



The Effect of Using Colored Sand on Children's Cognitive Development

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ABSTRACT

This study aims to enhance children's cognitive development in color recognition, specifically their ability to name, point to, and group various colors, which has not yet developed as expected. The research method used is quantitative research of the experimental type. The research subjects consisted of all 15 children in Group B of Al-Khairaat Rarampadende Kindergarten. Data collection was conducted through observation of the children's cognitive abilities before and after the intervention, which involved playing with colored sand. The data were analyzed by comparing the children's cognitive development results before and after the intervention. The results of the study showed that before the intervention, no children (0%) were in the Very Well Developed (BSB) category; 11% of the children were in the Developing as Expected (BSH) category; 75.6% were in the Beginning to Develop (MB) category; and 13.3% were in the Not Yet Developed (BB) category. After receiving treatment using colored sand, the children's cognitive development improved, with 40% of children in the BSB category, 51% in the BSH category, 9% in the MB category, and none (0%) in the BB category. Based on these research results, the statistical test revealed a calculated t-value of 12.961 with a significance level of 0.001 (< 0.05), thus accepting the alternative hypothesis (H1) and rejecting the null hypothesis (H0). These findings indicate that play-based learning media using concrete objects can help children become more active, understand color concepts more easily, and increase their engagement in the learning process. It can be concluded that the use of colored sand influences the cognitive development of children in Group B. Colored sand media can help children recognize colors more easily, increase their interest in learning, and create an active and enjoyable learning atmosphere.

INTRODUCTION

According to Wasis (2022), education is a conscious effort and a planned process to create a learning environment and facilitate the learning process so that students can actively develop their potential to possess religious and spiritual strength, self-control, a well-rounded personality, intelligence, noble character, and the skills needed by themselves, their community, the nation, and the state. The general purpose of education can be summarized as an effort to shape an individual's character through a specific, systematic, and planned process.

The definition of early childhood education, as outlined in Article 1, Paragraph 14 of the 2003 National Education System Law, states that: Early childhood education is a developmental effort directed at children from birth through age six, carried out through the provision of educational stimulation to support their physical and spiritual growth and development, so that children are prepared to enter further education. Another definition of early childhood, based on developmental psychology, refers to the age range of 0–8 years (Adawiah & Ubaidilah, 2023).

Young children generally learn through direct experience and play activities that engage their various senses. Therefore, learning activities for young children should be designed as fun play activities so that children can learn actively and have meaningful learning experiences. (Auliya et al., 2025). The role of educators in children's play activities is to encourage and guide children in their play and help them develop their potential, so that they become more creative children. (Nurwahidah et al., 2023).

The role of educators in children's play activities is to encourage and guide children in their play and help them develop their potential, so that they become more creative children. (Yunisari & Wahyuni, 2025). Children's various potentials are developed through play-based learning activities in Early Childhood Education to prepare them for the next level of education (Purwanti & Watini, 2022).

The ability to recognize colors is one aspect of cognitive ability. One of the skills that young children develop during their early years is the ability to recognize colors. According to (Ratna et al., 2022) Color is the first feature of an object that the eye perceives. According to the Ministry of National Education, color is the impression the eye receives from light reflected by objects it strikes. According to Mulyadi (Hidayana et al., 2024) The use of visually and tactilely engaging media can accelerate the understanding of concepts, including color.

Cognitive development in early childhood does not occur automatically but requires appropriate stimulation from the environment, both from parents and teachers at school. A common issue is the limited use of learning materials. Based on initial observations and interviews conducted in Group B at Alkhairaat Rarampadende Kindergarten, it was found that the children's cognitive development—particularly their problem-solving skills—has not yet developed optimally. This is evident from the difficulty some children have in naming different colors, identifying different colors, and grouping different colors. The interviews revealed that this problem stems from the lack of colored sand—a learning medium specifically designed to enhance children's cognitive development—at Alkhairaat Rarampadende Kindergarten.

Children's cognitive abilities can be developed through the teacher's guidance by using effective and creative teaching methods and learning media. According to Nirmala (2021) Children who receive appropriate and effective stimulation will improve their cognitive abilities more quickly than children who do not receive adequate stimulation.

