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The Effect of Constructive Play on Early Childhood Mathematics Skills in Indonesia: A Meta-Analysis

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Abstrak

Banyak penelitian telah mengksplorasi dampak permainan konstruktif tehadap kemampuan matematika awal anak usia dini dan menunjukkan hasil yang beragam. Oleh sebab itu, tujuan dari penelitian meta analisis ini adalah untuk menguji kembali pengaruh permainan konstruktif terhadap kemampuan matematika awal anak usia dini. Penelitian ini adalah penelitian meta analisis dengan pendekatan kuantitatif. Penelitian ini melibatkan hasil penelitian dari beberapa peneliti yang didapatkan melalui penelusuran google scholar dari tahun 2014 sampai 2024 dengan menggunakan tahapan PRISMA yaitu identifikasi, screening, kelayakan, dan inklusi. Analisis data dalam penelitian meta-analisis ini menggunakan bantuan aplikasi OpenMEE dengan tahapan – tahapan meliputi Uji bias publikasi, uji heterogenitas , menghitung effect size dari tiap-tiap studi primer, dan membuat kesimpulan dari hasil analisis. Hasil analisis ukuran efek dari 22 penelitian yang diterbitkan satu dekade menunjukkan bahwa permainan konstruktif berkontribusi positif terhadap ukuran efek keseluruhan penelitian dengan kategori Very Large dengan nilai sebesar 3,145. Selain itu, penelitian ini mengeksplorasi jenis – jenis permainan konstruktif dan kemampuan matematika awal anak usia dini yang dituju. Jenis permainan kostruktif yang paling efektif adalah papan magnet dengan nilai sebesar 7,263. Sedangkan, kemampuan matematika awal anak usia dini yang dituju adalah kemampuan berpikir logis matematis dengan nilai sebesar 8,138. Temuan penelitian ini menunjukkan bahwa permainan konstruktif memberikan pengaruh yang lebih efektif dan patut diterapkan dalam meningkatkan kemampuan matematka awal anak usia dini.

Kata Kunci: *Permainan Konstruktif, Kemampuan Matematika AUD, Meta Analisis*

Abstract

Many studies have explored the impact of constructive play on early childhood early math skills and have shown mixed results. Therefore, the purpose of this meta-analysis is to re-examine the effect of constructive play on early childhood early math skills. This research is a meta-analysis with a quantitative approach. This study involved the results of research from several researchers obtained through google scholar searches from 2014 to 2024 using the PRISMA stages of identification, screening, eligibility, and inclusion. Data analysis in this meta-analysis research uses the help of the OpenMEE application with stages including publication bias test, heterogeneity test, calculating the effect size of each primary study, and making conclusions from the analysis results. The results of the effect size analysis of 22 studies published in a decade showed that constructive play positively contributed to the overall effect size of the studies in the Very Large category with a value of 3.145. In addition, this study explored the types of constructive play and early math skills of the targeted young children. The most effective type of constructive play was the magnetic board with a value of 7.263. Meanwhile, the targeted early math skill was mathematical logical thinking with a score of 8.138. The findings of this research indicate that constructive games provide a more effective influence and should be applied in improving early childhood early math skills.

Keywords: Constructive Play, Early Childhood Math Skills, Meta Analysis

1. INTRODUCTION

Early childhood education is crucial as a foundational stage that supports the rapid and fundamental development of children for their future growth. This process occurs simultaneously with the ability to absorb new information and experiences that early

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childhood children gain at the beginning of their lives. Therefore, it requires appropriate stimuli and encouragement that align with the development of early childhood children to foster their intellectual, social, and emotional potential (Hendayanti et al., 2021; Khotimah & Agustini, 2023). The forms of stimulation provided to children must be done in ways that are appropriate and suited to each aspect of their development. One of the aspects of development that needs to be optimized in children is cognitive development.

Cognitive development is one of the aspects assessed in learning, along with the affective and psychomotor domains. These three aspects are interconnected in building a comprehensive understanding of a concept. In the context of early childhood education, the application of effective teaching methods is crucial to ensure that children gain a strong conceptual understanding of counting, number recognition, shapes, sizes, patterns, and other basic mathematical concepts (Marinda, 2020; Ondog & Kilag, 2024). Furthermore, Piaget's theory of cognitive development provides a valuable framework for understanding how children develop cognitively and acquire mathematical concepts. According to Piaget, children progress through different stages of cognitive development, each characterized by unique cognitive structures and ways of understanding the world (Khotimah & Agustini, 2023; Ondog & Kilag, 2024). The processes of assimilation and accommodation, which are central to Piaget's theory, describe how children incorporate new information into existing cognitive structures or alter these structures to accommodate new information. These processes are essential for understanding how children approach and comprehend early mathematical concepts during the early stages of childhood development.

