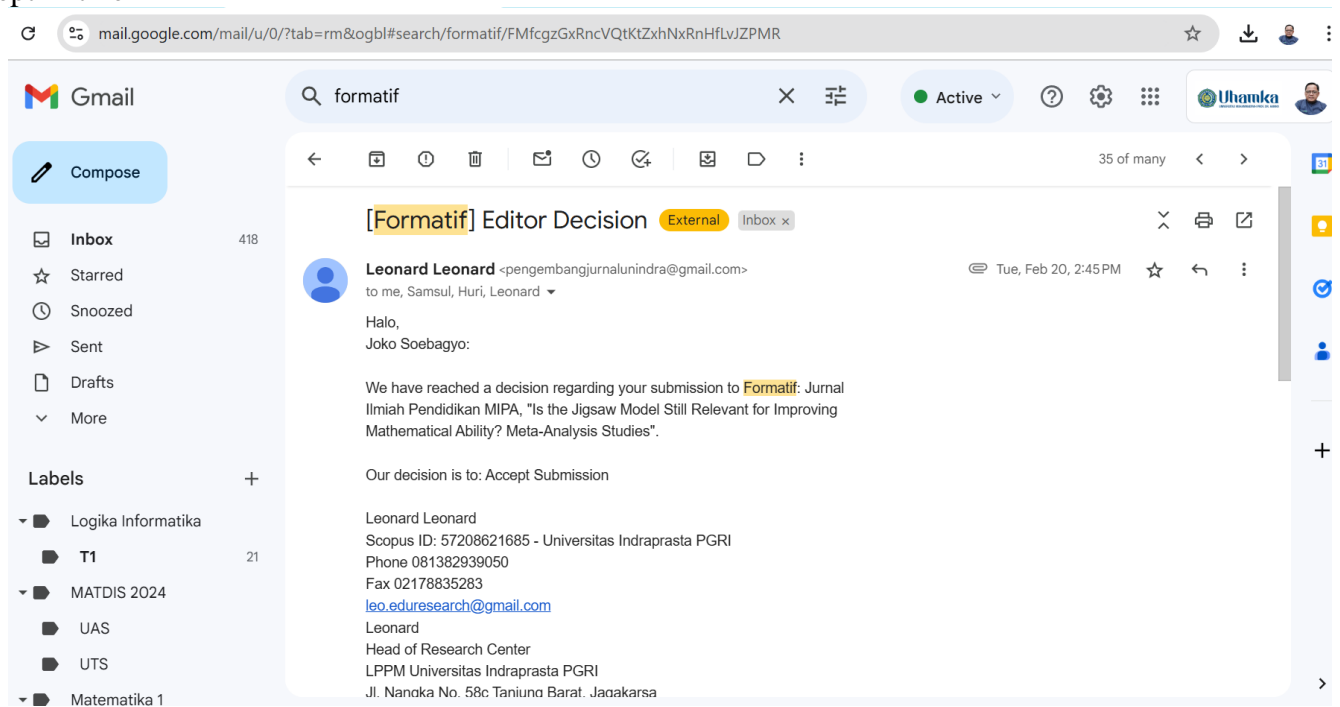
- JKPM (Jurnal Kajian Pendidikan Matematika)*, 8(1), 1. <https://doi.org/10.30998/jkpm.v8i1.13529>
- Siswono, T. Y. E. (2014). Permasalahan Pembelajaran Matematika dan Upaya Mengatasinya. *FMIPA UNESA*, 1–9.
- Sukmawati, A. (2020). Meta Analisis Model Problem Based Learning Dalam Meningkatkan Kemampuan Berpikir Kritis Pada Pembelajaran Matematika. *Thinking Skills and Creativity Journal*, 3(2), 63–68. <https://doi.org/10.23887/tscj.v3i2.30211>
- Sulistiyowati, D. P., & Astuti, S. (2020). Efektivitas Model Pembelajaran Kooperatif Tipe Jigsaw Dan Student Teams Achievement Divisions (STAD) Ditinjau Dari Keterampilan Kerjasama Pada Mata Pelajaran Matematika Siswa Kelas 5 SD. *Jurnal Karya Pendidikan Matematika*, 7(1), 92. <https://doi.org/10.26714/jkpm.7.1.2020.92-103>
- Sumarmo, U. (2012). Pendidikan Karakter serta Pengembangan Berfikir dan Disposisi Matematik dalam Pembelajaran Matematika. *Seminar Pendidikan Matematika*, 1–26.
- Tamur, M., Subaryo, S., Ramda, A. H., Nurjaman, A., Fedi, S., & Hamu, A. (2021). Pengaruh Pembelajaran Kooperatif Tipe Jigsaw Terhadap Kemampuan Berpikir Kritis Siswa SMP. *Journal of Honai Math*, 4(2), 173–182. <https://doi.org/10.30862/jhm.v4i2.201>
- Timayi, J. M., Bolaji, C., & Kajuru, Y. K. (2015). Effects of Jigsaw IV Cooperative Learning Strategy (J4CLS) on Academic Performance of Secondary School Students in Geometry. *International Journal of Mathematics Trends and Technology*, 28(1), 12–18. <https://doi.org/10.14445/22315373/ijmtt-v28p504>
- Turyanto, T., Agustito, D., & Widodo, S. A. (2019). Think Pair Share With Comic For Mathematical Problem Solving Skills. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 9(3), 181–190. <https://doi.org/10.30998/formatif.v9i3.3773>
- Utami, P., Kadir, & Herlanti, Y. (2021). Meta-Analisis Pembelajaran Kooperatif di Indonesia. *Jurnal Inovasi Pendidikan IPA*, 7(1), 106–115. <https://doi.org/10.21831/jipi.v7i1.39574>
- Wardani, D. T. (2015). Pengaruh Pembelajaran Kooperatif Tipe STAD (Student Teams Achievement Divisions) Dan Jigsaw Terhadap Prestasi Belajar Ekonomi Ditinjau Dari Motivasi Belajar Siswa Tahun Ajaran 2014/2015. *EQUILIBRIUM: Jurnal Ilmiah Ekonomi Dan Pembelajarannya*, 3(2), 105–111. <https://doi.org/10.25273/equilibrium.v3i2.657>
- Werdiningsih, E., & Mukhlisin, M. I. (2021). Penerapan Model Pembelajaran Kooperatif Tipe Jigsaw di Kelas. *Jurnal Pendidikan Berkarakter*, 4(2), 60–65.
- Widarti, A. (2013). “Kemampuan Koneksi Matematis Dalam Menyelesaikan Masalah Kontekstual Ditinjau dari Kemampuan Matematis Siswa” (jurnal STKIP jombang, 2012). *Jurnal Pendidikan Matematika*, 1(003), 1–2.
- Widyastuti, E. (2015). Peningkatan Kemampuan Pemahaman Konsep Dan Komunikasi Matematis Siswa Dengan Menggunakan Pembelajaran Kooperatif Jigsaw. *Journal of Mathematics Education*, 1(1), 1–14.
- Wijayanti, A., & Kusdiyanta, A. (2019). Cooperative Skills Improvement Through Mind Mapping Assisted Pair Check Peningkatan Keterampilan Kooperatif Melalui Pair Check Berbantuan Mind Mapping. *Jurnal Ilmiah Pendidikan MIPA*, 9(3), 257–266. <https://doi.org/10.30998/formatif.v9i3.2927>
- Yayuk, E., Purwanto, As’Ari, A. R., & Subanji. (2020). Primary School Students’ Creative Thinking Skills in Mathematics Problem Solving. *European Journal of Educational Research*, 9(3), 1281–1295. <https://doi.org/10.12973/eu-jer.9.3.1281>
- Yeubun, I. Z. S., Noornia, A., & Ambarwati, L. (2020). The Effect of Jigsaw Cooperative Learning Methods on Mathematical Communication Ability Viewed Based on Student Personality. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 9(4), 333–338.