In response to this issue, one medium that can be used to stimulate children's cognitive development is colored sand. According to (Humaira, 2022) In the Kamus Besar Bahasa Indonesia (KBBI), "pasir" means small or fine grains. Sand is a naturally occurring substance. We often find sand in our surroundings—on the streets, at the beach, or in our

yards. The use of sand as a learning or play medium in teaching and learning activities in early childhood education, particularly in kindergartens. Sand is a natural material that is very easy to find; moreover, playing with sand is very appealing to children because they can use it to pour, fill, mold, scatter, and build structures, and sand can also be colored. Meanwhile, according to (Sari, 2022) Sand is a natural material that is very easy to find. Furthermore, playing with sand is very appealing to children, because with sand they can play and pour, fill, mold, scatter, and build structures.

Playing with sand has been a favorite pastime for children from ancient times to the present. According to the Indonesian Dictionary, “pasir” refers to small or fine grains. Sand is a natural component that we commonly find in our surroundings, such as on roads, in yards, or on beaches. Color, on the other hand, is the first design element that can attract a person's attention and interest. (Humaira et al., 2023).

according to Olivia in Atika & Andajani, (2018) Research has shown that children can maintain their concentration better when presented with visual stimuli. Colored sand, though seemingly simple, offers significant benefits and can be used as a learning tool.

Meanwhile, according to (Apriani & Hartati, 2024) The use of colored sand can serve as an innovative play activity to foster children's creativity; children can engage with this colored sand through play. Using colored sand, children can draw with various colors of sand, create different animal shapes, and build castles according to their imagination.

The concept of using colored sand to maximize children's cognitive abilities has been supported by several previous studies. This study shows that based on the observed activities—as seen in the summary results—the average for the BSB, BSH, and MB categories was 18.94% before the intervention and 26.13% after the intervention, representing an increase of 7.19%.

Based on these findings, it can be concluded that colored sand has an effect on children's cognitive development. (Shofyatun & Fernanda, 2022). In line with this, this study shows that colored sand is effective in enhancing children's cognitive abilities. Data on children's abilities before and after the intervention were measured using a rating scale and analyzed using SPSS. Based on research on the use of colored sand—specifically, that colored sand influences the cognitive development of 5- to 6-year-old children at Ananda Yara Sukamaju Kindergarten—the results demonstrate that after being exposed to colored sand, the cognitive development of 5- to 6-year-old children at Ananda Yara Sukamaju Kindergarten improved.

Furthermore, other studies on colored sand indicate that learning processes utilizing colored sand as a medium have a positive effect on children's cognitive development. Hypothesis testing of the post-test data from the control group yielded a calculated R value of 8, with a critical R value of 8 from the one-sample R test table at a 5% significance level. From the table, with $n_1 = 15$ and $n_2 = 15$, the critical run value is 10 for a 5% error rate. Based on this, the calculated run value is greater than the critical run value ($8 > 10$). Since the calculated run value is greater than the critical run value, H_0 is rejected and H_1 is accepted. (Demi, 2020).

Several previous studies have shown that the use of colored sand can help enhance cognitive development in young children. A study conducted by Shofyatun and Fernanda

(2022) indicates an improvement in children's cognitive development after using colored sand in learning activities. The study results show that children's average developmental achievement increased by 7.19% after being exposed to colored sand. The study proves that playing with colored sand can positively stimulate children's cognitive abilities.

Another study conducted by Mawaddah and Pohan (2024) also showed that colored sand is effective in improving the cognitive abilities of children aged 5–6 years. The study used pre- and post-intervention measurements analyzed using SPSS, with results indicating that the children's cognitive development improved after participating in play activities using colored sand. In addition, the study Demi (2020) found that the use of colored sand has a positive effect on children's cognitive development, based on the results of hypothesis testing that showed differences in children's abilities after learning with this medium.

Although several previous studies have examined the effectiveness of colored sand on children's cognitive development, these studies generally focused on improving general cognitive abilities and did not emphasize a guided play approach to developing problem-solving skills in early childhood. Furthermore, strategies for implementing colored sand in learning activities within the early childhood education context have not yet been thoroughly explained, particularly regarding how this medium is actively used to train children to think, explore, and solve simple problems through play-based activities.