Piaget's theory has stated that early childhood experiences different stages of cognitive development. Therefore, Early Childhood Education (PAUD) plays a crucial role in the cognitive development of young children, including early mathematical skills. Furthermore, research has shown that cognitive development and mathematical abilities at each stage of early childhood development can be stimulated through constructive play. This aligns with Piaget's cognitive development theory, which emphasizes the role of play in learning (Istiqomah & Maemonah, 2021; Juwantara, 2019; Permadi & Dewi, 2022).

Furthermore, Vygotsky's theoretical view emphasizes the importance of social interaction and the role of teachers or adults in supporting children's learning. In the context of early childhood education, social interaction and the role of teachers or adults in supporting children's learning can be done through games because they have great potential as a fun and effective learning tool for children. The importance of play in child development by highlighting its role in cognitive, language, psychomotor, and physical development. Further other researchers further explore the use of deep play in early childhood education to improve reading skills. These studies collectively underline the value of constructive play in various aspects of child development (Bachtiar, 2021; Kutu, 2020; Permadi & Dewi, 2022; Ritonga & Yulizar, 2022).

Constructive play is defined as a play activity that involves the construction or construction of objects or ideas. Constructive play can be a tool that supports collaborative learning and the development of mathematical understanding through interaction with adults or peers. Constructive play in particular can provide interactive learning experiences, encourage exploration, and stimulate the development of cognitive skills (Istiqomah & Maemonah, 2021; Permadi & Dewi, 2022; Warmansyah & Amalina, 2019). Constructive games can include different types of games, such as building blocks, geometric construction games, legos, puzzles or other creative games that involve mathematical elements (Azkia et al., 2022; Bachtiar, 2021; Ginting, 2018).

In an era where technology is constantly evolving, constructive games can also be presented in the form of interactive educational apps or software. The use of interactive educational software and applications, including constructive play, has the potential to improve early childhood math skills (Rahmatia et al., 2021; Warmansyah & Amalina, 2019). Some examples of constructive play presented in the form of popular and effective math education apps or software for children of this age include Montessori apps, game-based apps, and visual programming apps. Montessori apps are inspired by the Montessori method which emphasizes independent and experiential learning. Montessori number rods can improve the number concept skills of children aged 3-4 years. Game-based applications can be created in the form of an Android operating system that is intended and can be used for early childhood learning between the ages of 3-6 years, for example, number tower games or geometry puzzle games. While Visual Programming applications such as ScratchJr allow children to create simple animations and games. other researchers shows that through the use of ScratchJr, children can use geometry and measurement concepts such as coordinates, angle and length measurements, as well as facilitate creative problem solving, logical reasoning, and support early childhood collaboration. Several studies have shown the effectiveness of using interactive educational software and applications in improving early childhood math skills. For example, the use of interactive multimedia can improve mathematical reasoning skills in early childhood (Nurjanah et al., 2022; Nurjanah & Mukarromah, 2021; Roostin, 2021; Syaefudin & Annasya, 2023).

Previous studies on the influence of constructive play on early childhood math skills have yielded mixed findings. Therefore, a thorough analysis and synthesis of these findings is needed to obtain a clearer and more consistent picture of the results of the influence of constructive play on early childhood mathematical skills. While there is potential for positives, the application of constructive play in the context of early childhood education requires a deep understanding of the factors that influence its effectiveness. Challenges such as game design, child characteristics, and learning environment need to be understood comprehensively. Therefore, in this study, there is a moderate analysis related to the types of constructive games and early childhood mathematics skills that are intended to provide a comprehensive picture. Some previous studies may have limitations such as limited samples, different research methods, or variables that are not fully controlled. Therefore, this study aims to thoroughly analyze the effect of constructive play on early childhood early math skills in Indonesia. Using a meta-analysis method, this research will collect and evaluate the results of previous studies examining the impact of constructive play on children's development of basic mathematical skills, such as number recognition, patterns, shapes, as well as logic and problem-solving skills. The focus of the meta-analysis is to identify and synthesize findings from empirical studies that examine the impact of constructive play on young children's early mathematics skills (Azkia et al., 2022; Makarim et al., 2023; Wang et al., 2022). This involves statistical analysis of the results of the study to get an overview of the extent to which constructive play can contribute to early childhood math skills. By understanding the background of the problem and the purpose of this study, this research is expected to provide a comprehensive picture of the extent to which constructive games contribute to improving early childhood early math skills in Indonesia. In addition, it is expected to provide strong empirical evidence of the effectiveness of these games, so that they can be a reference in the development of more innovative and interactive math learning methods in early childhood education.

2. METHOD

The type of this research is ameta-analysis research. It is used to summarize, estimate, test and compare the effects of constructive play by analyzing and combining a number of primary studies that address research topics that are similar to or relevant to the purpose of this research. This study uses a quantitative approach with quantitative descriptive methods and calculation of effect sizes to obtain accurate conclusions. Several studies that use the same meta-analyst and analysis methods can be seen in the same research (Makarim et al., 2023; Mao et al., 2022; Shah et al., 2020; Wang et al., 2022). This study involves the results of research from several researchers obtained through a google scholar search from 2014 to 2024 using the PRISMA stage which refers to the research. This research uses the *Boolean searching* to search for the keyword of this research data, namely "constructive game" *and* "Early childhood math skills" and "constructive play" *or* "Early Childhood Mathematical Skills".