Author. / Formatif: Jurnal Ilmiah Pendidikan MIPA 10(1), 1-6

<https://doi.org/10.30998/formatif.v9i4.4132>

Zuhasni, N. (2022). *Penerapan Model Jigsaw untuk Meningkatkan Kemampuan Berpikir Kritis dan Hasil Belajar Siswa Kelas V SDN 2 Celala Aceh Tengah.*

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Is the Jigsaw Model Still Relevant for Improving Mathematical Ability? Meta-Analysis Studies

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Is the Jigsaw Model Still Relevant for Improving Mathematical Ability? Meta-Analysis Studies

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Abstract

The Jigsaw learning model focuses on student activities in general learning and influences students' mathematical abilities. Still, some do not have a significant influence. This research attempts to answer the question of how much impact the Jigsaw model has based on the desired categorical variables. Therefore, meta-analysis research is needed to provide comprehensive and in-depth conclusions about applying the Jigsaw model to students' mathematical abilities. Comprehensive Meta-Analysis (CMA) evaluates a property's value based on comparisons to similar properties in the same area. Using the Google Scholar database, data was obtained from Publish or Perish (PoP), which had 500 articles from 2010 to 2023. The number of journals that meet the requirements and will be analyzed is 30 sample articles with a total of 1252 students. The moderator variables in this study are country, education level, sample size, and publication source. Based on research findings, the Jigsaw model significantly influences numeracy skills (P-value 0.05), with an effect size of 1.146, classified as very high based on fixed effects and a standard error of 0.045. The research results show that the Jigsaw model is still relevant for improving students' mathematical abilities, especially at the elementary school level. This meta-analysis study reveals no difference in the results of implementing the Jigsaw model on students' mathematical skills in all country categories.

Keywords: Jigsaw Model, Meta-Analysis, Mathematical Abilities

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INTRODUCTION

Recognize mathematics as an abstract science that is the basis for achieving other sciences. Mathematics complements all existing sciences, including science, technology, art, and many others (Kamarullah, 2017). The difficulty level in mathematics is often used as a benchmark in achieving success. No wonder many of the nation's students must be proficient in mathematics. Sometimes, the difficulty in solving abstract problems often decreases interest in learning, so you are too lazy to learn; this is a trigger factor for problems in learning (Siswono, 2014). In mathematics, mathematical ability is not only measured on one ability. Mathematical abilities are grouped into five understandings: mathematical understanding, problem-solving, reasoning, connection, and communication (Sumarmo, 2012). Mathematics learning must instill rational thinking processes with the laws of mathematical logic to develop thinking processes in solving mathematical problems (Maarif et al., 2018). Understanding logic, of course, requires motivation and good learning and teaching. Not all teaching provided can make some students interested in learning. Therefore, as a good teacher, there needs to be variety in providing learning models. This variant ensures that learners grasp the topic and achieve learning objectives. Currently, many learning models are often found, ranging from Problem-Based Learning (PBL), Project Learning (PBjL), and Realistic Mathematics Education (RME) to Cooperative

Learning (CL). With the development of technology, much research is related to learning. There are not a few studies that vary learning with other methods.

Cooperative learning was first studied in 1898 by Roger and Johnson in about 600 experiments. Cooperative learning creates interaction between group members, and teachers try to condition it by motivating students to develop a sense of mutual need in a team (Jaelani, 2015). Social behavior learning is specifically developed to assist students in collaborating while learning. Cooperative learning is a learning paradigm in which students participate and interact with one another in small groups of four to six persons (Saputra et al., 2017). There are various variations of models that can be used in cooperative learning, namely (1) Student Team Achievement Division (STAD), (2) Group Investigation, (3) Jigsaw, (4) Think-Pair-Share, (5) Inside-Outside Circle, (6) Make a Match, (7) Listening Team, (8) The Power of Two, and (9) Bamboo Dancing.

Jigsaw is one of the models of cooperative learning. One of the reasons why the Jigsaw model was chosen to be researched through meta-analysis is because there are not many similar studies that specifically examine it in mathematics learning. Jigsaw-type learning is learning in a learning group where there is interaction between each group member, who has responsibility for the material in the group, and the ability to master and teach the topic to the other group members (Lubis & . The initial and expert groups are displayed in the puzzle cooperative learning paradigm. The origin group, or parent group of students, consists of students from different racial, ethnic, and socioeconomic backgrounds. At the same time, the expert group consists of members of different origin groups. It is tasked with researching and studying certain subjects while carrying out tasks that will be communicated to members of the origin group. Several specialists from the initial group have been combined to form the expert group. Being interconnected with each other, where each student can convey the information needed to their teammates so that the goal of solving problems can be achieved, is the key to the success of Jigsaw (Werdiningsih & . In this learning, students work in a team and are assigned to read and study a subject. Random selection is made for each group member designated as an expert in a particular field. Furthermore, the experts reported to the group and met with other groups to discuss the material learned, then returned to their group to teach the material to their teammates (Widyastuti, 2015). The characteristic of the Jigsaw type that distinguishes it from other types of cooperatives is that there are study and specialist groups (Hibattulloh & Sofyan, 2014).

One of the learning models that can promote student activity, involvement, and knowledge of the material is cooperative learning. The Jigsaw cooperative learning model is one example (Nurfitriyanti, 2017). This learning model can apply to young children because this type of children is also divided into several heterogeneous groups according to ability and gender so that group characters are formed into parallels (Poerwati et al., 2020). The Jigsaw cooperative paradigm is intended to improve students' problem-solving and critical-thinking abilities. In discussion activities, students are grouped into specialist groups and origin teams to solve mathematical problems (Handayani, 2020).

