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Relationship between Cooperative learning method and Students' Mathematics Learning Achievement: A Meta-Analysis Correlation

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Abstract

An appropriate learning method can improve students' learning achievement. The cooperative learning method encourages students to improve their mathematics learning achievement. Mathematics learning achievement is one indicator of achieving learning objectives. Mathematics is an important lesson to be learned and must be mastered by students. The purpose of this research was to analyze the effect size of the relationship between Cooperative learning method and mathematics learning achievement through meta-analysis quantitative research approach. In this research, the cooperative learning method serves as an independent variable, and mathematics learning achievement serves as the dependent variable. The data was obtained from the online database search results on Google Scholar in 2010-2020. The sample used was 16 research publications that have met the specified criteria. The data analysis technique used was the meta-analysis quantitative approach with correlation meta-analysis. The results showed that there was a positive and significant relationship (level of 5%) between the cooperative learning method and students' mathematics learning achievement. The average effect size value was 0.15 in the range of 0.04 to 0.27 which was included in the low category. These results have proven the consistency of the findings of previous research.

Key Words: Cooperative Learning Method; Learning Achievement, Mathematics; Meta-Analysis.

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Introduction

It is important to learn mathematics in daily life because it is directly related to technological development (Mutlu, 2019). Mathematics is a knowledge gained from the learning process (Gie, 1993). Repetition in learning mathematics will form a meaningful formation of mathematical knowledge as well as forming interactions between students and materials learned with daily life since the learning theories are both constructivism and behaviorism (Cobb, Wood, and Yackel, 1992; Lerman, 1996; Zevenbergen, 1996). Mathematics in the curriculum must be taught since basic education (Kemendikbud, 2013). Learning mathematics is still considered difficult by most students from basic education to higher education in terms of interpreting mathematical symbols, mathematical concepts, and procedures (Silver, 1986; Hiebert and Lefevre, 1986; Lampert, 1986; Wearne and Hiebert, 1988; Research Council, 1989; Byrnes and Wasik, 1991; Hiebert and Carpenter, 1992; Janvier, Girardon, Morand, 1993; Ben-Zeev, 1996; Yetkin, 2003; National; Acharya, 2017). A research conducted by Prabowo, et al (2018a) reveals that based on the results of the national examinations in 2013 to 2016, mathematics is the most difficult subject to be mastered by students at the junior high school level compared to other subjects tested on the national examination. Even in 2017, the average score of national exam for

junior high school students decreased compared to the previous years (Prabowo, et al., 2019). Thus, the need to know, test, and prove the relationship between Cooperative learning method and learning outcomes should be done by investigating the effect size value generated from studies related to the problem.

One of the factors that affect students' ability to master the material is related to learning methods. Learning should be carried out with a variety of learning methods (Prabowo, 2017). The use of appropriate learning methods can reduce the level of difficulty of mathematics considering mathematics is a subject that is learned from basic education.

Students' mathematics learning achievement can improve well if the communication between the parties, namely students, teachers, schools, parents, or close relatives runs well (Chen and Cheng, 2013). The use of appropriate learning media, both printed and electronic, (Prabowo, et al. , 2018b) is also able to improve students' mathematics learning achievement (Li and Ma, 2010). The learning approaches used to provide different results to students' mathematics learning achievement (Wewe, 2017). A collaboration among students to achieve a shared vision can encourage achieving the goal of building each other's ideas collaboratively, supporting one another, criticizing or arguing with each other, solving several problems together which ultimately increase students' achievement collectively (Johnson and Johnson, 1989, 1999; Pimphan, 2001; Johnson, Johnson, and Smith, 2006; Huan, Su, Yang, and Liou, 2017). The cooperative learning method is very popular in the United States and Europe. Among several countries that use the Cooperative learning method are the United States, Britain, Australia, Norway, and Israel (Rattanatumma and Puncreobutr, 2016).

The cooperative learning method utilizes instructional small groups to facilitate the students' in learning and working together to improve their understanding and mutual learning (Johnson, Johnson and Smith, 2014). The Center for Social Organizations of Schools of John Hopkins University has developed and evaluated five cooperative-based learning models (Slavin and Cooper, 1989). The five models are (1) Student-Teams Achievement Division (STAD) (Slavin, Leavy, and Madden, 1984), (2) Team-Game-Tournament (TGT) (Slavin, Leavy, and Madden, 1984), (3) Cooperative Integrated Reading and Composition (CIRC) (Stevens, Madden, Slavin, and Famish, 1987), (4) Team Assisted Individualization (TAI) (Slavin, Leavy, and Madden, 1984), and (5) JIGSAW (Slavin, 1986).

The cooperative learning method provides a learning experience so that students can collaborate with their peers on various tasks that can improve their cognitive by observing and practicing certain settings to help them internalize cognitive functions and to understand the material provided (Vygotsky, 1978). Cooperative student interaction can help students explain to their peers using their own words so that they can be actively and effectively involved in conveying their ideas which make the cooperative learning method a learning tool at various levels of education in various fields of study (Brown and Campione, 1986; Wittrock, 1986; Steven and Slavin, 1995; Zakaria and Iksan, 2007). There are five important elements in the cooperative learning method (Johnson, Johnson, and Holubec, 1994), namely (a) positive interdependence, (b) promotive interaction, (c) individual accountability, (d) interpersonal and small-group skills, and (e) group processing. The cooperative learning method changes the teacher-centered learning paradigm to be more student-centered (Effandi, 2005).