This study uses the following inclusion criteria: (1) The study is a study on the influence of constructive games on early childhood mathematics skills; (2) Research on primary studies is carried out at the PAUD level in Indonesia; (3) Primary studies in the form of articles in journals; and (4) Primary studies are quantitative research and contain statistical data to find the size of the effect which includes sample size, standard deviation and mean. Furthermore, Figure 1 shows the data collection process which is divided into four stages, namely identification, screening, eligibility, and inclusion. In the identification stage, the article search process was carried out using Google Scholar with predetermined keywords and year restrictions from 2014 to 2024. After that, the screening process of studies obtained from the identification stage was then selected based on the title and abstract. Studies that did not fit the theme of this research were excluded. The next stage is the eligibility stage, studies are selected based on the inclusion criteria that have been set. If the study did not meet any of the predetermined inclusion criteria then the study was excluded and not included in the next process. And the final stage, all data that meet the inclusion criteria will be further analyzed by meta-analysis to obtain the effect size of each study and the combined effect size of the study.

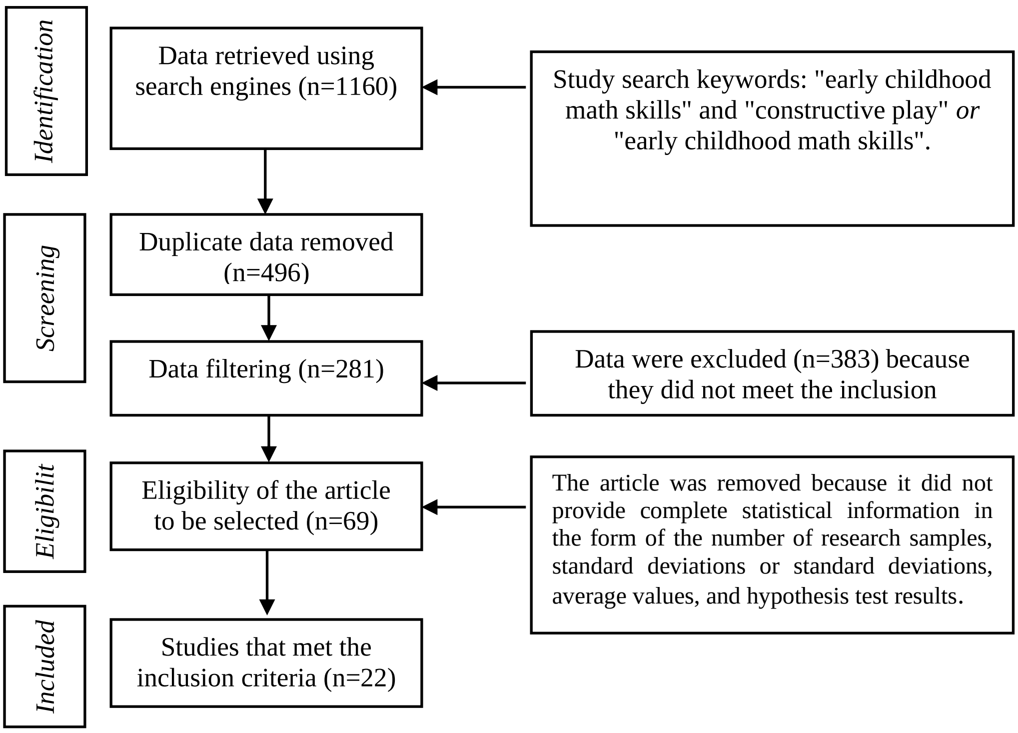

Figure 1. Study Selection Flow Chart by PRISMA Stages

Data analysis in this meta-analysis study uses the help of the OpenMEE application with the following stages. First, the publication bias test uses funnel plot analysis and test *fail-safe N Rosenthal*. The second is to conduct a heterogeneity test of each study used in the meta-analysis. The third stage is to calculate *effect size* from each primary study. The results of data acquisition on *effect size* each study or *effect size* The combined studies were then interpreted using the categories developed by Cohen (1988) become The five criteria are: *Ignored* ($0.00 \leq ES < 0.20$), *small* ($0.20 \leq ES < 0.50$), *moderate* ($0.50 \leq IS < 0.80$), *large* ($0.80 \leq ES < 1.30$ and *very large* ($ES \geq 1{,}30$). And, the last stage is to make conclusions from the results of the analysis.