To understand abstract science, students must be taught the ability to train in critical thinking (Sarman & Soebagyo, 2022). Critical thinking is the ability of human thinking to have systematic and logical steps (Saviraningrum & Soebagyo, 2022). Thinking logically means being precise, an essential skill for life, and working effectively in all areas of life. The advantage of critical thinking is that we can assess the level of thoroughness or truth of the question, and without any information, it is not easy to express what we want to convey (Zuhasni, 2022). In addition, mathematical creative thinking skills, namely the ability to think based on data and information, are available to find possible answers to such problems from different points of view on problems in each individual where it is more emphasized the suitability of answers and the versatility of answers (Yayuk et al.,

2020). Creative thinking skills should belong to everyone (Florentina & Leonard, 2017). No less important, the capacity to make mathematical connections is required to find relationships from a representation of concepts and procedures, to grasp between mathematical themes, and to apply mathematical concepts in other fields or daily life (Widarti, 2013).

The Jigsaw model, derived from research findings, assists students in understanding the findings they make (Sari & Fitriani, 2018). In other studies, there is an influence on students' mathematical ability, but there are also those that do not have a significant influence. Of course, there are different kinds of conclusions in various studies, even though the variables studied have similarities. Based on the existing problems, meta-analysis can provide comprehensive and in-depth conclusions on specific variables or topics that must be discussed. This study can answer the question of **how much influence the Jigsaw model has based on** the desired category variables. One of the research results showed a significant increase in students' mathematical abilities after attending Jigsaw model lectures with discussion assessments based only on the findings of the initial and final tests (Edriati et al., 2015).

METHODS

This study focuses on quantitative data research analysis based on Google Scholar database sources, specifically to investigate *Jigsaw models* with *math ability*. This analysis **aimed to identify the magnitude of the influence on the Jigsaw model** and investigate the impact of characteristics on mathematical ability in determining the variation in effect size of each available research. A meta-analysis approach is used to achieve this purpose. Meta-analysis compares primary studies with other scientific advancements by drawing statistical findings in effect size on quantitative data studies based on relevant themes (Rosdiana, 2021). The steps in compiling the meta-analysis start from (1) choosing the criteria for the article to be researched, (2) looking for literature sources related to relevant research to be used, (3) coding the article to be used, (4) conduct analysis and classification, (5) interpret findings based on the article under study (Sukmawati, 2020).

Literary Search

This research uses the Google Scholar database as a location for document searches. Furthermore, the use of Publish or Perish is applied as a reference in downloading studies **related to the application of the Jigsaw model by** combining keywords into Jigsaw and math ability (Eryanti & Soebagyo, 2021; Haniyah & Soebagyo, 2021; Sarman & Soebagyo, 2022). As seen in Figure 1, it is obtained that the search process for applying the Jigsaw model on Google Scholar using the PoP application reaches 500 data.

Search terms	Source	Papers	Cites	Cites/y...	h	g	h _i no...	h _i ann...	h _a	acc...	Search date	Cache date	Las...
✓ jigsaw, math ability from 2010 to 2023	Google Sc...	500	29230	2248.46	70	163	50	3.85	24	80	13/05/2023	13/05/2023	0
✓ math props from 2010 to 2023	Google Sc...	981	46593	35842.54	294	657	232	17.85	103	855	12/05/2023	12/05/2023	0
✗ algebraic, mathematical ability	Scopus	0	0	0.00	0	0	0	0.00	0	0	22/03/2023	22/03/2023	514
✗ mathematical communication ...	Google Sc...	0	0	0.00	0	0	0	0.00	0	0	22/03/2023	22/03/2023	512
✗ ethnomathematics	Google Sc...	998	236241	47248.20	186	443	129	25.80	100	923	16/11/2022	16/11/2022	0
	Google Sc...	100	10772	291.14	54	100	43	1.16	16	29	25/10/2022	25/10/2022	0

Cites	Per year	Rank	Authors	Title	Year	Publication	Publisher	Type
9	3.00	1	N Rambe, E Syahp...	The Effect of the Jigsaw Cooperat...	2020	... Research and Critics in ...	pdfs.semanticscholar.org	PDF
41	5.86	2	I Dewi, MS Harahap ...	of Geometri Teaching Materials...	2016	Journal of Education and ...	ERIC	
14	2.80	3	S Sumarni, D Darh...	The students' mathematical conc...	2018	Journal of Physics ...	iopscience.iop.org	
34	6.80	4	DP Sari, E Syahput...	An analysis of spatial ability and s...	2018	American ...	article.sciencedirect.com	PDF
22	2.75	5	S Edriati, V Anggra...	Efektivitas Model Jigsaw Disertai ...	2015	Jurnal Cakrawala Pendidik...	journal.uny.ac.id	
4	1.33	6	AH Diani, D Dwija...	Mathematical creative thinking a...	2020	Unnes Journal of Mathem...	journal.unnes.ac.id	
25	6.25	7	E Eriana, K Karton...	Understanding Ability of Mathem...	2019	Journal of Primary Educat...	journal.unnes.ac.id	
2	0.67	8	IZS Yeubun, A No...	The Effect of Jigsaw Cooperative ...	2020	Formatif: Jurnal Ilmiah ...	ejournal.lppmunindra.ac.id	
8	4.00	9	H Sa'idiah, S Syef...	Student team achievement divisi...	2021	Desimal: Jurnal ...	ejournal.radenintan.ac.id	
46	5.75	10	F Maonde, A Bey...	The discrepancy of students' mat...	2015	International Journal of ...	ijem.com	PDF
1	0.20	11	DR Sinto, E Surya...	Differences Ability of Problem Sol...	2018	3rd Annual International ...	atlantis-press.com	
19	2.11	12	K Asri, M Ikhsan...	Meningkatkan Kemampuan Pem...	2014	Jurnal Didaktik Matematika	jurnal.unsyiah.ac.id	
21	2.33	13	C Young, E Cartm...	Gesture and speech input are inte...	2014	Proceedings of the ...	escholarship.org	PDF
60	5.45	14	C Damon, C Buch...	The jigsaw technique and self-eff...	2012	European journal of psyc...	Springer	
44	11.00	15	R Fanari, C Meloni...	Visual and spatial working memo...	2019	Frontiers in Psychology	frontiersin.org	HTML
14	2.33	16	M Juliana, E Surya	An Analysis Of Jigsaw Cooperativ...	2017	... Of Advance Research A...	researchgate.net	PDF
4	0.80	17	AA Sitingjak, H Ma...	THE DIFFERENCE OF STUDENTS ...	2018	... Journal of Mathematic...	core.ac.uk	PDF
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Figure 1. Google Scholar database search results (Jigsaw, Math ability)

Literary Inclusion Criteria

Throughout the present investigation, the research that was successfully found using the PoP software was then collated based on the requirements listed: (1) write keywords using English settings, then retrieve the Google Scholar database at a vulnerable time between 2010-2023 due to the novelty and dynamics of research, (2) statistical information is used to obtain the effect size value. Moreover, journals or study criteria that do not match will be removed from the analysis data, and (3) learning to use a quantitative approach where there must be control groups and experiments in quantitative data. Journals or papers with just a single sample and a qualitative approach will be excluded from the data analysis. The data screening in this investigation was done using the PRISMA protocols shown in Figure 2.