Several studies have shown that cooperative learning methods can enhance students' learning achievement in mathematics. Thus, it is recommended for mathematics teachers to create an effective learning atmosphere (Slavin, Leavey and Madden, 1984; Reid, 1992;

Kramasrski and Mevarech, 2003; Ajaja and Eravwoke, 2010;2010; Zakaria, Chin and Daud, 2010; Wyk, 2011, 2012; Zakaria, Slofitri, and Daud, 2013; Tran, 2014; Altun, 2017). The results of this study were obtained with a variety of correlation coefficients (rxy) which can be shown in table 1. The research samples were characterized by transforming the value of t and F to rxy.

Scientific truth must be objective, verifiable, and can be communicated to meet scientific requirements (Suryabrata, 1998). One of the systematic scientific methods that are capable of integrating findings or research results is a meta-analysis (Hunter and Schmidt, 1990; Haidich, 2010;). Meta-analysis is a statistical technique that summarizes and corrects empirical findings across independent studies to get a more precise estimate of the relationship between variables, to compile several studies and then analyzes them, and to compare treatments and predicts a particular phenomenon by using appropriate statistics to explain them more broadly (Hunter and Schmidt, 2004; Enwemeka, Dowdy, Harkness, & Woodruff, 2004; Green, 2005; Junhua, Hongcai, Xiumei, Boli, Hongbo, & Ming, 2007; Riley, Lambert, & Abo-Zaid, 2010; Kilpeläinen , Brage, Sharp, Sonestedt, Demerath, & Holzapfel, 2011; Koricheva, Gurevitch, & Mengersen, 2013; White, 2015; Stanley, Doucouliagos, Johnston, & Rosenberger, 2013;).

The function of Meta-analysis is to measure the errors or range limitations, both directly and indirectly, so that it can provide corrections to research results, quantitatively combine other studies objectively by focusing on the effect size, avoid biased publications, provide good decisions in a short amount of time, and summarize various studies (Hunter and Schmidt, 2015; King, William & He, Jun 2006; Riley, Lambert, & Abo-Zaid, 2010; Green, 2005; Akobeng, 2005).

Based on the description, the researchers were interested to conduct research using a quantitative meta-analysis approach. The research objectives were; (1) knowing the value of the effect size based on the relationship of the cooperative learning method and students' mathematics learning achievement in Indonesia and (2) testing or proving the relationship of the cooperative learning method and students' mathematical learning in Indonesia.

the Research Methods

The design of this research was quantitative meta-analysis designs. Quantitative meta-analysis was done by combining two or more published research results through statistical analysis and review. (Wolf, 1986; Hunter & Schmidt, 2004; Haidich, 2010).

The steps of the research were: (a) determining several interesting theoretical relationships, (b) gathering the population to obtain the data, (c) determining the specific study, (d) assessing the effect size, (e) examining the effect size, (f) analyzing the impacts of moderation variables, and (g) interpreting and reporting the results. The fixed effects and random effects in the meta-analysis were determined by assuming that all studies had the same or different treatment effects (Riley, Higgins, & Deeks, 2011).

Research publications related to the influence or relationship of cooperative learning method on mathematics learning achievement. To analyze the data, Jeffrey's Amazing Statistics Program (JASP. 0.11. 1.0. JASP) software was utilized. The stages of data analysis were based on opinions from Grasman (2017), Borenstein, Hedges, Higgins, & Rothstein, (2009), and Hunter & Schmidt (2004) which consisted of (a) analyzing sample characteristics, (b) performing heterogeneity test, (c) checking publication biases, (d) estimating the effect size value and estimating the summary of effect size, (e) making forest plots, and (f) calculating p-values to test the hypotheses.

the Results of the Research and the Discussion

The initial stages of the analysis were carried out to achieve the research objectives by describing the characteristics of the research samples as presented in table 1.

Table 1. Characteristics of the Research Sample

No	Year	Researchers	N	F	t	r	Characteristics
1	2013	Putu, I Made, & I Made Kirna	119	21,996	4,68999	0.03854	Junior High School Students
2	2015	Ni Luh, Nyoman, & I Made	12		32,756	0,76611	Elementary School Students
3	2014	Ni Komang, I Nyoman, & I Wayan	75		7.94	0.0981	Elementary School Students
4	2014	Ni Luh, Dewa, & Ni Nyoman	50		3.88	0.07479	Elementary School Students
5	2016	Wilibaldus Bhoke	80	2.955	1.71901	0.02156	Elementary School Students
6	2017	Test Cahyaningsih1	73		2,073	0.02837	Elementary School Students
7	2016 Post-	Hadi Pradana	20	6.96	2.63818	0.12783	Elementary School Students
8	2013	Kd Dian, I Gst.	32		15.46	0.34008	Elementary School Students
9	2016	Ai Solihah	40		3.86	0.09221	Vocational High School Students
10	2016	Ummi Rosyidah	28		1.87	0.0671	Junior High School Students
11	2011	La Singga	20	3.362	1.83358	0.09245	Junior High School Students
12	2014	Mira, Faad, and Abd	180	9.92	3.1496	0.01739	Junior High School Students
13	2016	Mohammed, Muliani	20	0, 69	0.83126	0.04414	Junior High School Students
14	2017	Sri, Tohimin Apriyanto	30		3.3	0.10543	Elementary School Students
15	2016	Jhoni Warmansyah	44	14.5	3.80789	0.08313	Elementary School Students
16	2013	I Made, I Wayan, & Sariyasa	55			0,235	Elementary School Students

The table shows that the results of published research, both in journals and proceedings, within 2011 to 2017 display a positive relationship between cooperative learning method and students' mathematics learning achievement with a variety of samples and correlation values. The samples of each research were of at least 12 students to 10 students and the correlation values ranging from 0.01 to 0.76. The description of the year and place of publication can be seen in Figures 1 and 2.