3. RESULTS AND DISCUSSION

Results

The article search process is divided into 4 stages, namely identification, screening, feasibility, and inclusion. In the process of identifying the article search process, it is carried out using the Google application with predetermined keywords and year restrictions from 2014 to 2024. After that, a screening process was carried out for the studies obtained from the identification stage and then selected based on the title and abstract. Studies that are not in accordance with the theme of this research were issued. The next stage is the feasibility stage, studies are selected based on the inclusion criteria that have been set. If the study does not meet one of the inclusion criteria that have been set, the study is excluded and not included in the next process. And in the final stage, all data that meet the inclusion criteria will be further analyzed with meta-analysis to obtain the effect size of each study and the combined effect size of the study. The four specifications refer to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) presented in Figure 1.

There are 1160 articles identified. Then the collection of articles is exported into Microsoft Excel and 496 articles were removed for duplicates. The remaining 664 articles are included in the screening stage. As for the screening process, articles are selected based on the suitability of the article title, journal index, and research design. Articles with titles on the variety of constructive games, articles published in sinta-indexed journals, and articles with experimental research designs are included in the list. The list of articles after being selected at the screening stage was 281 articles and 383 articles were removed from the list. The stage is feasibility, selected after reading the research methods and results. Articles that do not list sample size, mean, standard deviation and control group intervention will be excluded. There are 212 excluded articles so that the articles that will be reviewed in this study are 69 articles. Furthermore, 69 articles were reviewed based on the predetermined inclusion requirements. The selection results obtained 22 articles that met the inclusion requirements.

Publication bias from various sources can affect the results of meta-analysis studies. Publication bias can occur when only positive study results are published, and funnel plots can be used to assess the validity of meta-analyses. If there is a publication bias in the meta analysis, the funnel plot will become an asymmetrical funnel. Conversely, if the funnel plot is an asymmetrical inverted funnel, it indicates the absence of publication bias. Furthermore, this test was carried out to find out whether the data that had been collected could be used as a representative sample of the population or not by looking at whether the funnel plot showed a symmetrical or asymmetrical shape. The results of the publication bias test were carried out with a funnel plot on Figure 2.

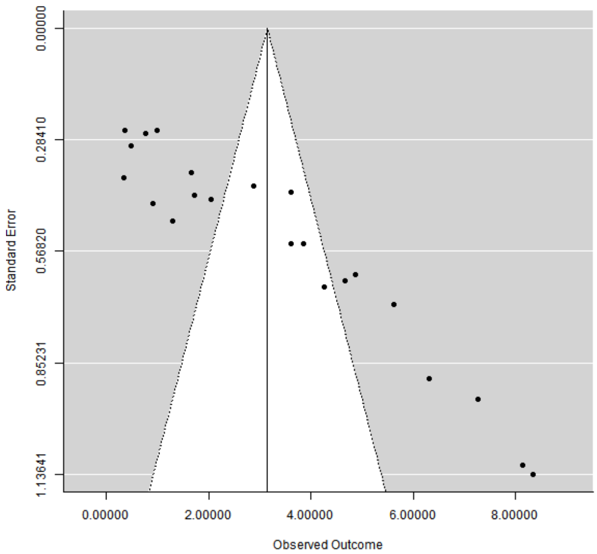

Figure 2. Publication Bias Test Plot Funnel

By Figure 2, the funnel plot looks asymmetrical and most of the research is at the top and bottom of the funnel plot, indicating that there is an indication of publication bias. Will but it is difficult to conclude whether the funnel plot results are really asymmetrical or not, so it is necessary to use the help of another method, namely Fail-Safe N. If the fail-safe value N is greater than the Rosenthal formula 5K + 10, then it indicates that there is no publication bias. The fail-safe value of N in this study is 5000 which means that it is suspected that there are 5000 publications whose results are biased or methodologically not done well, so the study is not published. Furthermore, the fail-safe value of N is compared to the value of 5K + 10 with K being the number of studies that are meta-analyzed. Because K = 22 so 5(22) + 10 = 120, which means that the fail-safe value N > 5K+10 with a significance target of 0.05 and p < 0.0001. With this, it can be concluded that there is no publication bias problem in the meta-analysis results and the plot funnel can be said to be symmetrical.

The heterogeneity test is checked by looking at the value of *p-value* and Q value. If the value *p-value* < 0.05, it can be interpreted that the distribution of the primary study used is heterogeneous, so the analysis model chosen is a random effect model. On the other hand, if the value *p-value* > 0.05, it can be interpreted that the distribution of the primary study used is homogeneous, so the analysis model chosen is a fixed-effect model (Mao et al., 2022; Wang et al., 2022). The results of the heterogeneity test are found in Table 1.

Table 1. Heterogeneity Test Results

tau^2	Q(df=21)	Het. P-Value	I^2
3.014	357.590	< 0.001	94.127

Based on Table 1, the p-value < 0.001 with a confidence level of 0.05 and I2 of 94.127 shows that constructive play has a significant effect on early childhood mathematics ability and the sample effect size in this study is heterogeneous with a value of 94.127% which is categorized as very high. This means that *the random effect model* in meta-analysis research is considered appropriate to use because of the heterogeneous results. Effect size is the basic unit in meta-analysis studies in the form of a measure that represents the effect (effect) caused by a certain treatment. The measure of the effect of scientific publication articles on the influence of constructive play on early childhood math skills consists of five categories belonging to Cohen (1988). *The overall Forest Plot* effect size using the OpenMEE application can be seen in Figure 3.