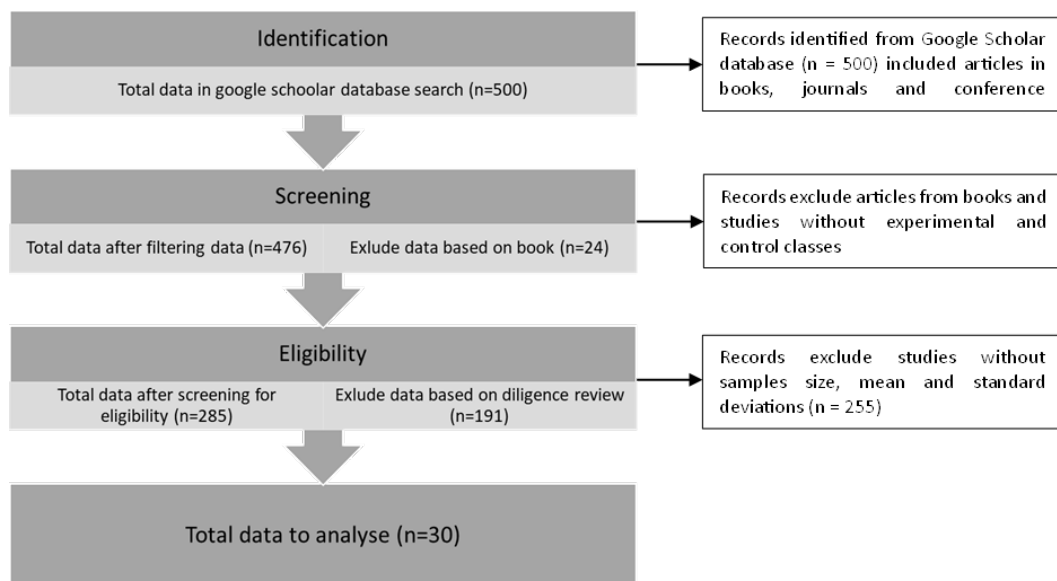


Figure 2. Filter data using PRISMA

Coding

All studies that match the criteria are coded manually using a detailed coding scheme based on protocols. This study's criteria were carried out using codes (*categories*). Coding is carried out to separate individual data information into numerical data. Random samples from 5 valid studies were reproduced and divided among three coders from one research group to determine reliability. Three coders received a copy of the article, the coding form, and the protocol. The following formula was used to calculate the percentage agreement (PA) to assess the reliability of this coder. In this scenario, N_A represents the total number of agreements, while N_P represents the entire number of disagreements.

$$CapPA = \frac{N_A}{N_A + N_P} \times 100\%$$

Statistical Analysis

The data was evaluated with the CMA application, with particular attention paid to the effect size, defined as the influence of the Jigsaw approach on students' mathematical skills. The Comprehensive Meta-Analysis is beneficial for adjusting the effect size of research, including the overall effect size, P-value, Q-statistic, and confidence interval. In addition, the program creates research forest plots and funnel plots. The g Hedges measure was utilized in this analysis. The side effect (δ) was classified as $\delta < 0.2$ (negligible), $0.2 \leq \delta < 0.5$ (small effect), $0.5 \leq \delta < 0.8$ (modesignificantsignificante effect), $0.8 \leq \delta < 1.3$ (big effect), and $1.3 \leq \delta$ (huge effect) (Cohen et al., 2007). The random effect technique was chosen as the estimation method since no assumption exists that all research has the same effect. The randomized effect model in this study was selected after a successful heterogeneity test. The p-value is used to perform this test. If the p-value is less than 0.05, all studies will be identical, and the null hypothesis and homogeneity will be rejected. The rejection of the null hypothesis suggests that population parameters may not be measured with the same effect size across studies or study groups (Retnawati et al., 2018). There is evidence that different study categories affect study effect sizes differently.

To avoid misrepresentation of results, publication bias is checked. Publication bias is the likelihood that studies appearing in published literature are considered statistically significant to be published (Cooper et al., 2009). In anticipation, a bias analysis was carried out on the funnel plot to see if the research was free from bias. When the distribution of impact sizes on vertical lines was symmetrical, publication bias was judged to be strong in this study. However, if the size distribution of the effect is not perfectly symmetrical, it is necessary to use the trim and fill method. If the observed and virtual effects generated by randomized effects models are similar, then the study is immune to publication bias.

RESULTS & DISCUSSION

Results

Literature Search Results

This study aimed to determine whether the magnitude of the effect created affected learning the Jigsaw model and mathematical competence based on category variables. Therefore, researchers try to search literature using PoP software by applying several criteria. The first criterion is that researchers use vulnerable research time in 2010 – 2023. Furthermore, the second criterion researchers used was jigsaw and math ability, and the

maximum number of results was limited to 500 documents. Five hundred articles were collected from the topics used, with 24 data from books and the rest from journals and conference proceedings.

Literature Selection Results

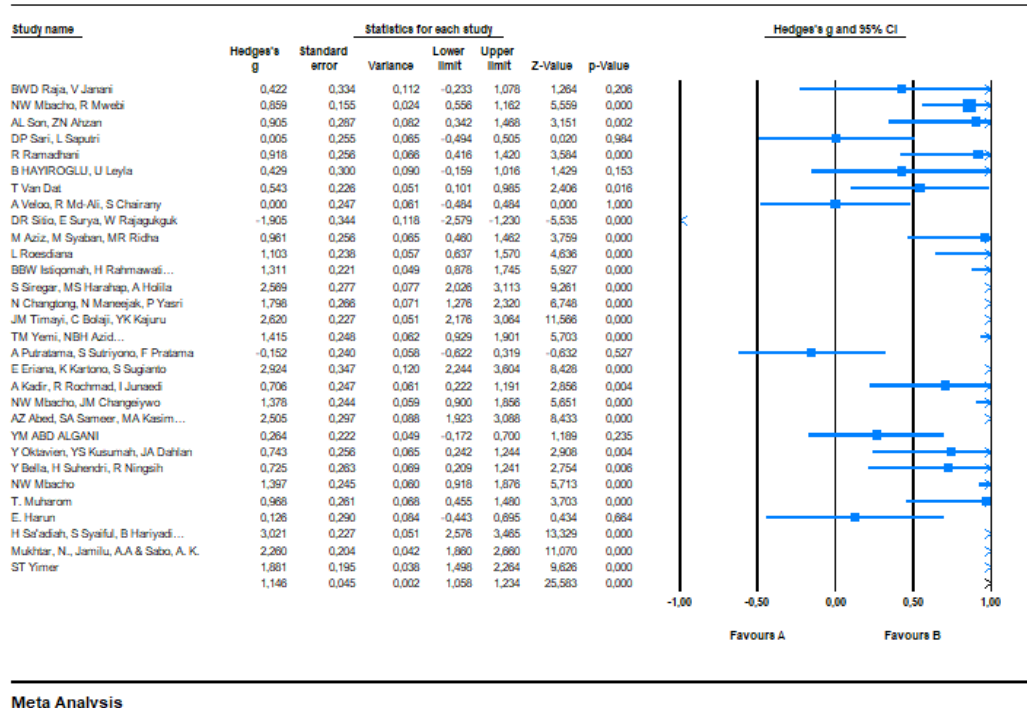
After setting the criteria for the literature search, the researcher converts the data into Excel and eliminates the data in the appropriate journal. First, researchers filter data that is included in journals and conference proceedings. Second, researchers use a quantitative approach to collect data that has an experimental class and a control class. Third, researchers collect statistical data such as the sample size, mean, and standard deviations. This statistical data aims to calculate the effect size to be studied. Furthermore, screening through the PRISMA method is carried out to ensure the accuracy of the data obtained. Not only that, but researchers must guarantee that the journal's title and theme are consistent with the criteria variables.