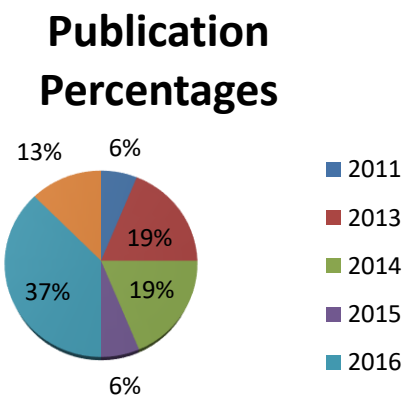

Figure 1. Publication Percentages

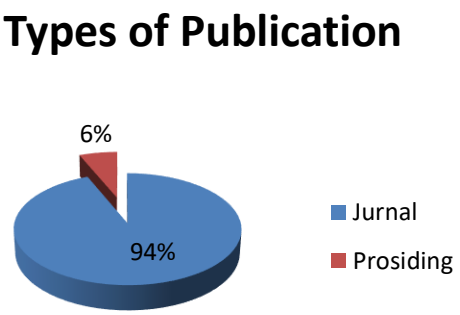

Figure 2. Types of Publication

Based on figure 1, the percentage of publication on the relationship between cooperative learning method and mathematics learning achievement in the 2011-2017 interval was mostly produced in 2016 which consisted of 37% of the whole research. Only a small number of research was published in 2011 and 2016 by only 6%. The type of publication at the same year interval was mostly in the form of journals by 94% and Proceedings by 6%. The most popular journal was the national journal.

The second stage of the research was the heterogeneity test to determine whether the fixed effects or the random effects that should have been used.

Table 2. Fixed and Random Effects

	Q	df	P
Omnibus test of Model Coefficients	6,554	1	0.010
Test of Residual Heterogeneity	48,351	15	< .001

The table shows the Q value on the heterogeneity residual test was 48, 351 with p-value < 0.001 which meant that the publications used in this study were based on the heterogeneity correlation value. This was consistent with the heterogeneity residual test estimate where the value of τ^2 was 0.039 and the value of τ was 0.197 (greater than zero). The value of I^2 was 73.083% which was approaching 100% so that the meta-analysis used to calculate publication bias, effect size value, a summary of effect size, and the p-value was the random effects.

The third stage was done by checking publication bias using random effects by utilizing the rank correlation test for funnel plot asymmetry. The Kendall's value **τ** can be seen in Table 3 and the regression test for Funnel plot asymmetry (Egger's test) for z value can be seen in table 4.

Table 3. Rank Correlation Test for Funnel Plot Asymmetry

	Kendall'sτ	P
Rank test	0.247	0.189

Table 4. Regression Test for Funnel Plot Asymmetry (Egger's test)

	z	p
sei	0.683	0.495

Based on the tables, the obtained Kendall's value **τ** was 0.247 with the p-value of 0.189 and the z value of 0.683 with the p-value of 0.495. It means that there was no publication bias because

the p-values of the two tests were greater than 0.05. The tests' results were in accordance with the funnel plot based on the diagnostic trim-fill analysis presented in figure 3 and Figure 4.