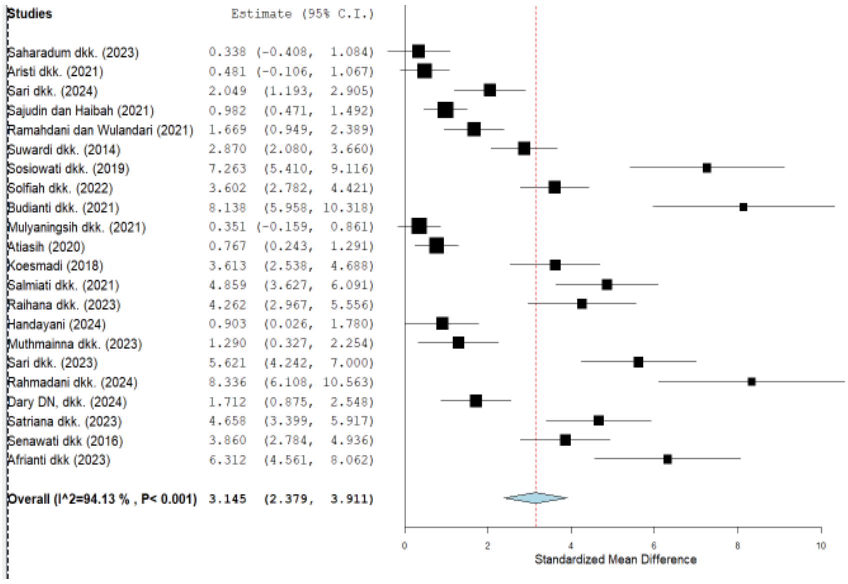

Figure 3. *Forest Plot Effect Size* Overall Results

The results of the data analysis on Figure 3 shows that the results of the overall effect of the study Analyzed with a value of 3,145 securities size, which is included in the category of *very large*. The results of the observed effect size have different values with 95% *Confident Interval* from 2,379 to 3,913. Moreover *Forest Plot Effect Size* The overall results showed that the plot points were after the number zero indicating that constructive play had a positive effect on early childhood math ability. Based on Figure 3, the average effect of constructive play is 3.145 on early childhood math ability. This shows that in the experimental class, constructive games are able to improve early childhood mathematics skills by 3.145 times the standard deviation of the average score of the control group. The use of a control group in each primary study to test the effect of the intervention on the experimental group, the initial mathematical ability of AUD obtained is the effect of the intervention given, namely constructive play. It can be concluded that there is a very large influence of the use of constructive games on early childhood mathematics skills.

The type of constructive games is one of the aspects analyzed in this study. Based on the primary studies conducted, the types of constructive games used are wooden blocks, legos, puzzles, number pins, magnetic boards, digital-based games, and traditional games and waste recycling. The results of the test of the effect size of the sub-group of constructive games can be seen in Table 2.

Table 2. Sub Groups of Conconstructive Game Types

Types of Constructive Games	Effect Size (*d*)	Lower bound	Upbound	Std. error	*p*-Value	Category
Wooden Beams	1.854	0.436	3.272	0.724	0.010	*very large*
Lego	2.354	0.976	3.732	0.703	< 0.001	*very large*
Puzzle	2.042	0.052	4.033	1.015	0.044	*very large*

Types of Constructive Games	Effect Size (*d*)	Lower bound	Upbound	Std. error	*p*-Value	Category
Number Clamp	1.669	0.949	2.389	0.367	NA	*very large*
Magnetic Board	7.263	5.410	9.116	0.945	NA	*very large*
Digital-Based Gaming	4.144	2.254	6.035	0.965	< 0.001	*very large*
Traditional games and waste recycling	5.849	0.525	11.172	2.716	0.031	*very large*
Overall	**3.145**	**2.379**	**3.911**	**0.391**	**< 0.001**	

By Table 2, the average measure of the highest and significant effect on children's early math ability based on the aspect of the type of constructive play used is the Magnet Board. In addition to magnetic boards, digital-based games and traditional and waste recycling games are in the second and third positions with very high categories. This means that both types of constructive play can significantly improve early math skills in young children. The intended early childhood math ability is one of the aspects analyzed in this study. Based on the primary studies carried out, the intended early childhood mathematical abilities are spatial ability, creativity, numerical ability, understanding of mathematical concepts, mathematical logical thinking skills, and mathematical problem-solving skills. The results of the test for the effect of the early childhood mathematics ability subgroup can be seen in Table 3.