Therefore, this study offers a novel approach to the use of colored sand as a medium for exploratory play-based activities, utilizing sand from Donggala Beach and food coloring as a learning medium to develop the cognitive abilities of 5–6-year-old children, particularly in the area of problem-solving skills. This study also focuses on the implementation of more interactive and enjoyable learning strategies in line with the learning characteristics of young children in an early childhood education (PAUD) setting. Based on this description, the researcher is interested in conducting a study titled “The Effect of Using Colored Sand on the Cognitive Development of Children in Group B at Al-Khairaat Rarampadende Kindergarten.”

METHOD

This study employed a quantitative approach using a pre-experimental design. The research design used was a one-group pretest-posttest design, in which a single group—without a control group—underwent a pretest, an intervention, and a posttest. This design was used to determine the effect of using colored sand on children's cognitive development before and after the intervention. The study was conducted at Al-Khairaat Rarampadende Kindergarten, Dolo Barat Subdistrict, Sigi Regency, Central Sulawesi, over a period of four weeks.

The subjects in this study were 15 children in Group B, consisting of 7 girls and 8 boys. The sampling technique used was saturation sampling, in which the entire population was included in the sample because the population size was relatively small, making it possible to study the entire group. The independent variable in this study was the use of colored sand, while the dependent variable was the cognitive development of early childhood.

Research data were collected through observation, interviews, and documentation. The primary instrument used was an observation sheet for children's cognitive development. Observations were conducted to assess the development of children's abilities before and after the use of colored sand. The indicators for assessing cognitive development included the ability to name various colors, point to colors according to instructions, and group objects based on the same color.

The assessment of children's development used the following categories: Developing Very Well (BSB), Developing as Expected (BSH), Beginning to Develop (MB), and Not Yet Developing (BB). Children who were able to name, point to, and group more than four colors independently were categorized as BSB. Children who were able to perform four color indicators were categorized as BSH; those who were able to perform two color indicators were categorized as MB; and those who still required teacher assistance were categorized as BB.

Data validity was ensured through the validation of observational instruments and systematic direct observation throughout the learning process. The research data were analyzed using quantitative descriptive statistics by calculating the average developmental scores of the children before and after the intervention. In addition, a normality test was conducted using the Shapiro-Wilk test to determine whether the data were normally distributed. After the data were confirmed to be normally distributed, hypothesis testing was performed using a paired-sample t-test to determine whether the use of colored sand had an effect on the cognitive development of young children. If the significance value was < 0.05 , the hypothesis was accepted, meaning that the use of colored sand had an effect on children's cognitive development.

RESULTS

Based on the results of preliminary observations conducted by the researcher prior to the treatment, the summary of findings is presented in the table below according to the aspects observed, namely:

Table 1. Pre-treatment observations

Category	Naming colors		Identifying colors		Grouping colors		Average %
	F	%	F	%	F	%	
BSB	0	0	0	0	0	0	0
BSH	2	13	2	13	1	7	11
MB	10	67	12	80	12	80	75,7
BB	3	20	1	7	2	13	13,3
AMOUNT	15	100	15	100	15	100	100

Based on the results of initial observations prior to the intervention involving colored sand play, the children's cognitive abilities were still in the low to moderate range. In terms of naming colors, 10 children were in the "Beginning to Develop" (MB) category, while only 2 children were in the "Developing as Expected" (BSH) category and 3 children were in the

“Not Yet Developing” (BB) category. Furthermore, no child reached the “Developing Very Well” (BSB) category. This indicates that most children still struggle to recognize and name colors independently. The children still require the teacher’s assistance when asked to name specific colors.

In terms of pointing to colors, the children’s abilities were also relatively low. A total of 12 children were in the Beginning to Develop (MB) category, 2 children were in the Developing as Expected (BSH) category, and 1 child was in the Not Yet Developing (BB) category. These results indicate that the children are not yet able to point to colors accurately according to the teacher’s instructions. The children still frequently confuse colors and are not yet able to identify colors consistently.

Meanwhile, regarding color grouping, most children also fell into the “Beginning to Develop” (MB) category—12 children in total—while only 1 child was in the “Developing as Expected” (BSH) category and 2 children were in the “Not Yet Developing” (BB) category. These results indicate that the children’s ability to group objects based on similar colors has not yet developed optimally. The children still have difficulty distinguishing between similar colors and require teacher guidance during the learning process.