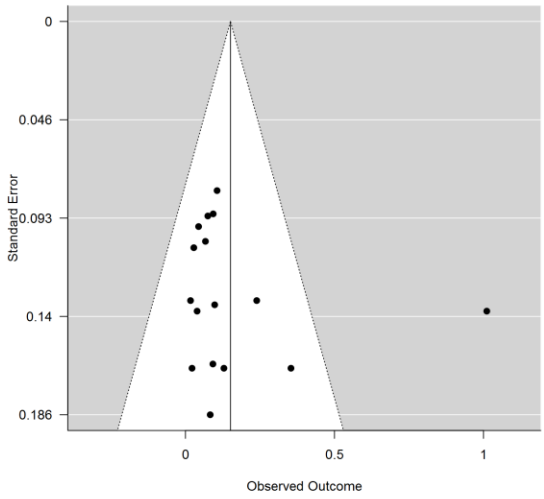

Figure 3. Initial Funnel Plot

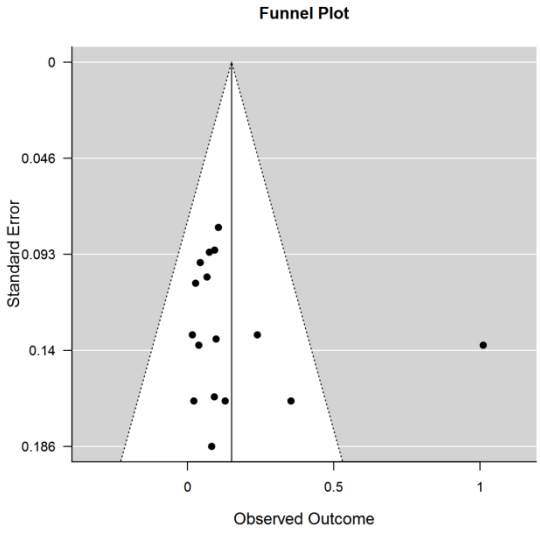

Figure 4. Funnel Plot Diagnostic Trim-Fill Analysis

Based on Figure 3 and Figure 4, the funnel plots show no difference between the initial funnel plot before the diagnostic and funnel plot after the diagnostic. The images show no publication bias so that no additional samples were made in the data analysis. The fourth stage was analyzing the summary effect size. In this stage, the values of the effect size of each publication are presented in Figure 5.

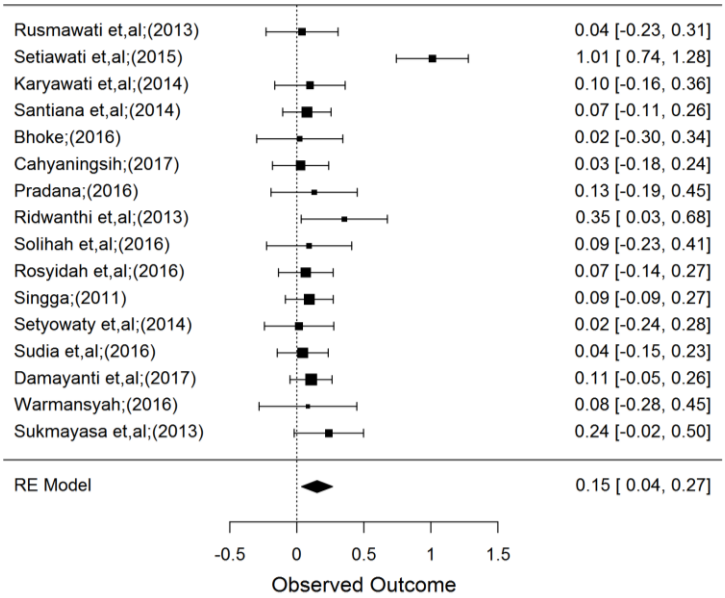

Figure 5. Forest Plot Random Fixed

Figure 5 shows each value of effect size with their respective intervals, for example, the publication by Rusnawati et, al with the value of 0.04 at -0, 23, and 0.31 intervals; the publication by Pradana with the value of 0.13 at -0.19 and 0.45 intervals; and the publication by Sukmayasa with the value of 0.24 at -0.02 and 0.50 intervals. The average effect size value was 0.15 at 0.04 and 0.27 intervals, so the variance and standard error can be determined.

One-tailed t-test with a significance level of 5% and a p-value of 0.05 was performed. The p-value obtained was 0.00621. Because the p-value obtained was 0.00621 which was smaller than 0.05, it could be concluded that Ho was rejected. It means that there was a significant relationship between learning achievement and the cooperative learning method.

Mathematical learning methods that are appropriate to students' characteristics will improve students' mathematics learning achievement (Hariyati, Mardiyana, and Usodo, 2013; Hong, 1996; Kebritchi, Hirumi, and Bai, 2010). The cooperative learning method is one method that has been developed in several countries and gives good results on students' mathematics learning achievement (Rattanatumma and Puncreobutr, 2016). Students' achievement is also influenced by other factors, namely motivation (Mata, Monteiro and Peixoto, 2012), emotions (Ahmed, Van der Werf, Minnaert, 2013), and gender differences (Fennema and Sherman, 1977). Students' mathematics learning achievement is a main indicator of the ability to absorb the material provided.

Based on the results of the analysis of 16 research publications in Indonesia on the cooperative learning method and students' learning achievement through the meta-analysis approach, the average effect size value was 0.15. According to Cohen, Manion, and Morrison (2007), the effect size should be 0 to 1. It means that the effect size value of this research was categorized in the low category. However, there was no publication bias which showed that the research sample used was in accordance with the criteria or valid. The absence of publication bias signified that no publication was lost in the analysis, so there was no need to add more publication to be analyzed.

The positive value of the average effect size showed that the cooperative learning method was one of the variables that had a positive relationship with students' mathematics learning achievement at school, at home, or in other formal institutions. The right learning method can motivate students to learn mathematics. On the contrary, a learning method that does not pay attention to students' characteristics can reduce their motivation in learning mathematics. Mathematics learning methods can improve students' mathematical communication skills even though the material learned is of higher difficulty (Artut, 2009; Tarim, 2009; Tinungki, 2015; Hasanah and Surya, 2017; Maonde, Bey, Salam, Suhar, Anggo, and Tiya, 2015).

The results of hypothesis testing at a significant level of 5% indicated that there was a significant relationship between the cooperative learning method and students' mathematics learning achievement. To that end, in teaching mathematics, each instructor should master the cooperative learning method as one of the learning methods that can improve students' mathematics learning achievement. One step that can be done is to form small groups to discuss each topic to make it easier for teachers to apply the cooperative learning method in the classroom.