Table 3. Sub-group of Children's Math Ability

AUD Math Ability	Effect size (*d*)	Lower bound	Upbound	Std. error	p-Value	Category
Spatial Abilities	1.667	0.015	3.319	0.843	0.048	*very large*
Creativeness	1.375	0.355	2.395	0.520	0.008	*very large*
Numerical Capabilities	4.604	2.450	6.758	1.099	< 0.001	*very large*
Understanding Mathematical Concepts	3.316	1.940	4.693	0.702	< 0.001	*very large*
Mathematical Logical Thinking Skills	8.138	5.958	10.318	1.112	NA	*very large*
Math Problem-Solving Skills	0.767	0.243	1.291	0.268	NA	*moderate*
Overall	**3.145**	**2.379**	**3.911**	**0.391**	**< 0.001**	

By Table 3, the average measure of the highest and significant effect when viewed from the child's early mathematical ability is the ability to think logically in mathematics. In addition to mathematical logical thinking ability, numerical ability and understanding of mathematical concepts also have the highest average effect size and are significant.

Discussion

This study shows that the average effect of constructive games is 3.145 on early childhood early math skills. This shows that in the experimental class, constructive play was able to improve early math skills of young children by 3.145 times the standard deviation of the mean value of the control group. The use of a control group in each primary study to test the effect of the intervention on the experimental group, the early math ability of AUD obtained is the effect of the intervention provided, namely constructive play. It can be concluded that there is a very large effect of using constructive play on early math skills of young children. Furthermore, the average size of the highest and significant effect on early math skills of children after early based on the aspect of the type of constructive game used is the Magnet Board. Meanwhile, the highest and significant average effect size in terms of early math skills is the ability to think logically in mathematics.

This study shows that when viewed from the type of constructive games that can improve early childhood early math skills, the highest and significant average effect size is the magnetic board game. Papan Magnet is a board made of a layer of white enamel on a piece of metal, so that light objects with magnetic interaction can be attached to the surface. Further, other researchers revealed that the magnetic board is a game activity carried out by children and is assumed to be able to stimulate children's numeracy skills. Magnetic boards can also be used to improve children's mathematical logic intelligence (Khoirunnisa et al., 2022; Rahmalia & Suryana, 2021; Susilowati et al., 2019).

The study also showed that in terms of the targeted early math skills, the highest and most significant effect size, on average, was the ability to think logically in mathematics. The ability to think logically in mathematics is the ability to logic and the ability to calculate so that students can solve a problem logically. Further, revealed that observation of pictures, numbers around children or concrete objects aims to improve children's logical and systematic thinking skills which can be done through math games. This shows that children's logical mathematical abilities at an early age can be improved through mathematical play. Number puzzle math games can improve mathematical logic intelligence. The game *super smart kids* can improve mathematical logical thinking skills. Children's mathematical logic skills after being treated with constructive play methods with block media were different, namely children's logic skills were more developed than before they were given treatment (Masganti et al., 2021; Nabighoh et al., 2022; Utami et al., 2018).

The results of the meta-analysis in this study validate the effectiveness of constructive play in improving early childhood early math skills. This is supported by the results of the meta-analysis for the effect size of the type of constructive game and the intended early math skills of young children. When viewed from the type of constructive game, the magnetic board game has the highest effect size. Meanwhile, when viewed from the intended math ability, the ability to think logically in mathematics has the highest effect size. This shows that the magnetic board is a game activity carried out by early childhood and is able to stimulate children's counting ability and increase children's mathematical logic intelligence (Khoirunnisa et al., 2022; Rahmalia & Suryana, 2021). Other research also shows that early childhood mathematical logic skills can be improved by being treated with the Lego constructive play method and number puzzles (Herman & Herlina, 2023; Nabighoh et al., 2022).

The implications of these findings for the development of mathematics education for early childhood are as follows. (1) The results of the meta-analysis show that constructive play significantly affects early math skills, strengthening the empirical basis for educators and policy makers to adopt more interactive learning approaches in Indonesia. (2) The results of this study can be used as a basis for recommendations to integrate constructive play into the early childhood education curriculum, especially in math learning. (3) The results of this study can be used as a basis for training early childhood teachers in using constructive play as an effective learning tool and encouraging more innovative teaching.

4. CONCLUSIONS AND SUGGESTIONS

Based on data analysis, it can be concluded that constructive play has a positive and significant effect or a large impact on children's early math ability with a score of 3.145. The most effective type of constructive game is the magnetic board. Meanwhile, the intended early childhood mathematics ability is the ability to think logically mathematically. Thus, the constructive game of the magnetic board can improve the mathematical logical thinking ability of early childhood. Suggestions for improving meta-analysis research in the future need to be submitted after this meta-analysis research process. As one of the variables discussed in this study, early childhood math ability is influenced by the application of constructive games. Therefore, PAUD teachers in the process of learning mathematics for early childhood are expected to use constructive games.

