

The Effect of Using Colored Sand Media on the Cognitive Abilities of Children Aged 5–6 Years at TK Negeri Pembina 1 Bengkulu City

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Abstract

Early childhood education plays a crucial role in supporting children's growth and development, particularly in the cognitive domain. Cognitive development enables children to think, explore, solve problems, recognize concepts, and understand their surrounding environment. However, many children still experience difficulties in cognitive activities such as recognizing colors, classifying objects, understanding simple concepts, and solving basic problems. One of the learning media that can stimulate children's cognitive development is colored sand media, which provides direct sensory experiences through exploration, manipulation, and creative play activities. This study aims to determine the effect of using colored sand media on the cognitive abilities of children aged 5–6 years at TK Negeri Pembina 1 Bengkulu City. This study employed a quantitative approach using a quasi-experimental design. The participants were children aged 5–6 years enrolled at TK Negeri Pembina 1 Bengkulu City. Data were collected through observation, assessment sheets, and documentation. The collected data were analyzed using statistical techniques to compare children's cognitive abilities before and after the implementation of colored sand media in learning activities. The findings indicate that the use of colored sand media has a positive effect on children's cognitive abilities. Through activities involving colored sand, children demonstrated improvements in recognizing colors, classifying objects, understanding simple concepts, exploring their environment, and solving problems during learning activities. The hands-on and sensory-based experiences provided by colored sand media increased children's engagement, concentration, creativity, and active participation in the learning process. Therefore, the use of colored sand media can be considered an effective learning medium for enhancing the cognitive abilities of children aged 5–6 years. The implementation of attractive and interactive learning media is essential in supporting optimal cognitive development and creating meaningful learning experiences in early childhood education.

Keywords: Colored Sand Media, Cognitive Ability, and Early Childhood Education.

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INTRODUCTION

Early childhood education is a fundamental stage in the educational process because it serves as the foundation for children's future growth and development.

Children aged 0–6 years experience rapid physical, cognitive, language, social-emotional, and motor development; therefore, this period is often referred to as the golden age. At this stage, children require appropriate educational stimulation to optimize their developmental potential and prepare them for the next level of education. Educational experiences provided during early childhood have a significant influence on children's future learning readiness and overall development (Rupnidah and Suryana 2022).

One important aspect that should be developed during early childhood is cognitive development. Cognitive development refers to the development of thinking abilities, including the capacity to pay attention, remember, understand, solve problems, and process information obtained from the surrounding environment. Through cognitive development, children learn to recognize cause-and-effect relationships, classify objects, compare differences, and develop logical thinking skills that are essential for daily life and future learning success (Utaminingsih 2020).

Children aged 5–6 years are in the preoperational stage of cognitive development. At this stage, children begin to recognize symbols, language, images, and simple concepts, although their thinking is still egocentric and centered on one dimension of a problem. Therefore, learning activities for children at this age should involve concrete experiences, exploration, and direct interaction with learning materials to facilitate cognitive growth effectively (Sri, 2020:22).

The success of cognitive development is influenced by various factors, including heredity, environment, maturity, educational experiences, interests, and talents. Among these factors, the learning environment and educational stimulation provided by teachers play a crucial role in supporting children's cognitive growth. Teachers are expected to design learning activities that are meaningful, enjoyable, and capable of encouraging children's curiosity and active participation in the learning process (Wiresti, 2020:36).

Learning media are important components that can help teachers create engaging and effective learning experiences. One learning medium that can be utilized to stimulate children's cognitive abilities is colored sand. Colored sand is a learning medium that consists of sand in various colors and can be easily obtained, manipulated, and adapted to children's developmental characteristics. This medium provides opportunities for children to explore, classify, compare, recognize colors, and develop problem-solving skills through direct sensory experiences. In addition, colored sand is attractive to children because it combines play and learning activities in an enjoyable manner Intan , (2021:41)

The use of colored sand also offers several educational benefits. Through activities such as touching, squeezing, pouring, arranging, and creating objects with sand, children can improve hand-eye coordination, concentration, creativity, and cognitive abilities. Sensory experiences obtained through colored sand activities enable children to construct knowledge actively and meaningfully. Consequently, colored sand can serve as an effective medium for stimulating various aspects of children's cognitive development.