Conclusion and Suggestion

The cooperative learning method can encourage students to improve their learning achievement by forming small groups in the classroom. Although mathematics is a difficult subject, the right learning method can motivate the students to learn and complete the tasks given. The meta-analysis approach showed that there was a positive influence between cooperative learning method and students' achievement in Indonesia with an average effect size value of 0.15 at 0.04 and 0.27 intervals, the variance of 0.0028, and standard error of 0.053 which indicated

that there was no publication bias. The success of students' mathematics learning will encourage them to improve their ability in learning mathematics.

The cooperative learning method is one indicator that has been proven to have a positive impact on students' achievement. For this reason, the studies related to cooperative learning methods at schools are needed.

References

Acharya, B. R. (2017). Factors affecting difficulties in learning mathematics by mathematics learners. *International Journal of Elementary Education*, *6*(2), 8-15.

Ahmed, W., Van der Werf, G., Kuyper, H., & Minnaert, A. (2013). Emotions, self-regulated learning, and achievement in mathematics: A growth curve analysis. *Journal of educational psychology*, *105*(1), 150.

Ajaja, O. P., & Eravwoke, O. U. (2010). Effects of cooperative learning strategy on junior secondary school students achievement in integrated science. *Electronic Journal of science education*, *14*(1).

Akobeng, A. K. (2005). Understanding systematic reviews and meta-analysis. *Archives of disease in childhood*, *90*(8), 845-848.

Altun, S. (2017). The effect of cooperative learning on students' achievement and views on the science and technology course. *International Electronic Journal of Elementary Education*, *7*(3), 451-468.

Artut, P. D. (2009). Experimental evaluation of the effects of cooperative learning on kindergarten children's mathematics ability. *International journal of educational research*, *48*(6), 370-380.

Ben-Zeev, T. (1996). When erroneous mathematical thinking is just as "correct": The oxymoron of rational errors. In R. J. Sternberg & T. Ben-Zeev (Eds.), "The nature of mathematical thinking," (pp. 55-80), Mahwah, NJ: Lawrence Erlbaum.

Bhoke, W. (2016). Pengaruh Model Pembelajaran Kooperatif Tipe Student Teams Achievement Division (STAD) dan Motivasi Belajar terhadap Hasil Belajar Matematika Siswa Kelas V SD Gugus 2 Kecamatan Bajawa Kabupaten Ngada-Flores. *Jurnal Ilmiah Pendidikan Citra Bakti*, *3*(1), 102-112.

Brown, A., & Campione J. (1986). Psychological theory and the study of learning disabilities American Psychologist, 14, 1059-1068.

Byrnes, J. P., & Wasik, B. A. (1991). Role of conceptual knowledge in mathematical procedural learning. "Developmental Psychology," 27, 777-786. [EJ 438 150]

Cahyaningsih, U. (2017). Pengaruh Model Pembelajaran Kooperatif Tipe Team Games Tournament (TGT) Terhadap Hasil Belajar Matematika Siswa SD. *Jurnal Cakrawala Pendas*, *3*(1).

Chen, Y.-S., & Cheng, C.-H. (2013). *Assessing mathematics learning achievement using hybrid rough set classifiers and multiple regression analysis. Applied Soft Computing, 13(2), 1183–1192.*

Cobb, P., Yackel, E. and Wood, T.: 1992, 'A constructivist alternative to the representa-tional view of mind in mathematics education',Journal for Research in Mathematics Education 23, 2–33.

Cohen, L., Manion, l., & Morrison, K. (2007). *Research methods in education*. Sixth edition. Madison Avenue: New York.

Effandi Zakaria. (2005). Asas Pembelajaran Koperatif Dalam Matematik . Shah Alam: Karisma Publications Sdn Bhd.

Enwemeka, C. S., Parker, J. C., Dowdy, D. S., Harkness, E. E., Harkness, L. E., & Woodruff, L. D. (2004). The efficacy of low-power lasers in tissue repair and pain control: a meta-analysis study. *Photomedicine and Laser Therapy*, *22*(4), 323-329.

Fennema, E., & Sherman, J. (1977). Sex-related differences in mathematics achievement, spatial visualization and affective factors. *American educational research journal*, *14*(1), 51-71.

Gie, T.L. (1993). Filsafat matematika bagian kedua epistimologi matematika.Yogyakarta. PUBIB

Green, S. (2005). Systematic reviews and meta-analysis. *Singapore medical journal*, *46*(6), 270.

Haidich, A. B. (2010). Meta-analysis in medical research. *Hippokratia*, *14*(Suppl 1), 29.

Hariyati, E., Mardiyana, M., & Usodo, B. (2013). Efektivitas Model Pembelajaran Kooperatif Tipe Team Assisted Individualization (TAI) dan Problem Based Learning (PBL) Pada Prestasi Belajar Matematika Ditinjau Dari Multiple Intelligences Siswa SMP Kabupaten Lampung Timur Tahun Pelajaran 2012/2013. *Jurnal Pembelajaran Matematika*, *1*(7).

Hasanah, M. A., & Surya, E. (2017). Differences in the abilities of creative thinking and problem solving of students in mathematics by using cooperative learning and learning of problem solving. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, *34*(01), 286-299.

Hiebert, J., & Carpenter, T. P. (1992). Learning and teaching with understanding. In D.Grouws (Ed.), "Handbook for research on mathematics teaching and learning" (pp.65-97). New York: MacMillan.