Results Criteria

The criteria results in this study focused on vulnerable years 2010 - 2023. The selection of criteria for this year's vulnerability was conducted to ensure the available research was up-to-date. From the results of the criteria that have been filtered, researchers consider choosing research sourced from journals and proceedings. In addition, researchers also obtained various journals from various countries with the same topic, ranging from Asian to European countries. Furthermore, researchers consider the degree of education beginning with (pre-school, elementary, junior high, high school, and university). The many variations that have been studied at this level of education add to the accuracy of a study. Furthermore, researchers also looked at the number of sample sizes in a study and considered whether each of these journals had a control class and an experimental class. The selected research is also equipped with post-test and pre-test data and mean and standard deviations to see the extent of the data spread and whether there are data deviations in the mean.

Statistical Analysis Results

The results of the study here aim to answer the research question. Figure 3 depicts the findings of a meta-analysis of 30 filtered and collected data from Google Scholar. Figure 3 contains the names of the studies identified. Furthermore, the magnitude of the effect, which contains the results of the intervention, is shown. It can be seen that 1 data is less than 0 or under consideration, while the average confidence interval that stretches horizontally or is more than 0 is on the right. This means that the effects of the intervention are beneficial. In addition, Figure 3 also shows the heterogeneity of data to see discrepancies in the source of findings from the study.



Meta Analysis

Figure 3. Research Forest Plot

According to Figure 3, the response rate is inconsistent. The research is likely to be diverse. As a result, the starting assumptions must be statistically examined to be consistent with the estimation approach.

Model	N	Hedge's	Standard error	Test of null		Q	P	Decision
				Z-value	P-value			
Fixed-effects	30	1.146	0.045	25.583	0.000	447.062	0.000	Reject
Random-effects	30	1.095	0.177	6.189	0.000			

Figure 4. Meta Results - Analysis according to the Estimation method

Figure 4 displays the findings of a meta-analysis of 30 articles from international conference proceedings and journals. Several examples of international conferences and journal proceedings can be seen in Figure 1. Figure 4 shows that the P value is 0.05, indicating that each study has a diverse effect size. Therefore, a fixed effect model with a high effect size of 1.146 was used. They use a null test of P less than 0.05 with a fixed effects model. In addition, a z value of 25,583 was obtained, indicating that the research results were significant for $P < 0.05$ (Musna et al., 2021). To put it another way, the Jigsaw-type learning model significantly impacts mathematical ability.

Then, as shown in Figure 4, we will show a funnel plot with the research spread out and not symmetrical in the funnel, requiring trim and fill to check whether there is a difference in the influence of publication bias. In addition, trim and fill were performed to estimate potentially missing studies due to publication bias.

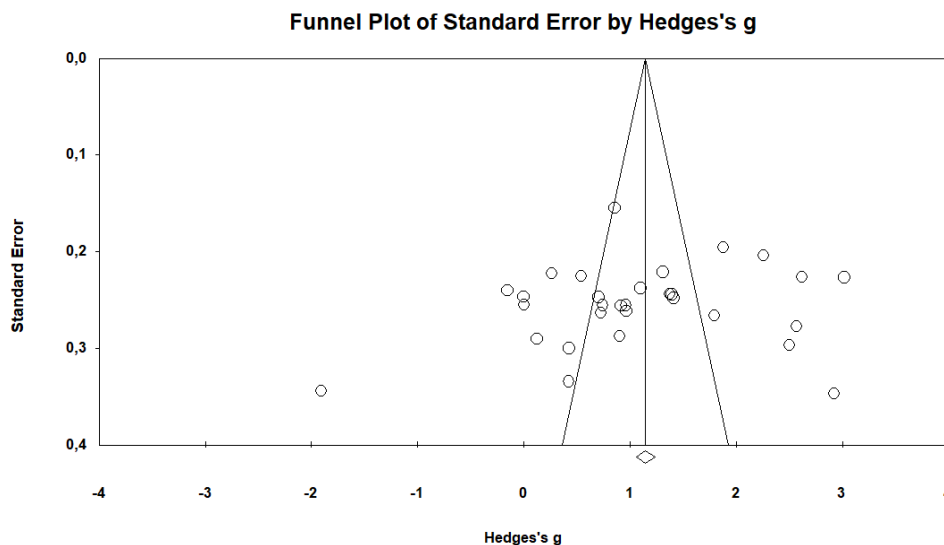


Figure 5. Funnel plot of 30 samples

Duval and Tweedie's trim and fill

	Fixed Effects			Random Effects			Q Value	
	Studies Trimmed	Point Estimate	Lower Limit	Upper Limit	Point Estimate	Lower Limit		Upper Limit
Observed values		1,14597	1,05817	1,23376	1,09469	0,74799	1,44139	447,06230
Adjusted values	0	1,14597	1,05817	1,23376	1,09469	0,74799	1,44139	447,06230

Figure 6. Trim and Fill

The findings of trim and fill in Figure 5 indicate no difference or opposite according to the fixed effect model, so no research or study is trimmed or added to this study. The overall effect size is 1.14597, rounded up to 1.146, which is a very high value for effect size.

Furthermore, in addressing the research question, it is demonstrated that the estimation approach, as previously stated, matches the fixed effect model. This shows that each study's effect sizes vary, necessitating a detailed examination of the categorical factors influencing the association between the Jigsaw learning model and mathematical competence. As a result, Figure 6 shows the summary results of the category variable analysis.

Country

The effect size in the Indonesian study was 3.439, whereas the effect size in international research was 5.412. According to the heterogeneity of Q -value = 0.331 and $p > 0.05$, it is clear that research in Indonesia has a significant effect, as does research abroad. Further testing shows that research in Indonesia and abroad has effects that are not significantly different. This means that the results of Indonesian and foreign research are identical.