The results of the observations following the treatment are summarized in the table below:

Table 2. Post-Treatment Observation Results

Category	Naming colors		Identifying colors		Grouping colors		Average %
	F	%	F	%	F	%	
BSB	9	60	4	27	5	33	40
BSH	6	40	8	53	9	60	51
MB	0	0	3	20	1	7	9
BB	0	0	0	0	0	0	0
AMOUNT	15	100	15	100	15	100	100

After participating in play activities using colored sand, the children’s cognitive abilities improved across all observed aspects. In terms of naming colors, the number of children in the “Developing Very Well” (BSB) category increased to 9, and those in the “Developing as Expected” (BSH) category increased to 6. No children remained in the “Beginning to Develop” (MB) or “Not Yet Developing” (BB) categories. This improvement indicates that playing with colored sand helps children more easily recognize and remember colors through concrete and enjoyable learning experiences.

In the aspect of pointing to colors, the children’s abilities also showed a significant improvement. The “Developing Very Well” (BSB) category increased to 4 children and the “Developing as Expected” (BSH) category increased to 8 children, while the “Beginning to Develop” (MB) category decreased to 3 children, and there were no longer any children in the “Not Yet Developing” (BB) category. This indicates that the use of colored sand helps children focus better and understand the teacher’s instructions more quickly when identifying the requested colors.

Furthermore, regarding color sorting, there was a significant improvement in the children’s abilities. The “Developing Very Well” (BSB) category increased to 5 children, and

the “Developing as Expected” (BSH) category increased to 9 children, while the “Beginning to Develop” (MB) category decreased to 1 child and the “Not Yet Developing” (BB) category dropped to 0%. These results indicate that the children began to be able to distinguish and group colors more accurately after participating in play activities using colored sand. The following describes the process of making colored sand with the children after the intervention was administered.



a. Children choose colors



b. The child begins to mix colors



c. A child is shaping sand with a mold



d. printing process

Table 3. Summary of Initial and Final Observation Results on Children's Cognitive Development

Category	Before Treatment						After Treatment					
	Naming colors		Identifying colors		Grouping colors		Naming colors		Identifying colors		Grouping colors	
	F	%	F	%	F	%	F	%	F	%	F	%
Developing Very Well (BSB)	0	0	0	0	0	0	9	60	4	27	5	33
Developing as Expected (BSH)	2	13	2	13	1	7	6	40	8	53	9	60

Start Grow (MB)	10	67	12	80	12	80	0	0	3	20	1	7
Underdev eloped (BB)	3	20	1	7	2	13	0	0	0	0	0	0

Based on the results of the analysis of children's cognitive development before and after the intervention involving colored sand play, an improvement in the children's cognitive abilities was observed across all assessed aspects. Regarding the ability to name colors, before the intervention, no child was in the "Very Well Developed" (BSB) category—that is, 0%. Most children were in the "Beginning to Develop" (MB) category (10 children), while only 2 children were in the "Developing as Expected" (BSH) category and 3 children were in the "Not Yet Developed" (MB) category. However, after the intervention using the colored sand play activity, there was a highly significant improvement in the ability to name colors. The "Very Good Development" (BSB) category increased to 9 children, and the "As Expected Development" (BSH) category increased to 8 children. Meanwhile, the "Beginning Development" (MB) and "No Development" (BB) categories both decreased to 0%.

In terms of color identification, before the intervention, most of the children—12 in total—were in the "Beginning to Develop" (MB) category. Only 2 children were in the "Developing as Expected" (BSH) category, and 1 child was in the "Not Yet Developing" (BB) category, while no children were in the "Developing Very Well" (BSB) category. After the intervention using colored sand, the children's ability in the aspect of identifying colors showed a significant improvement. The "Developing Very Well" (BSB) category increased to 4 children, and the "Developing as Expected" (BSH) category increased to 8 children. Meanwhile, the "Beginning to Develop" (MB) category decreased to 20%, and the "Not Yet Developing" (BB) category dropped to 0%. This improvement indicates that the colored sand medium helps children more easily recognize color differences through direct observation. The children became more focused when the teacher gave instructions because they could see and handle the medium concretely.