Hiebert, J., & Lefevre, P. (1986). Conceptual and procedural knowledge in mathematics: An introductory analysis. In J. Hiebert (Ed.), "Conceptual and procedural knowledge: The case of mathematics" (pp. 1-27). Hillsdale, NJ: Lawrence Erlbaum.

Hong, H. (1996). Effects of mathematics learning through children's literature on math achievement and dispositional outcomes. *Early childhood research quarterly*, *11*(4), 477-494.

Huang, C. S. J., Su, A. Y. S., Yang, S. J. H., & Liou, H.-H. (2017). *A collaborative digital pen learning approach to improving students' learning achievement and motivation in mathematics courses. Computers & Education, 107, 31–44.*

Hunter, J. E., & Schmidt, F. L. (2004). Methods of meta-analysis: Correcting error and bias in research findings. California: Sage Publications

Hunter,J.E.,& Schmidt, F. L. (1990). Methods of meta-analysis.Newbury Park, CA : Sage Publications,Inc

Janvier, C., Girardon, C., & Morand, J. (1993). Mathematical symbols and representations. In P. S. Wilson (Ed.), "Research ideas for the classroom: High school mathematics" (pp. 79-102). Reston, VA: National Council of Teachers of Mathematics.

Johnson, D. W., & Johnson, R. (1989). Cooperation and competition: Theory and research Edina, MN: Interaction Book Company.

Johnson, D. W., & Johnson, R. (1999). Learning together and alone: Cooperative, competitive, and individualistic learning(5th Edition). Boston: Allyn & Bacon. First edition 1975.

Johnson, D. W., Johnson, R. T., & Smith, K. A. (2014). Cooperative learning: Improving university instruction by basing practice on validated theory. *Journal on Excellence in University Teaching*, *25*(4), 1-26.

Johnson, D. W., Johnson, R., & Smith, K. (2006). Active learning: Cooperation in the university classroom(3rd ed.). Edina, MN: Interaction Book Company.

Junhua, Z., Hongcai, S., Xiumei, G., Boli, Z., Yaozu, X., Hongbo, C., & Ming, R. (2007). Methodology and reporting quality of systematic review/meta-analysis of traditional Chinese medicine. *The Journal of Alternative and Complementary Medicine*, *13*(8), 797-806.

Karyawati, N. K., Murda, I. N., & Widiana, I. W. (2014). Pengaruh model pembelajaran kooperatif tipe think pair square berbantuan kartu kerja terhadap hasil belajar matematika. *MIMBAR PGSD Undiksha*, *2*(1).

Kebritchi, M., Hirumi, A., & Bai, H. (2010). The effects of modern mathematics computer games on mathematics achievement and class motivation. *Computers & education*, *55*(2), 427-443.

Kemendikbud. (2013). *Petunjuk teknis persiapan implementasi kurikulum tahun 2013*. Direktorat Jenderal Pendidikan Menengah.

Kilpeläinen, T. O., Qi, L., Brage, S., Sharp, S. J., Sonestedt, E., Demerath, E., ... & Holzapfel, C. (2011). Physical activity attenuates the influence of FTO variants on obesity risk: a meta-analysis of 218,166 adults and 19,268 children. *PLoS Med*, *8*(11), e1001116.

King, William & He, Jun. (2006). A meta-analysis of the Technology Acceptance Model. Information & Management. 43. 740-755. 10.1016/j.im.2006.05.003.

Koricheva, J., Gurevitch, J., & Mengersen, K. (Eds.). (2013). *Handbook of meta-analysis in ecology and evolution*. Princeton University Press.

Kramarski, B., & Mevarech, Z. R. (2003). Enhancing mathematical reasoning in the classroom: The effects of cooperative learning and metacognitive training. *American Educational Research Journal*, *40*(1), 281-310.

Lampert, M. (1986). Knowing, doing, and teaching multiplication. "Cognition and Instruction," 3, 305-.342

Lerman, S.: 1996, 'Intersubjectivity in mathematics learning: A challenge to the radical constructivist paradigm?' Journal for Research in Mathematics Education 27(2), 133–150.

Li, Q., & Ma, X. (2010). *A Meta-analysis of the Effects of Computer Technology on School Students' Mathematics Learning. Educational Psychology Review, 22(3), 215–243.*

Maonde, F., Bey, A., Salam, M., Suhar, L., Anggo, M., & Tiya, K. (2015). The discrepancy of students' mathematic achievement through cooperative learning model, and the ability in mastering languages and science. *International Journal of Education and Research*, *3*(1), 141-158.

Mata, M. D. L., Monteiro, V., & Peixoto, F. (2012). Attitudes towards mathematics: Effects of individual, motivational, and social support factors. *Child development research*, *2012*.

Mutlu, Y. (2019). Math Anxiety in Students with and without Math Learning Difficulties. *International Electronic Journal of Elementary Education*, *11*(5), 471-475.

National Research Council, (1989). Everybody counts: A report to the nation on the future of mathematics education. Washington, D. C.: National Academy Press.

Pimphan Dechacoop. (2001). The Learning and Teaching that Mainly Focus on Learners, Concept, Method and Teaching Technique 1.Bangkok: The Master Group Management.

Prabowo, A., Anggoro, R. P., Astuti, D., dan Fahmi, S. (2017). Interactive multimedia-based teaching material for 3-dimensional geometry. *IOP Conf. Series: Journal of Physics: Conf. Series* 943 (2017) 012047 doi :10.1088/1742-6596/943/1/012047.