No	Variabel Moderator	Group	N	Combined Effect Size (Hedge's g)	Test of null (2-Tail)		Heterogeneity			
					Z	P-value	Between-Classes Effect (Q-value)	Df(Q)	P-value	Decision
1	Country	Indonesia	15	0.99	3.439	0.001	0.331	1	0.565	Accept H_0
		Overseas	15	1.199	5.412	0				
2	Educational Level	University	4	1.172	3.797	0	32.466	4	0	Reject H_0
		High School	9	0.942	3.672	0				
		Primary School	15	1.09	3.702	0.000				
		Elementary	1	2.924	8.428	0.000				
		Pre School	1	0.429	1.429	0.153				
3	Sample Size	30 or less	7	0.114	0.361	0.000	12.005	1	0.001	Reject H_0
		31 or more	23	1.384	7.51	0.000				
4	Publication Source	Journal	29	0.178	5.919	0.000	19.84	1	0	Reject H_0
		Proceeding	1	2.26	11.07	0.000				

Figure 7. Summary of Category Variable Analysis

Education Level

According to Figure 6, the effect size at the education level is as follows: Pre-school (0.429), Elementary (2,924), Junior High School (1.09), Senior High School (0.942), and University (1,172). Heterogeneity tests yielded Q-value = 32.466 and $p < 0.05$, indicating that applying Jigsaw learning to mathematical abilities was influential at all stages of schooling, from pre-primary to university.

Sample Size

Based on Table 2. It was shown that a sample size with a group of 30 or less had an effect size of 0.114, while a sample size with a group of 31 or more had an effect size of 1.384. Based on the heterogeneity test, Q-value = 12.005 and $p < 0.05$. This situation suggests that the sample size influences the Jigsaw model with students' mathematical abilities.

Publication Source

According to the publication source, the effect size of journal research was 0.178, whereas the effect size of proceedings research was 2.26. Judging from the heterogeneity of Q-value = 19.84 and $p < 0.05$, publication type shows that Jigsaw learning affects students' mathematical abilities.

Discussion

Essentially, the purpose of this study is to determine whether the Jigsaw approach has a significant impact on students' mathematical abilities. Based on the analysis, an effect size of 1.146 was obtained, which shows that this study has a considerable influence. To the research that has been conducted, there is a possibility that students can contribute to solving problems in group discussions using the Jigsaw learning model due to its significant influence (Tamur et al., 2021).

The number of subjects studied in this study was 1252, with an average of 69 students. In this case, the effect size of 1.146 shows that the Jigsaw model affects mathematical ability (Cohen et al., 2018). In line with other studies, learning using the Jigsaw model is more fun than ordinary learning because students can find information from other groups (Wardani, 2015). Next, researchers conducted an analysis based on categorical variables. It can be seen that the amount of influence in this study is clarified, beginning with the level of education, country, sample size, and publication source.

Analysis of country categories found that research in Indonesia and abroad showed that research in Indonesia and abroad has effects that are not significantly different. This means that the results of Indonesian and foreign research are identical. In this study, the number of samples from 30 papers is comparable. This means that in addition to Indonesia and abroad, this research has been carried out a lot, even not a few who use modifications to the variables studied, with the primary variable being Jigsaw learning. For example, research (Abed et al., 2020) predicts Jigsaw-type learning strategies on students' mathematics learning achievement. Furthermore, other data show that the Jigsaw model of learning geometric information is more effective than the lecture method (Timayi et al., 2015). Another study related to jigsaw learning in Turkey states that it influences students' abilities in natural science laboratory practice (Karacop, 2017).

Next, the category variables related to education level will be analyzed. Judging from the comparison of the magnitude of the effect size between preschool, Elementary, Junior High, High School, and University (0.429: 2.924: 1.09: 0.942: 1.172), the research results show that the Jigsaw model of learning has a significant influence from elementary to tertiary level, but not at the pre-school level. The effect size of the implementation of the Jigsaw model at the preschool level is in the small effect category because the model only influences the choice of learning goals in young children and encourages children to change their learning goals while doing the task (Leclercq et al., 2022). On the other hand, one of the research results showed a decrease in the average score during the four treatments using the Jigsaw model in social learning, although there was an average increase between the pre-test and post-test of 5% (Karta et al., 2021).

The findings also show that learning mathematics using the Jigsaw model is more effective at the elementary level than at other levels. According to research (Sulistiyowati & Astuti, 2020), the Jigsaw learning model has a high level of cooperation, as indicated by post-test and pre-test findings. This finding aligns with other research, which states that the jigsaw model is an active learning model with a higher level of social connectedness when using jigsaw-type cooperative learning (Costouros, 2020). Other findings show that the Jigsaw model influences students' motivation to learn mathematics (Amin et al., 2020), mathematical representation abilities (Rambe et al., 2020), retention (Baken et al., 2020), collaboration abilities (Chang & Benson, 2020), and communication skills (Namaziandost et al., 2020). However, this is a contradiction, as learning mathematics using the Jigsaw model at the high school level affects students' mathematical communication skills (Yeubun et al., 2020).

Learning mathematics using the Jigsaw model, as shown in Figure 6, also demonstrates that many research samples were collected at the secondary school level. This happens because the level of thinking has entered the formal stage. On the other hand, this learning triggers the psychology of students to be curious about their peers (Utami et al., 2021). In addition to their mathematical abilities, students' mathematical successes have beneficial consequences after implementing the Jigsaw learning approach (Ribut, 2021). However, other studies on cooperative learning with the type of Think Pair Share aided by comics show that it is no better than not using comics to develop problem-solving skills (Turyanto et al., 2019). However, Pair Check cooperative learning has improved students' overall cooperative abilities (Wijayanti & Kusdiyanta, 2019).

In this study, sample size was also applied to categorical variables to clarify the size of the effect on the study. The findings showed that (31 or more) had a more significant influence than other categories. This study also analyzed publication sources on categorical variables. Based on the findings, one piece of literature was obtained from proceedings, and 29 others were obtained from journals. These data imply that the study was free of publication bias, supported by trim and fill.

Many studies have not been taken or do not fall into the required category while examining this research. Such research was conducted by (Budiawan and using the same variables but carried out on sports subjects. In addition, there are also some unqualified studies where there is a lack of pretest data as a control study. Of the 500 data collected, only about 30 studies were included in the requirements after several screenings. It does not end there; this study needs further research to determine its effectiveness.

CONCLUSION

This research used articles from proceedings and international journals from 2010 – 2023. Meta-analysis research with 30 samples revealed a fixed effect with an effect size of 1.146, indicating that mastering the Jigsaw technique significantly impacted students' mathematical abilities. This means that jigsaw learning is still relevant in improving students' mathematical skills. Furthermore, this study conducted an analysis based on category variables divided into four variables. Based on the analysis of education levels, it was discovered that the degree of influence varied depending on the study. However, learning using the Jigsaw model is more influential at the elementary level than at other levels. In addition, the number of samples in 31 or more has a higher effectiveness, and publication sources based on journals have a more significant influence. Meanwhile, analysis of country categories shows no differences in the results of implementing the Jigsaw model for research in Indonesia or abroad. In the world of education, applying the Jigsaw model is quite adequate, as proven by the findings of several studies, especially at the elementary school level, where students enjoy playing and studying in groups, exchanging information, and working together to find information. This research has limitations because the samples were obtained from Google Scholar using PoP software, which means there are still many other research samples that were not carried out due to access or payment constraints. Recommendations for further research are to re-examine the same themes using the Scopus database and compare the implementation of the Jigsaw model in mathematics learning with other models.