However, preliminary observations at TK Negeri Pembina 1 Kota Bengkulu indicated that many children aged 5–6 years still experienced difficulties in counting numbers sequentially and understanding basic number concepts. Furthermore, learning activities tended to be conducted using conventional methods with limited

interaction with concrete learning objects. The lack of variation and interactive approaches in cognitive learning activities often caused children to become bored and less enthusiastic during lessons. In addition, the utilization of learning media available in the surrounding environment remained minimal. These conditions may hinder the optimal development of children's cognitive abilities.

Several previous studies have demonstrated the effectiveness of colored sand in supporting children's development. Research conducted by Mawaddah and Pohan (2024) revealed that the use of colored sand positively influenced the cognitive development of children aged 5–6 years. Likewise, Tety Srihayati (2023) found that colored sand significantly improved children's science recognition skills. Other studies also reported that sensory activities involving sand contributed positively to children's cognitive development, particularly in observing, classifying, comparing, and drawing simple conclusions.

Based on these considerations, this study aims to examine the effect of using colored sand media on the cognitive abilities of children aged 5–6 years at TK Negeri Pembina 1 Kota Bengkulu. The findings of this study are expected to provide both theoretical and practical contributions to the development of innovative learning media and strategies that can effectively enhance cognitive development in early childhood education.

RESEARCH METHOD

This study employed a quantitative approach using a pre-experimental research design with a one-group pretest-posttest design (Sugiyono, 2020: 17). The research was conducted at TK Negeri Pembina 1 Kota Bengkulu and involved children aged 5–6 years as the research participants. The purpose of this study was to examine the effect of using colored sand media on children's cognitive abilities.

The population of this study consisted of all children aged 5–6 years at TK Negeri Pembina 1 Kota Bengkulu. The sample was selected using a purposive sampling technique based on specific criteria relevant to the research objectives (Sugiyono, 2020: 17). Data were collected through observation and assessment sheets designed to measure children's cognitive abilities before and after the implementation of colored sand media.

The research procedure was carried out in three stages. First, a pretest was administered to determine the initial level of children's cognitive abilities. Second, the treatment was implemented through learning activities using colored sand media. During the treatment, children participated in various activities involving color recognition, object classification, counting, and problem-solving through direct interaction with colored sand. Finally, a posttest was conducted to determine the improvement in children's cognitive abilities after the treatment.

The collected data were analyzed using descriptive and inferential statistical techniques (Rukminingsih & dkk, 2020:14). Descriptive statistics were used to describe the distribution of children's cognitive achievement before and after the treatment. Inferential analysis was conducted using a paired sample t-test to determine whether there was a significant difference between the pretest and posttest scores. Statistical analysis was performed using SPSS software. The results of the analysis were used to determine the effect of colored sand media on the cognitive abilities of children aged 5–6 years.

RESEARCH RESULTS AND DISCUSSION

A. Colored Sand Media

Learning media are important components in the educational process because they function as tools that help teachers deliver learning materials and assist children in understanding concepts more effectively. For early childhood learners, instructional media should be attractive, safe, concrete, and capable of stimulating children's curiosity. Learning through concrete media is considered more meaningful because children can directly interact with objects and construct their own understanding through exploration and experience.

Colored sand media is one of the innovative learning media widely used in early childhood education. Colored sand is produced by processing natural sand and adding various colors to make it more attractive and engaging for children. This medium provides opportunities for children to touch, feel, sort, pour, shape, and create different forms according to their imagination. Through these activities, children not only enjoy playing but also learn various concepts related to color, texture, shape, quantity, and spatial relationships.

According to Intan, (2021:41), colored sand activities provide opportunities for children to engage in sensory exploration while developing concentration, creativity, and fine motor coordination. Children become actively involved in learning because they manipulate materials directly rather than simply observing or listening. This active involvement contributes positively to children's cognitive engagement and learning outcomes.