Prabowo, A., Anggoro, R.P., dan Rahmawati U. (2018a). Profil Hasil Ujian Nasional Materi Matematika SMP/MTs. EduMa, 7(2), 31-39.

Prabowo, A., Anggoro, R. P., Adiyanto, R., dan Rahmawati, U. (2018b). Interactive Multimedia-based Teaching Material for Trigonometry. *IOP Conf. Series: Journal of Physics: Conf. Series* 1097 (2018) 012138 doi :10.1088/1742-6596/1097/1/012138.

Prabowo, A., Rahmawati, U., & Anggoro, R.P. (2019). Android-based Teaching Material for Statistics Integrated with Social Media WhatsApp. *International Journal on Emerging Mathematics Education, 3*(1), 93-104. http://dx.doi.org/10.12928/ijeme.v3i1.11961

Prabowo, A., Anggoro, R. P., Rahmawati, U., dan Rokhima, N. (2019). Android-based teaching material for straight-sides solid. *Journal of Physics: Conference Series* 1321 *(2019) 032097*, doi:10.1088/1742-6596/1321/3/032097.

Pradana, P. H. (2017). Pengaruh Pembelajaran Kooperatif Tipe NHT & STAD dan Motivasi Belajar Terhadap Hasil Belajar Matematika. *Gammath: Jurnal Ilmiah Program Studi Pendidikan Matematika*, *1*(2).

Rattanatumma, T., & Puncreobutr, V. (2016). Assessing the Effectiveness of STAD Model and Problem Based Learning in Mathematics Learning Achievement and Problem Solving Ability. *Journal of Education and Practice*, *7*(12), 194-199.

Reid, J. (1992). The Effects of Cooperative Learning with Intergroup Competition on the Math Achievement of Seventh Grade Students.

Ridwanthi, K. D. P., Japa, I. G. N., & Agung, A. G. (2013). Pengaruh Model Pembelajaran Kooperatif Tipe NHT Berbantuan Media Question Cards Terhadap Hasil Belajar Matematika Siswa Kelas IV SDN 6 Bondalem. *MIMBAR PGSD Undiksha*, *1*(1).

Riley, R. D., Higgins, J. P., & Deeks, J. J. (2011). Interpretation of random effect meta-analyses, *BMJ*, 342,d549

Riley, R. D., Lambert, P. C., & Abo-Zaid, G. (2010). Meta-analysis of individual participant data: rationale, conduct, and reporting. *Bmj*, *340*, c221.

Rosyidah, U. (2016). Pengaruh model pembelajaran kooperatif tipe jigsaw terhadap hasil belajar matematika siswa kelas VIII SMP Negeri 6 Metro. *SAP (Susunan Artikel Pendidikan)*, *1*(2)

Rusmawati, P. E., Candiasa, I. M., Kom, M. I., & Kirna, I. M. (2001). Pengaruh Model Pembelajaran Kooperatif TGT terhadap Prestasi Belajar Matematika Ditinjau dari Motivasi Berprestasi Siswa Kelas VIII SMP Negeri 2 Semarapura Tahun Pelajaran 2012/2013. *Jurnal Teknologi Pembelajaran Indonesia*, *3*(1).

Santiana, N. L. P. M., Sudana, D. N., Garminah, N. N., & Hum, M. (2014). Pengaruh Model Pembelajaran Kooperatif Tipe Numbered Heads Together (NHT) Terhadap Hasil Belajar Matematika Siswa Kelas V Sekolah Dasar di Desa Alasangker. *MIMBAR PGSD Undiksha*, *2*(1).

Schmidt, F. L., & Hunter, J. E. (2015). Methods of meta-analysis: Correcting error and bias in research findings (3rd ed.). Thousand Oaks, CA: SAGE. doi:10/b6mg

Setiawati, N. L. P., DANTES, D. N., CANDIASA, D. I. M., & Komp, M. I. (2015). Pengaruh Model Pembelajaran Kooperatif Thinking Aloud Pair Problem Solving (TAPPS) berbantuan LKS Terhadap Sikap Sosial dan Hasil Belajar Matematika Siswa Kelas VI SLB Negeri Gianyar. *Jurnal Penelitian dan Evaluasi Pendidikan Indonesia*, *5*(1).

Setyowaty, M. S., Maonde, F., & Sani, A. (2017). Pengaruh Pembelajaran Kooperatif, Perilaku Berkarakter dan Pengetahuan Dasar Siswa terhadap Hasil Belajar. *Jurnal Pendidikan Matematika*, *5*(2), 136-149.

Silver, E. A. (1986). Using conceptual and procedural knowledge: A focus on relationships. In J.

Hiebert (Ed.), "Conceptual and procedural knowledge: The case of mathematics" (pp. 181-197). Hillsdale, NJ: Lawrence Erlbaum.

Singga, L. (2017). Pengaruh model pembelajaran kooperatif tipe jigsaw dan tsts terhadap hasil belajar matematika. *Jurnal Pendidikan Matematika*, *2*(1).

Slavin, R. E. (1986). Using student team learning. (3rd ed.). Baltimore: Johns Hopkins University, Center for Research on Elementary and Middle Schools.