REFERENCES

- Abed, A. Z., Sameer, S. A., Kasim, M. A., & Othman, A. T. (2020). Predicting the effect of implementing the jigsaw strategy on students' academic achievement in mathematics classes. *International Electronic Journal of Mathematics Education*, 15(1), 1–7. <https://doi.org/10.29333/iejme/5940>
- Amin, M., Nur, F., Diah, M., Damayanti, E., & Harti, S. (2020). The influence of jigsaw-type cooperative learning model on students' mathematics learning outcomes and motivation. *Desimal: Jurnal Matematika*, 3(3), 235–246. <https://doi.org/10.24042/djm.v3i3.6831>
- Baken, E. K., Adams, D. C., & Rentz, M. S. (2020). Jigsaw method improves learning and retention for observation-based undergraduate biology laboratory activities ABSTRACT. *Journal of Biological Education*, 00(00), 1–6. <https://doi.org/10.1080/00219266.2020.1796757>
- Budiawan, M., & Arsani, N. L. K. A. (2013). Pengaruh model pembelajaran kooperatif tipe jigsaw dan motivasi belajar terhadap prestasi belajar ilmu fisiologi olahraga. *Pendidikan Indonesia*, 2(1), 138–144. <https://doi.org/10.3102/0013189X18785613>

- Chang, W. L., & Benson, V. (2020). Jigsaw teaching method for collaboration on cloud platforms. *Innovations in Education and Teaching International*, 00(00), 1–13. <https://doi.org/10.1080/14703297.2020.1792332>
- Cohen, L., Manion, L., & Morrison, K. (2007). Book reviews research methods in education. *The Austr Alian Educational Researcher*, pp. 2, 147–156.
- Cohen, L., Manion, L., & Morrison, K. (2018). Research methods in education. In *Jurnal Penelitian Pendidikan Guru Sekolah Dasar* (Vol. 6, Issue August).
- Cooper, H., Hedges, L. V., & Valentine, J. C. (2009). Handbook of research synthesis and meta-analysis 2nd Edition. In *The Lancet* (Vol. 389, Issue 10082).
- Costouros, T. (2020). Jigsaw Cooperative Learning Versus Traditional Lectures : Impact on student grades and learning experience. *Teaching & Learning Inquiry*, 8(1), 154–172.
- Edriati, S., Anggraini, V., & Siska, M. (2015). Efektivitas model jigsaw disertai penilaian diskusi untuk meningkatkan kemampuan matematis mahasiswa. *Jurnal Cakrawala Pendidikan*, 2(2), 288–295. <https://doi.org/10.21831/cp.v2i2.4833>
- Eryanti, I., & Soebagyo, J. (2021). Bibliometric analysis of blended learning mathematics in scientific publications indexed by Scopus. *Numerical: Jurnal Matematika Dan Pendidikan Matematika*, 91–102.
- Florentina, N., & Leonard, L. (2017). Pengaruh model pembelajaran kooperatif terhadap kemampuan berpikir kreatif matematis siswa. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 7(2), 96–106. <https://doi.org/10.30998/formatif.v7i2.1877>
- Handayani, H. (2020). Pengaruh implementasi pembelajaran kooperatif tipe jigsaw terhadap kemampuan berpikir kritis matematis siswa sekolah dasar. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, 5(1), 50–60. <https://doi.org/10.23969/jp.v5i1.1944>
- Haniyah, D., & Soebagyo, J. (2021). Analisis bibliometrik terhadap kemampuan komunikasi matematis dalam pembelajaran matematika berdasarkan perbedaan gender berbasis VOSViewer. *Buana Matematika: Jurnal Ilmiah Matematika Dan Pendidikan Matematika*, 11(2), 121–136.
- Hibattulloh, N., & Sofyan, D. (2014). Perbandingan kemampuan komunikasi matematis siswa antara yang menggunakan model pembelajaran kooperatif tipe jigsaw dengan konvensional (studi quasi eksperimen di kelas VII SMP Negeri 2 Bayongbong). *Jurnal Pendidikan Matematika*, 3(3), 169–178.
- Jaelani, A. (2015). Pembelajaran kooperatif, sebagai salah satu model pembelajaran di madrasah ibtidiyya (MI). *Al Ibtida: Jurnal Pendidikan Guru MI*, 2(1), 1–16. <https://doi.org/10.24235/al.ibtida.snj.v2i1.189>
- Kamarullah, K. (2017). Pendidikan matematika di sekolah kita. *Al Khawarizmi: Jurnal Pendidikan Dan Pembelajaran Matematika*, 1(1), 21. <https://doi.org/http://dx.doi.org/10.22373/jppm.v1i1.1729>
- Karacop, A. (2017). The effects of using jigsaw method based on cooperative learning model in the undergraduate science laboratory practices. *Universal Journal of Educational Research*, 5(3), 420–434. <https://doi.org/10.13189/ujer.2017.050314>
- Karta, I. W., Rachmayani, I., & Rasmini, N. W. (2021). The influence of cooperative learning through authentic assessment-based jigsaw on the social development of early childhood. *JPI (Jurnal Pendidikan Indonesia)*, 10(4), 633–642. <https://doi.org/10.23887/jpi-undiksha.v10i4.34353>
- Leclercq, M., Gimenes, G., Maintenant, C., & Clerc, J. (2022). Goal choice in preschoolers is influenced by context, cognitive flexibility, and metacognition. *Frontiers in Psychology*, 13(February), 1–19. <https://doi.org/10.3389/fpsyg.2022.1063566>
- Lubis, N. A., & Harahap, H. (2016). Pembelajaran kooperatif tipe jigsaw. *Jurnal As-Salam*, 1(1), 96–102.