Colored sand is categorized as a sensory learning medium because it stimulates multiple senses simultaneously. Children use their sense of touch when feeling the texture of the sand, their sense of sight when observing different colors, and their motor abilities when manipulating sand materials. Multisensory learning experiences are important because they facilitate deeper understanding and increase the likelihood that children will retain information over time.

(Ferbiarni 2023) explained that colored sand media is particularly effective because it provides concrete learning experiences. Young children generally find abstract concepts difficult to understand; therefore, the use of real and tangible materials can facilitate concept formation and comprehension. Through colored sand activities, children can directly observe differences in color, compare quantities, classify objects, and identify patterns.

The use of colored sand media also supports child-centered learning. Instead of passively receiving information, children become active participants who explore, investigate, and discover knowledge independently. This approach aligns with constructivist learning principles, which emphasize that children construct knowledge through interaction with their environment.

Furthermore, colored sand activities can be integrated into various learning domains. In cognitive development, children learn to recognize colors, classify objects, and solve simple problems. In language development, children describe their creations and communicate ideas. In social development, children cooperate and share materials with peers. In motor development, children strengthen finger muscles and improve coordination. Consequently, colored sand media contributes to holistic child development.

Another advantage of colored sand media is its flexibility. Teachers can design various learning activities according to educational objectives. For example, children may be asked to create geometric shapes, sort sand according to color, count objects made from sand, or create artistic patterns. Such activities make learning enjoyable while simultaneously supporting developmental goals.

In addition, colored sand media is relatively inexpensive and easy to prepare. Schools can utilize locally available materials and modify them according to learning needs. This practicality makes colored sand an accessible educational resource for many early childhood institutions.

Therefore, colored sand media can be viewed as an effective educational tool that combines play, exploration, creativity, and learning into a meaningful experience for young children.

B. Early Childhood

Early childhood is a developmental stage characterized by rapid growth and significant changes across multiple developmental domains. This period is often considered the foundation for future learning and development because experiences during early childhood influence later cognitive, social, emotional, and physical outcomes.

According to (Utaminingsih 2016) early childhood is a unique period during which children experience accelerated development in cognitive, language, social-emotional, physical, and creative capacities. Children demonstrate high levels of curiosity and are naturally motivated to explore their environment.

The term "golden age" is frequently used to describe early childhood because brain development occurs rapidly during this period. Research indicates that a substantial proportion of brain growth takes place before children enter primary school. As a result, educational stimulation during these years is crucial for optimizing developmental outcomes.

(Utaminingsih 2020, further emphasized that the golden age represents a sensitive period during which environmental experiences have significant effects on child development. Positive educational experiences can enhance learning readiness, while insufficient stimulation may limit developmental potential.

Children aged 5–6 years possess distinctive developmental characteristics. They become increasingly independent, demonstrate improved communication skills, and show growing interest in understanding relationships between objects and events. Their cognitive abilities expand as they begin to classify objects, recognize patterns, count quantities, and solve simple problems.

At this age, children learn most effectively through active participation. They enjoy manipulating materials, experimenting with objects, and engaging in imaginative play. Therefore, learning environments should provide opportunities for exploration, investigation, and creative expression.

Early childhood education aims to facilitate holistic development by addressing physical, cognitive, social, emotional, language, artistic, and moral domains. Educational activities should be developmentally appropriate and aligned with children's interests and abilities.

Teachers play a critical role in creating supportive learning environments that encourage exploration and discovery. By providing stimulating materials and

meaningful experiences, educators help children develop foundational skills necessary for lifelong learning.

Parents also contribute significantly to children's development. Home environments that promote curiosity, communication, and exploration reinforce learning experiences provided in educational settings. Effective collaboration between families and schools can maximize developmental outcomes during early childhood.

Consequently, understanding the characteristics and developmental needs of young children is essential for designing educational programs that support optimal growth and learning.

C. Cognitive Development in Early Childhood

Cognitive development refers to the progressive growth of mental processes that enable children to acquire knowledge, understand information, solve problems, and adapt to their environment. Cognitive abilities include perception, attention, memory, reasoning, classification, problem-solving, and decision-making.