In terms of color sorting, before the intervention, most children were in the "Beginning to Develop" (MB) category—12 children—while 1 child was in the "Developing as Expected" (BSH) category and 2 children were in the "Not Yet Developing" (BB) category. No child was in the "Developing Very Well" (BSB) category. This indicates that the children's ability to group objects based on the same color was still low. After being given the intervention in the form of a colored sand game, the children's ability to group colors showed a significant improvement. The number of children in the Developing Very Well (BSB) category increased to 4, and those in the Developing as Expected (BSH) category increased to 8. Meanwhile, the number in the Beginning to Develop (MB) category decreased to 3, and the Not Yet Developing (BB) category dropped to 0%.

Overall, the results of the initial and final observations showed significant changes in the children's cognitive development following the implementation of the colored sand play activity. Before the intervention, the majority of children were still in the "Beginning to

Develop” (MB) and “Not Yet Developing” (BB) categories. However, after the intervention, most children advanced to the “Developing as Expected” (BSH) and “Developing Very Well” (BSB) categories. This improvement demonstrates that the use of colored sand is effective in supporting the cognitive development of young children, particularly in color recognition through activities such as naming, pointing to, and grouping colors. The following graph summarizes the children’s cognitive development.

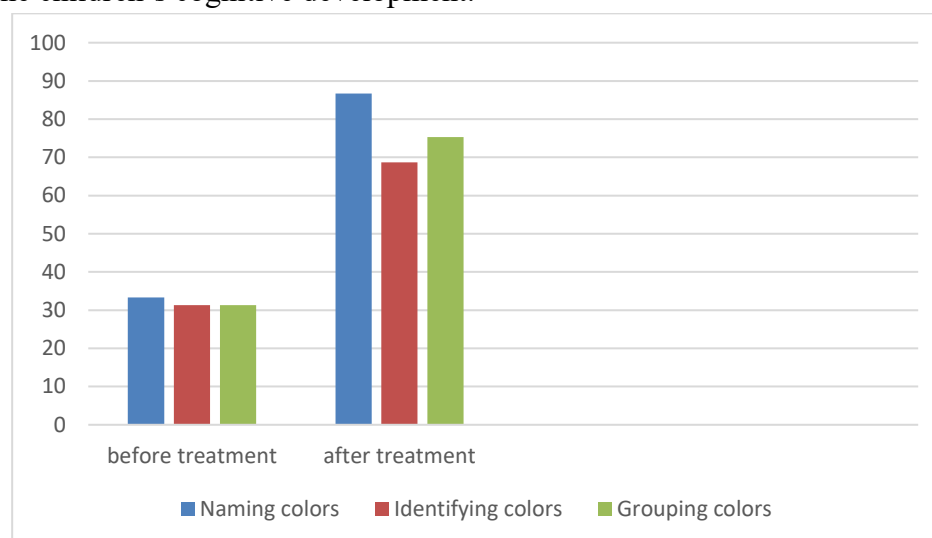


Chart 1. Summarizing cognitive development

Based on the summary graph of the children’s cognitive development, it can be seen that the children’s abilities improved after being exposed to the colored sand play intervention. In terms of naming colors, the children’s average score before the intervention was 33.3%, which then increased to 86.7% after the intervention was administered. This increase indicates that the children were better able to recognize and name colors independently after participating in the colored sand play activity. In terms of pointing out colors, the average score before the intervention was 31.3% and increased to 68.7% after the intervention.

This indicates that the children began to identify colors according to the teacher’s instructions more accurately than before using the colored sand. The children also appeared more focused and demonstrated a better understanding of color differences. Furthermore, regarding color grouping, the average score before the intervention was 31.3% and increased to 75.3% after the intervention. This increase indicates that the children were better able to distinguish and group similar colors independently through play activities using colored sand.

Table 3. Test Of Normality

	Shapiro-Wilk Statistic	df	Sig.
Sebelum Perlakuan	0,967	15	0,807
Sesudah Perlakuan	0,895	15	0,79

According to the table above, the df values for the pre- and post-treatment groups are both 15, which means the sample size is less than 50. The use of the Shapiro-Wilk test to assess normality in this study can be considered appropriate. Furthermore, from the table above, it can be seen that the significance value for the pre-treatment group is 0.807 and the significance value for the post-treatment group is 0.79. Since the significance values for both groups are greater than > 0.05 , it can be concluded that the research data for both the pre- and post-treatment groups are normally distributed.