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6. REFERENCE

Azkia, S. A. S., Hidayat, H., & Nurdiansah, N. (2022). Pengaruh Metode Bermain Konstruktif Terhadap Kemampuan Mengenal Bentuk Geometri Pada Anak Usia Dini Kelompok B Di Ra Al-Mufassir Kecamatan Paseh Kabupaten Bandung. *JURALIANSI: Jurnal Lingkup Anak Usia Dini*, *3*(2), 56–63. https://doi.org/10.35897/juraliansipiaud.v3i2.872

Bachtiar, M. Y. (2021). Peningkatan Kemampuan Mengenal Konsep Bilangan melalui Kegiatan Bermain Konstruktif untuk Siswa TK. *Journal of Elementary School (JOES)*, *4*(2), 179–186. https://doi.org/10.31539/joes.v4i2.3127

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (Second Edi, Vol. *11*(1). Lawrence Erlbaum Associates. https://doi.org/10.4324/9780203771587

Ginting, M. B. (2018). Membangun Pengetahuan Anak Usia Dini Melalui Permainan Konstruktif Berdasarkan Perspektif Teori Piaget. *Jurnal Caksana : Pendidikan Anak Usia Dini*, *1*(02), 159–171. https://doi.org/10.31326/jcpaud.v1i02.190

Hendayanti, N. P. N., Suniantara, I. K. P., Suwardika, G., Pramayasa, I. M. H. M., Pratiwi, L. P. S., Masakazu, K., Rudita, I. M., & Suardika, I. G. (2021). Meningkatkan Kemampuan Berhitung Anak Menggunakan Metode Jarimatika Di TK Mekar Kumara Desa Kesiut. *Widyabhakti Jurnal Ilmiah Populer*, *4*(1), 59–64. https://widyabhakti.stikom-bali.ac.id/index.php/widyabhakti/article/view/288

Herman, H., & Herlina. (2023). The Effect Of Constructive Play With Block Media On Mathematical Logic Ability in Kindergarten. *Proceeding of The International Conference on Science and Advanced Technology (ICSAT)*. https://ojs.unm.ac.id/icsat/article/view/18050

Istiqomah, N., & Maemonah, M. (2021). Konsep Dasar Teori Perkembangan Kognitif Pada Anak Usia Dini Menurut Jean Piaget. *Khazanah Pendidikan*, *15*(2), 151–158. https://doi.org/10.30595/jkp.v15i2.10974

Juwantara, R. A. (2019). Analisis Teori Perkembangan Kognitif Piaget Pada Tahap Anak Usia Operasional Konkret 7-12 Tahun Dalam Pembelajaran Matematika. *Al-Adzka: Jurnal Ilmiah Pendidikan Guru Madrasah Ibtidaiyah*, *9*(1), 27–34. https://jurnal.uin-antasari.ac.id/index.php/adzka/article/view/3011

Khoirunnisa, I., Sianturi, R., & Lidinillah, D. A. M. (2022). Analisis analisis media magnetic number untuk meningkatkan kemampuan berhitung anak usia 5-6 tahun. *Jurnal Pendidikan Dan Konseling (JPDK)*, *4*(4), 1748–1753.

Khotimah, K., & Agustini, A. (2023). Implementasi Teori Perkembangan Kognitif Jean Piaget Pada Anak Usia Dini. *Al Tahdzib: Jurnal Pendidikan Islam Anak Usia Dini*, *2*(1), 11–20. https://doi.org/10.54150/altahdzib.v2i1.196

Kutu, A. (2020). *Pemuridan Kontekstual Terhadap Pertumbuhan Iman Anak Remaja di Era Perkembangan Iptek Melalui Kambium*. https://osf.io/preprints/osf/ybpxe

Makarim, N., Fathurrohman, M., & Jaenudin. (2023). Meta Analisis : Pengaruh Pembelajaran Berbasis Permainan terhadap Motivasi dan Hasil Belajar Matematika Siswa. *Journal on Education*, *06*(01), 10284–10293. https://jonedu.org/index.php/joe/article/view/4725

Mao, W., Cui, Y., Chiu, M. M., & Lei, H. (2022). Effects of Game-Based Learning on Students' Critical Thinking: A Meta-Analysis. *Journal of Educational Computing Research*, *59*(8), 1682–1708. https://doi.org/10.1177/07356331211007098

Marinda, L. (2020). Teori Perkembangan Kognitif Jean Piaget dan Problematikanya pada Anak Usia Sekolah Dasar. *An-Nisa: Jurnal Kajian Perempuan & Keislaman*, *13*(1), 116–152. https://doi.org/10.29303/cep.v5i1.2788

Masganti, Arlina, & Widai. (2021). Dampak Permainan Super Smart Kids Terhadap Kecerdasan Logika-Matematika Anak Usia Dini. *Jurnal Pendidikan Anak Usia Dini Undiksha*, *9*(3), 310–317. https://doi.org/10.23887/paud.v9i3.36855