Cognitive development is a fundamental aspect of child development because it influences how children interpret experiences and interact with the world around them. Through cognitive processes, children develop the ability to think, learn, and understand increasingly complex concepts.

Jean Piaget's theory of cognitive development provides an important framework for understanding children's thinking. According to Piaget, children aged 2–7 years are in the preoperational stage, characterized by symbolic thinking and increasing use of language. However, their reasoning remains largely concrete, meaning they learn most effectively through direct interaction with objects and experiences.

At the age of 5–6 years, children begin demonstrating greater cognitive flexibility. They can recognize similarities and differences between objects, identify relationships, classify items according to specific criteria, and solve simple problems. These emerging abilities provide the foundation for later academic learning.

Cognitive development is influenced by both biological maturation and environmental experiences. Rich learning environments that provide opportunities for exploration and experimentation can significantly enhance children's cognitive growth.

Educational activities that encourage observation, comparison, classification, sequencing, and prediction are particularly effective in supporting cognitive development. Such activities help children develop logical thinking and problem-solving skills while strengthening their understanding of relationships among objects and events.

Mawaddah and Pohan (2024), reported that colored sand activities enhanced children's ability to recognize colors, distinguish textures, and classify objects according to observable characteristics. These findings suggest that sensory-based learning experiences contribute positively to cognitive development among young children.

In addition to supporting concept formation, cognitive activities involving manipulation of materials encourage children to ask questions, test ideas, and

evaluate outcomes. These processes foster critical thinking and scientific reasoning, which are important components of cognitive competence.

Thus, cognitive development should be understood as an active and dynamic process through which children construct knowledge by interacting with their environment and engaging in meaningful learning experiences.

D. Science Learning in Early Childhood

Science learning in early childhood education is a process that introduces children to the natural world through direct observation, exploration, experimentation, and discovery. Unlike science learning at higher educational levels, early childhood science education emphasizes hands-on experiences rather than the memorization of scientific facts. The primary objective is to develop children's curiosity, critical thinking skills, and positive attitudes toward learning.

Young children are naturally curious about their surroundings. They continuously ask questions, observe changes, investigate objects, and seek explanations for events occurring around them. These characteristics make science learning highly appropriate during early childhood because it aligns with children's natural tendencies to explore and discover.

Science learning activities provide opportunities for children to develop observation skills, compare objects, identify similarities and differences, classify materials, predict outcomes, and draw simple conclusions. Such experiences contribute significantly to cognitive development because they require children to think, analyze, and interpret information.

According to (Humaira et al. 2023), colored sand media can effectively support science learning by encouraging children to explore colors, textures, and material characteristics through direct sensory experiences. Children become active investigators who observe, compare, and classify different types of sand according to observable attributes.

Science learning in early childhood is closely related to inquiry-based learning. Inquiry-based learning encourages children to ask questions, explore possibilities, and discover answers through investigation. Teachers act as facilitators who guide children's exploration rather than simply providing information. This approach supports the development of independent thinking and problem-solving skills.

When using colored sand media, teachers can encourage scientific inquiry by asking questions such as:

- What differences do you notice between these colors?
- Which sand feels smoother?
- What happens when two colors are mixed together?
- How can we separate different colors of sand?
- Which container holds more sand?

Such questions stimulate children's thinking processes and encourage them to make observations, predictions, and conclusions based on evidence.

Science learning also promotes the development of process skills. Process skills refer to abilities used in scientific investigation, including observing, classifying, measuring, predicting, communicating, and experimenting. These skills are foundational for later scientific understanding and academic success.

Barus and Marbun (2025) reported that colored sand activities provide meaningful opportunities for developing scientific literacy among young children

because children actively engage in exploration and discovery processes. Through these experiences, children begin constructing scientific concepts based on direct observation and interaction with materials.

Furthermore, science learning contributes to language development because children communicate observations, describe experiences, and explain findings. During discussions about colored sand activities, children learn new vocabulary related to colors, textures, quantities, shapes, and spatial relationships.