DISCUSSION

The results of the study show that the use of colored sand has a positive effect on the cognitive development of children at Alkhairaat Rarampadende Kindergarten. This is evident from the improvement in the children's abilities after they participated in play activities using colored sand. This improvement was evident in the children's ability to name colors, point to colors according to instructions, and group colors by type. Before the intervention, most children still had difficulty recognizing colors on their own, so they required the teacher's assistance in naming and distinguishing colors. However, after the colored sand play activities were implemented, the children appeared more active, enthusiastic, and better able to understand color concepts.

The improvement in children's cognitive development observed in this study aligns with the theory of cognitive development proposed by Jean Piaget. According to Piaget, young children are in the preoperational stage—a stage in which they begin to learn to use symbols and understand simple concepts through real-life experiences and play activities. At this stage, children are not yet able to fully understand abstract concepts, so they need concrete materials that they can touch, see, and play with directly. The use of colored sand in this study provided children with a concrete learning experience because they could hold, move, mix, and group the sand based on specific colors. Through these hands-on experiences, children found it easier to understand the concept of color than if they had simply listened to the teacher's verbal explanations.

Colored sand also provides children with the opportunity to learn through exploration. Children can try various simple activities, such as selecting the same color, matching colors, and grouping sand according to the teacher's instructions. These activities help children build knowledge through their own experiences. This aligns with Piaget's view that children's learning occurs when they actively interact with their surroundings. The more concrete experiences children gain, the more their thinking skills and conceptual understanding develop in early childhood.

Furthermore, the findings of this study are also supported by the theory of social constructivism proposed by Lev Vygotsky. Vygotsky explains that children's cognitive development is influenced by social interaction and support from adults and peers. During the colored sand play activity, the teacher acts as a facilitator who provides guidance, examples, motivation, and assistance to children when they encounter difficulties. Teachers not only explain the material but also accompany children throughout the play process. For example, teachers help children name colors, demonstrate how to group colors, and ask simple questions that stimulate children's thinking skills.

The guidance provided by teachers during play activities helps children feel more confident in attempting and completing learning tasks. Children who were initially unable to identify colors on their own became more willing to try because they received support from their teachers. The interactions that took place during the learning process also created a fun learning environment, so that children did not feel pressured while learning. This demonstrates that the use of colored sand not only supports children's cognitive development but also enhances their active participation in learning activities.

The use of colored sand is considered effective because it aligns with the learning characteristics of young children, who tend to enjoy play-based activities. Young children find it easier to understand lessons when they are directly involved in engaging and enjoyable activities. Colored sand has shapes, textures, and colors that capture children's attention, helping them stay focused throughout the activity. Additionally, this medium stimulates various senses, such as sight and touch, making the learning process more meaningful.

Playing with colored sand also gradually develops children's thinking skills. When children are asked to point out a specific color, they learn to recognize and remember colors. As they group colors together, they begin to learn how to compare, classify, and solve simple problems. These activities are part of the cognitive skills that are important to develop from an early age, as they form the foundation for children's learning in later stages.

The results of this study indicate that concrete, play-based learning materials can provide a more effective learning experience for young children. The use of colored sand makes the learning process more interactive and less monotonous, and helps increase children's interest in learning. Therefore, colored sand can serve as an effective alternative learning material for developing the cognitive abilities of young children, particularly in introducing color concepts, training thinking skills, and improving their ability to solve simple problems in an early childhood education setting.

CONCLUSION

Based on the research findings, the use of colored sand had a significant effect on improving the cognitive development of children in Group B at Alkhairaat Rarampadende Kindergarten, particularly in their ability to recognize colors through activities such as naming, pointing out, and grouping colors. Statistical test results show a calculated t-value of 12.961 with a significance level of 0.001 (< 0.05), so the alternative hypothesis (H1) is accepted and the null hypothesis (H0) is rejected. These findings can serve as teaching material for teachers because the "play-based learning" approach helps foster children's interest in learning, enables them to understand color concepts, and increases their engagement in the learning process. Therefore, colored sand can be used as an effective and enjoyable alternative learning medium to support the cognitive development of young children in early childhood education settings.

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