Nabighoh, W. N., Mustaji, & Hendratno. (2022). Meningkatkan Kecerdasan Logika Matematika Anak Usia Dini melalui Media Interaktif Puzzl e Angka. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(4), 3410–3417. https://doi.org/10.31004/obsesi.v6i4.2410

Nurjanah, N. E., Hafidah, R., Syamsuddin, M. M., Pudyaningtyas, A. R., Dewi, N. K., & Sholeha, V. (2022). Dampak Aplikasi ScratchJr terhadap Ketrampilan Problem-Solving Anak Usia Dini. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(3), 2030–2042. https://doi.org/10.31004/obsesi.v6i3.1531

Nurjanah, N. E., & Mukarromah, T. T. (2021). Pembelajaran Berbasis Media Digital pada Anak Usia Dini di Era Revolusi Industri 4.0 : Studi Literatur. *Jurnal Ilmiah Potensia*, *6*(1), 66–77. https://doi.org/10.33369/jip.6.1.66-77

Ondog, J., & Kilag, O. K. T. (2024). A Constructivist Framework for Early Grade Numeracy : Drawing on Jean Piaget's Cognitive Development Theory. *International Multidisciplinary Journal of Research for Innovation, Sustainability, and Excellence (IMJRISE)*, *1*(5), 456–463. https://www.researchgate.net/publication/376646246_A_Constructivist_Framework_for_Early_Grade_Numeracy_Drawing_on_Jean_Piaget's_Cognitive_Development_Theory

Permadi, K. S., & Dewi, P. Y. A. (2022). Esensi Permainan Playdough Dapat Meningkatkan Kemampuan Kognitif Anak Usia Dini. *Widya Kumara: Jurnal Pendidikan Anak Usia Dini*, *3*(1), 41–50. https://doi.org/10.55115/widyakumara.v3i1.2071

Rahmalia, D., & Suryana, D. (2021). Pengembangan Media papan flanel untuk meningkatkan kecerdasan logika matematika pada anak. *Jurnal Basicedu*, *5*(2), 605–618. https://doi.org/10.31004/basicedu.v5i2.782

Rahmatia, R., Pajarianto, H., Kadir, A., Ulpi, W., & Yusuf, M. (2021). Pengembangan Model Bermain Konstruktif dengan Media Balok untuk Meningkatkan Visual-Spasial Anak. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(1), 47–57. https://doi.org/10.31004/obsesi.v6i1.1185

Ritonga, E., & Yulizar, I. (2022). Upaya Meningkatkan Kemampuan Membaca Permulaan Melalui Permainan Kartu Huruf Pada Anak di TK Ummi Asmah Rantauprapat. *Tarbiyah Bil Qalam: Jurnal Pendidikan Agama Dan Sains*, *6*(2). https://doi.org/10.58822/tbq.v6i2.94

Roostin, E. (2021). Analisis Kemampuan Konsep Bilangan Anak Usia 3-4 Tahun dengan Media Montessori Number Rods. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(2), 801–808. https://doi.org/10.31004/obsesi.v6i2.1093

Shah, A., Jones, M. P., & Holtmann, G. J. (2020). Basics of meta-analysis. *Indian Journal of Gastroenterology*, *39*(5), 503–513. https://doi.org/10.1007/s12664-020-01107-x

Susilowati, R., Malik, H. A., & Kusuma, A. P. (2019). Pengaruh Permainan Papan Magnet terhadap Kemampuan Berhitung Awal Anak Usia Dini. *Prosiding Seminar Nasional Pendidikan STKIP Kusuma Negara*, 1–6. https://jurnal.stkipkusumanegara.ac.id/index.php/semnara2019/article/view/238

Syaefudin, A., & Annasya, B. Y. (2023). Aplikasi Multimedia Belajar Matematika Dasar Untuk Anak Usia Dini. *Jurnal Insan Unggul*, *11*(2), 249–266. https://doi.org/10.47926/jiu.2023.11.2.249-266%20

Utami, L. O., Utami, I. S., & Sumitra, A. (2018). Penggunaan Media Balok Kubus Untuk Meningkatkan Kemampuan Matematik Logis Anak Usia Dini di TK Nasywa Bandung. *CERIA (Cerdas Energik Responsif Inovatif Adaptif)*, *1*(4), 21–25. https://doi.org/10.22460/ceria.v1i4.p21-25

Wang, L. H., Chen, B., Hwang, G. J., Guan, J. Q., & Wang, Y. Q. (2022). Effects of digital game - based STEM education on students' learning achievement : a meta - analysis. *International Journal of STEM Education*, *9*(26). https://doi.org/10.1186/s40594-022-00344-0

Warmansyah, J., & Amalina, A. (2019). Pengaruh Permainan Konstruktif dan Kecerdasan Visual- Spasial Terhadap Kemampuan Matematika Awal Anak Usia Dini. *Math Educa Journal*, *3*(1), 71–82. https://doi.org/10.15548/mej.v3i1.270