Science learning also supports social development. Children often work collaboratively during exploration activities, sharing materials, discussing ideas, and solving problems together. These interactions help develop communication skills, cooperation, and respect for others' perspectives.

The integration of science learning with play activities is particularly important in early childhood education. Play-based science learning allows children to explore concepts in enjoyable and meaningful ways. Colored sand activities exemplify this approach because children perceive the experience as play while simultaneously engaging in scientific investigation and cognitive learning.

Another important aspect of science learning is fostering positive attitudes toward exploration and discovery. Children who experience enjoyable science activities are more likely to develop confidence, curiosity, and motivation to learn. These dispositions can contribute to long-term academic engagement and achievement.

Therefore, science learning in early childhood should focus on creating rich, interactive, and enjoyable experiences that encourage children to investigate their environment, ask questions, and construct understanding through direct exploration.

E. Relationship Between Colored Sand Media and Cognitive Development

The relationship between colored sand media and cognitive development can be understood through children's active engagement in exploration, manipulation, observation, and problem-solving activities. Cognitive development occurs when children interact with their environment and construct knowledge based on experiences. Colored sand media provides numerous opportunities for such experiences because it combines sensory exploration with meaningful learning activities.

According to constructivist learning theory, children actively construct knowledge rather than passively receiving information. Learning occurs when children interact with materials, test ideas, and make sense of their experiences. Colored sand activities align closely with this perspective because children manipulate materials directly and discover concepts through exploration.

One important cognitive skill developed through colored sand activities is classification. Children learn to sort sand according to color, texture, quantity, or other characteristics. Classification activities help children recognize similarities and differences among objects, which is an essential component of logical thinking.

Another cognitive benefit relates to concept formation. Through repeated interaction with colored sand, children develop concepts related to color recognition, size comparison, quantity, shape, and spatial relationships. These concepts provide foundations for later learning in mathematics and science.

Colored sand activities also support problem-solving abilities. Children

frequently encounter challenges during play, such as deciding how to create specific patterns, mix colors, or construct shapes. Solving these challenges requires planning, reasoning, experimentation, and evaluation.

(Annisa 2023) found that colored sand media significantly improved children's cognitive abilities, particularly in recognizing and differentiating colors. Children who participated in colored sand activities demonstrated greater accuracy in identifying colors and classifying objects according to color categories.

Similarly, Mawaddah and Pohan (2024) reported that colored sand activities enhanced children's abilities to distinguish textures, classify objects, and understand relationships among materials. These findings indicate that sensory-based learning experiences contribute positively to cognitive growth.

The cognitive benefits of colored sand media can also be explained through sensory integration theory. Sensory integration refers to the process by which the brain organizes and interprets information received through the senses. When children manipulate colored sand, they receive sensory input through touch, vision, and movement. These experiences stimulate neural connections that support learning and cognitive development.

Research findings presented in the thesis indicate that colored sand media significantly improved children's cognitive development. Statistical analysis revealed an increase in cognitive performance from a pretest mean score of 78.18 to a posttest mean score of 106.10 following intervention with colored sand activities. The significance value of $p = 0.000$ indicated that the observed improvement was statistically significant.

The improvement in cognitive performance can be attributed to several factors. First, colored sand activities increase children's engagement and motivation. Children are naturally attracted to colorful materials and enjoy manipulating them. Increased engagement leads to greater participation and learning.

Second, colored sand activities provide concrete learning experiences. Young children learn most effectively when they can directly observe and manipulate objects rather than relying solely on verbal explanations. Concrete experiences facilitate understanding and concept formation.

Third, colored sand activities encourage active learning. Instead of passively receiving information, children become participants who explore, investigate, and discover. Active learning promotes deeper cognitive processing and stronger retention of knowledge.

Fourth, colored sand activities support creativity and imagination. Children create patterns, designs, and structures according to their own ideas. Creative thinking contributes to cognitive flexibility and problem-solving abilities.