Slavin, R. E., Leavey, M. B., & Madden, N. A. (1984). Combining cooperative learning and individualized instruction: Effects on student mathematics achievement, attitudes, and behaviors. *The Elementary School Journal*, *84*(4), 409-422.

Slavin, R. E., Leavey, M., & Madden, N. A. (1984). Combining cooperative learning and individualized instruction: Effects on students' mathematics achievement, attitudes, and behaviors. Elementary School Journal, 84, 409-422

Slavin. Robert.E., Cooper. Robert. (1989). Improving Intergroup Relations: Lessons Learned From Cooperative Learning Programs. Journal of Social Issues, Winter, 55(4), p.647

Solihah, A. (2016). Pengaruh Model Pembelajaran Teams Games Tournament (TGT) terhadap Hasil Belajar Matematika. *SAP (Susunan Artikel Pendidikan)*, *1*(1).

Stanley, T. D., Doucouliagos, H., Giles, M., Heckemeyer, J. H., Johnston, R. J., Laroche, P., ... & Rosenberger, R. S. (2013). Meta-analysis of economics research reporting guidelines. *Journal of Economic Surveys*, *27*(2), 390-394.

Stevens, R. J., & Slavin, R. E. (1995). Effects of a cooperative learning approach in reading and writing on academically handicapped and nonhandicapped students. *The Elementary School Journal*, *95*(3), 241-262.

Stevens, R. J., Madden, N. A., Slavin, R. E., & Farnish, A. M. (1987). Cooperative integrated reading and composition: Two field experiments. Reading Research Quarterly,22, 433-454.

Sudia, M., & Majja, M. (2017). Pengaruh Motivasi Berprestasi Melalui Kombinasi Model Pembelajaran Kooperatif Terhadap Hasil Belajar Matematika. *Jurnal Pendidikan Matematika*, *7*(1), 1-13.

Sukmayasa, I. M. H., Lasmawan, I. W., & Sariyasa, S. (2013). *Pengaruh Model Pembelajaran Kooperatif Tipe NHT Berbantuan Senam Otak terhadap Keaktifan dan Prestasi Belajar Matematika* (Doctoral dissertation, Ganesha University of Education).

Suryabrata, 1998, Metode Penelitian Kuantitatif dan Kualitatif, Catatan Kuliah Program Pendidikan Doktor Psikologi UGM(tidak diterbitkan), Yogyakarta.

Tarim, K. (2009). The effects of cooperative learning on preschoolers' mathematics problem-solving ability. *Educational studies in mathematics*, *72*(3), 325-340.

Tinungki, G. M. (2015). The Role of Cooperative Learning Type Team Assisted Individualization to Improve the Students' Mathematics Communication Ability in the Subject of Probability Theory. *Journal of Education and Practice*, *6*(32), 27-31.

Tran, V. D. (2014). The effects of cooperative learning on the academic achievement and knowledge retention. *International journal of higher education*, *3*(2), 131-140.

Warmansyah, J. (2016). Pengaruh Metode Pembelajaran Kooperatif dan Motivasi Belajar Terhadap Hasil Belajar Matematika. *Jurnal Pendidikan Usia Dini*, *10*(1), 99-120.

Wearne, D., & Hiebert, J. (1988). A cognitive approach to meaningful mathematics instruction: Testing a local theory using decimal numbers. "Journal for Research in Mathematics Education," 19, 371-384. [EJ 380 725]

Wewe, M. (2017). The Effect Of Problem Based Learning Model And Mathematic-Logical Intelligence Toward Mathematics Learning Achievement. *Journal of Education Technology*, *1*(1), 13-17.

White, I. R. (2015). Network meta-analysis. *The Stata Journal*, *15*(4), 951-985.

Wittrock, M. (1986). Students' thought processes. In M.Wittrock (Ed.), Handbook of research on teaching (pp. 297-314). New York: Macmillan.

Wolf, F. M. (1986). *Meta-analysis: Quantitative methods for research synthesis* (Vol. 59). Sage.

Vygotsky, L.(1978). Mind and society: The de-velopment of higher psychological processes. Cambridge, MA: Harvard University Press.

Wyk, M. M. V. (2011). The effects of Teams-Games-Tournaments on achievement, retention, and attitudes of economics education students. *Journal of Social Sciences*, *26*(3), 183-193.

Wyk, M. M. V. (2012). The effects of the STAD-cooperative learning method on student achievement, attitude and motivation in economics education. *Journal of Social Sciences*, *33*(2), 261-270.

Yetkin, E. (2003). Student Difficulties in Learning Elementary Mathematics. ERIC Digest.

Zakaria, E., & Iksan, Z. (2007). Promoting Cooperative Learning in Science and Mathematics Education: A Malaysian Perspective. *Online Submission*, *3*(1), 35-39.

Zakaria, E., Chin, L. C., & Daud, M. Y. (2010). The effects of cooperative learning on students' mathematics achievement and attitude towards mathematics. *Journal of social sciences*, *6*(2), 272-275.

Zakaria, E., Solfitri, T., Daud, Y., & Abidin, Z. Z. (2013). Effect of cooperative learning on secondary school students' mathematics achievement. *Creative Education*, *4*(2), 98-100.

Zevenbergen, R.: 1996, 'Constructivism as a liberal bourgeois discourse', Educational Studies in Mathematics 31, 95–113.