- Maarif, S., Wahyudin, W., Noto, M. S., Hidayat, W., & Mulyono, H. (2018). Geometry exploration activities assisted with dynamic geometry software (Dgs) in a teacher education classroom. *Infinity Journal*, 7(2), 133. <https://doi.org/10.22460/infinity.v7i2.p133-146>
- Musna, R. R., Juandi, D., & Jupri, A. (2021). A meta-analysis study of the effect of the Problem-Based Learning model on students' mathematical problem-solving skills. *Journal of Physics: Conference Series*, 1882(1), 2–8. <https://doi.org/10.1088/1742-6596/1882/1/012090>
- Namaziandost, E., Gilakjani, A. P., & Hidayatullah. (2020). Enhancing pre-intermediate EFL learners' reading comprehension through the use of Jigsaw technique. *Cogent Arts and Humanities*, 7(1). <https://doi.org/10.1080/23311983.2020.1738833>
- Nurfitriyanti, M. (2017). Pengaruh model pembelajaran kooperatif tipe jigsaw terhadap hasil belajar matematika ditinjau dari kecerdasan emosional maya. *Jurnal Formatif*, 7(2), 153–162. <https://doi.org/10.31949/jcp.v8i4.2941>
- Poerwati, C. E., Suryaningsih, N. M. A., & Cahaya, I. M. E. (2020). Model pembelajaran kooperatif tipe jigsaw II dalam meningkatkan kemampuan matematika anak. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, 5(1), 281. <https://doi.org/10.31004/obsesi.v5i1.496>
- Rambe, N., Syahputra, E., & Elvis, E. (2020). The effect of the jigsaw cooperative learning model and the student's initial mathematical abilities and its effect on the mathematical representation ability and learning motivation of students in the PAB 10 Sampali Private Elementary School. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, 3(3), 1591–1599. <https://doi.org/10.33258/birle.v3i3.1249>
- Retnawati, H., Apino, E., Kartianom, Djidu, H., & Anazifa, R. D. (2018). *Pengantar Analisis Meta* (Issue July).
- Ribut, O. Y. P. (2021). Model pembelajaran kooperatif jigsaw pada prestasi matematika siswa sekolah menengah pertama. *Jurnal Jendela Pendidikan*, 1(02), 61–65. <https://doi.org/10.57008/jjp.v1i02.9>
- Rosdiana, R. (2021). *Studi Meta - Analisis Penggunaan Model Pembelajaran Kooperatif Terhadap Kemampuan Komunikasi Matematis Siswa*.
- Saputra, G. A. A., Agung, A. A. G., & Suwatra, I. W. (2017). Pengembangan multimedia interaktif sebagai suplemen pembelajaran kooperatif tipe stad pada mata pelajaran ips kelas Viii Smp. *Jurnal Edutech Undiksha*, 05(1), 121–131.
- Sari, S. R., & Fitriani, D. (2018). Meningkatkan komunikasi matematis melalui model pembelajaran kooperatif tipe jigsaw. *Journal for Research in Mathematics Learning*, 1(1), 183–188. <https://doi.org/10.30605/pedagogy.v7i1.1801>
- Sarman, S. N., & Soebagyo, J. (2022). Analisis bibliometrik terhadap kemampuan berpikir kritis matematika berdasarkan pemecahan masalah berbasis VOS viewer. *Vygotsky: Jurnal Pendidikan Matematika Dan Matematika*, 4(2), 117–128.
- Saviraningrum, W., & Soebagyo, J. (2022). Analisis bibliometrik dengan kata kunci mathematical critical thinking student independent menggunakan VOSviewer. *JKPM (Jurnal Kajian Pendidikan Matematika)*, 8(1), 1. <https://doi.org/10.30998/jkpm.v8i1.13529>
- Siswono, T. Y. E. (2014). Permasalahan pembelajaran matematika dan upaya mengatasinya. *FMIPA UNESA*, 1–9.
- Sukmawati, A. (2020). Meta analisis model problem based learning dalam meningkatkan kemampuan berpikir kritis pada pembelajaran matematika. *Thinking Skills and Creativity Journal*, 3(2), 63–68. <https://doi.org/10.23887/tscj.v3i2.30211>

- Sulistyowati, D. P., & Astuti, S. (2020). Efektivitas model pembelajaran kooperatif tipe jigsaw dan student teams achievement divisions (STAD) ditinjau dari keterampilan kerjasama pada mata pelajaran matematika siswa kelas 5 SD. *Jurnal Karya Pendidikan Matematika*, 7(1), 92. <https://doi.org/10.26714/jkpm.7.1.2020.92-103>
- Sumarmo, U. (2012). Pendidikan karakter serta pengembangan berfikir dan disposisi matematik dalam pembelajaran matematika. *Seminar Pendidikan Matematika*, 1–26.
- Tamur, M., Subaryo, S., Ramda, A. H., Nurjaman, A., Fedi, S., & Hamu, A. (2021). Pengaruh pembelajaran kooperatif tipe jigsaw terhadap kemampuan berpikir kritis siswa SMP. *Journal of Honai Math*, 4(2), 173–182. <https://doi.org/10.30862/jhm.v4i2.201>
- Timayi, J. M., Bolaji, C., & Kajuru, Y. K. (2015). Effects of jigsaw IV cooperative learning strategy (J4CLS) on academic performance of secondary school students in geometry. *International Journal of Mathematics Trends and Technology*, 28(1), 12–18. <https://doi.org/10.14445/22315373/ijmtt-v28p504>
- Turyanto, T., Agustito, D., & Widodo, S. A. (2019). Think pair share with comic for mathematical problem-solving skills. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 9(3), 181–190. <https://doi.org/10.30998/formatif.v9i3.3773>
- Utami, P., Kadir, & Herlanti, Y. (2021). Meta-analisis pembelajaran kooperatif di indonesia. *Jurnal Inovasi Pendidikan IPA*, 7(1), 106–115. <https://doi.org/10.21831/jipi.v7i1.39574>
- Wardani, D. T. (2015). Pengaruh pembelajaran kooperatif tipe STAD (student teams achievement divisions) dan jigsaw terhadap prestasi belajar ekonomi ditinjau dari motivasi belajar siswa tahun ajaran 2014/2015. *EQUILIBRIUM: Jurnal Ilmiah Ekonomi Dan Pembelajarannya*, 3(2), 105–111. <https://doi.org/10.25273/equilibrium.v3i2.657>
- Werdiningsih, E., & Mukhlisin, M. I. (2021). Penerapan model pembelajaran kooperatif tipe jigsaw di kelas. *Jurnal Pendidikan Berkarakter*, 4(2), 60–65.
- Widarti, A. (2013). “kemampuan koneksi matematis dalam menyelesaikan masalah kontekstual ditinjau dari kemampuan matematis siswa” (jurnal STKIP jombang, 2012). *Jurnal Pendidikan Matematika*, 1(003), 1–2.
- Widyastuti, E. (2015). Peningkatan kemampuan pemahaman konsep dan komunikasi matematis siswa dengan menggunakan pembelajaran kooperatif jigsaw. *Journal of Mathematics Education*, 1(1), 1–14.
- Wijayanti, A., & Kusdiyanta, A. (2019). Cooperative skills improvement through mind mapping assisted pair check peningkatan keterampilan kooperatif melalui pair check berbantuan mind mapping. *Jurnal Ilmiah Pendidikan MIPA*, 9(3), 257–266. <https://doi.org/10.30998/formatif.v9i3.2927>
- Yayuk, E., Purwanto, As’Ari, A. R., & Subanji. (2020). Primary school students’ creative thinking skills in mathematics problem-solving. *European Journal of Educational Research*, 9(3), 1281–1295. <https://doi.org/10.12973/eu-jer.9.3.1281>
- Yeubun, I. Z. S., Noornia, A., & Ambarwati, L. (2020). The effect of jigsaw cooperative learning methods on mathematical communication ability is viewed based on student personality. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 9(4), 333–338. <https://doi.org/10.30998/formatif.v9i4.4132>
- Zuhasni, N. (2022). Penerapan Model Jigsaw untuk Meningkatkan Kemampuan Berpikir Kritis dan Hasil Belajar Siswa Kelas V SDN 2 Celala Aceh Tengah.