(Ferbiarni 2023) further explained that sensory play activities involving colored sand help balance cognitive, motor, and emotional development. The interaction between sensory experiences and cognitive processes strengthens children's ability to interpret information and respond appropriately to learning challenges.

The relationship between colored sand media and cognitive development is therefore multifaceted. Through exploration, classification, comparison, observation, and problem-solving, children develop cognitive abilities that support academic readiness and lifelong learning.

In conclusion, colored sand media represents an effective educational resource

for promoting cognitive development among children aged 5–6 years. The combination of sensory engagement, active participation, and meaningful exploration creates learning experiences that enhance children's ability to think, reason, classify, and solve problems. Consequently, the use of colored sand media is highly recommended as a strategy for supporting cognitive development in early childhood education settings.

F. Relevant Previous Studies

Several previous studies have investigated the effectiveness of colored sand media in supporting children's cognitive development. These studies provide empirical evidence supporting the use of colored sand as an educational tool in early childhood settings.

(Annisa 2023) conducted a study examining the influence of colored sand media on children's cognitive development. The findings demonstrated that colored sand activities significantly improved children's ability to recognize and differentiate colors. The study concluded that colored sand media is effective because it provides concrete experiences that facilitate concept understanding and active participation.

(Humaira et al. 2023), investigated the use of colored sand in science learning activities for young children. The researchers found that colored sand stimulated children's curiosity and encouraged exploration, observation, and classification. As a result, children's cognitive abilities developed through meaningful scientific experiences.

Barus and Marbun (2025) reported that colored sand activities contributed positively to children's scientific literacy development. Their findings indicated that children became more engaged in learning and demonstrated improved observation and classification skills after participating in colored sand-based activities.

Mawaddah and Pohan (2024) examined the impact of colored sand media on cognitive development among children aged 5–6 years. Their study revealed significant improvements in children's abilities to recognize colors, distinguish textures, classify objects, and solve simple problems. The researchers concluded that colored sand media provides effective cognitive stimulation through sensory exploration and active learning.

The findings of these previous studies are consistent with the results of the present research. All studies indicate that colored sand media positively influences children's cognitive development by providing opportunities for exploration, investigation, and direct interaction with learning materials.

The present study differs from previous studies because it specifically examines the effect of colored sand media on the cognitive development of children aged 5–6 years within the research setting studied. Nevertheless, the findings reinforce existing evidence demonstrating the educational value of colored sand media in early childhood education.

Overall, the literature suggests that colored sand media is a practical, engaging, and effective learning tool capable of supporting various aspects of cognitive development. Therefore, the use of colored sand media should be considered an important strategy for enhancing learning experiences and promoting developmental outcomes among young children.

CONCLUSION

Based on the findings and discussion of this study, it can be concluded that the use of colored sand media has a positive and significant effect on the cognitive abilities of children aged 5–6 years at TK Negeri Pembina 1 Kota Bengkulu. Before the implementation of the treatment, children's cognitive abilities were still relatively low, particularly in recognizing numbers, classifying objects, identifying colors, and understanding simple concepts. However, after participating in learning activities using colored sand media, children's cognitive performance showed noticeable improvement.

The results of the statistical analysis indicated a significant difference between the pretest and posttest scores, demonstrating that colored sand media effectively enhanced children's cognitive abilities. The use of colored sand provided concrete and meaningful learning experiences that encouraged children to actively explore, observe, classify, count, and solve simple problems. These activities stimulated children's thinking processes and supported the development of their cognitive skills in accordance with their developmental characteristics.

Furthermore, colored sand media created a more engaging and enjoyable learning environment, increasing children's motivation and participation during learning activities. The findings of this study support previous research suggesting that sensory-based learning media contribute positively to children's cognitive development by providing direct and interactive learning experiences.

Therefore, colored sand media can be recommended as an innovative and effective learning medium for early childhood education. Teachers are encouraged to utilize colored sand media in classroom activities to support children's cognitive development and create meaningful learning experiences. Future researchers are also encouraged to explore the use of colored sand media in developing other aspects of early childhood development, such as language, creativity, social-emotional skills, and fine motor abilities.

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