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Efforts to Improve Fine Motor Skills of Early Childhood Through Science Games at RA An Nur Jogosatru Sukodono Sidoarjo

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Abstract: Science games are a learning activity or introduction to science that is adapted to the characteristics of early childhood children, where the delivery process is based on the principles of play (as one type of the concept of play). Fine motor skills are movements that only involve certain parts of the body and are performed by small muscles. Science toys are very supportive in improving the fine motor skills of early childhood children. But in reality, Children's fine motor development at RA AN NUR Jogosatru Sukodono Sidoarjo is only monotonous with the movement of holding pencils and crayons. Therefore, I will apply science games by packaging them in an interesting game concept, which is by inviting children to squeeze foam filled with water and paste leaves on picture paper so that children are more enthusiastic and interested in learning to improve children's fine motor skills at RA AN NUR Jogosatru Sukodono Sidoarjo. The purpose of this research is to apply science games in improving the fine motor skills of early childhood children at RA AN NUR Jogosatru Sukodono Sidoarjo. The method of data collection in this research is interview, observation and documentation. While the data analysis used is a qualitative descriptive analysis technique. The conclusion of this research is that the application of science games in improving the fine motor skills of early childhood children at RA AN NUR Jogosatru Sukodono Sidoarjo is very good so that the students are very happy and enthusiastic about learning.

Keywords: science games, fine motor, learning outcomes.

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INTRODUCTION

According to the 1945 Constitution (UUD 1945), article 31 paragraph (1) states that "Every citizen has the right to education, and paragraph (3) The Government works and maintains a national education system, in order to enlighten the life of the nation, which is regulated in the law." In the National Education System Law Number 20 of 2003 it is also stated that "The National Education System must be able to guarantee the equalization of educational opportunities, the improvement of quality and the relevance and efficiency of education management to face challenges in accordance with the demands of changes in local, national, and global life so that it is necessary to carry out reforms in a planned, directed, and continuous manner." In the (Islamic) view, children are a trust (trust) of Allah SWT that must be looked after, cared for, and nurtured as best as possible by every parent. Since birth, children have been given various potentials that can be developed to

support life in the future. If these potentials are not observed, later the child will experience obstacles in his growth and development.

Motoric development according to Elizabeth B. Hurlock (1978:159) is the development of the control of physical movement through nerve centers, nerves and coordinated muscles. Therefore, motor development is an integral part of early childhood life. A child's motoric development is closely related to the child's physical and intellectual condition and takes place gradually but has a different pace of development for each child. Specifically, motor development in children is divided into two, namely gross motor and fine motor. Gross motor skills are activities using large muscles that include basic locomotor, non-locomotor, and manipulative movements. While what is meant by fine motor skills is the ability of preschool children to engage in activities using fine muscles (small muscles) such as writing, drawing, etc.

According to John W. Santrock (2007:216) fine motor skills include grasping a toy, fixing a shirt, or doing anything that requires hand skills showing fine motor skills. Each child's motor skills are different, in general children who have good fine motor skills experience poor gross motor skills and vice versa. In general, there are groups of children with more dominant fine motor skills and more dominant gross motor skills. Prophet Muhammad SAW said: "teaching your children to swim and archery is an obligation," he then said: "teach your children archery and train them to ride until they become fluent" (HR. Bukhari). Based on the hadith, it can be understood that physical motoric development in children is absolutely necessary and even an obligation for educators to develop that potential. The fine motoric development of children aged 4-5 years is different for each child.

Fine motor development tasks in children aged 4-5 years, one of which is to be able to button a shirt. The stages of fine motor development of children aged 4-5 years old are: Children aged 4 years have the ability in fine motor aspects which consist of; build a tower as high as 11 boxes, draw something that is meaningful to the ank and can be recognized by others, use finger movements during the finger game, copy the picture of the box, write some letters. 5-year-old children have the ability in fine motor aspects which consist of; write first name, build a tower 12 boxes high, color with lines, Hold pencil correctly between thumb and two fingers, draw people with nose hair, copy rectangles and triangles, cut out simple shapes.

Fine motor skills are movements that only involve certain parts of the body and are performed by small muscles. Therefore, fine motor movements do not require too much energy, but require careful coordination and accuracy. Examples of fine motor movements are: taking an object with the thumb and forefinger, cutting, driving a car, writing, sewing, drawing and so on (Tadjuddin, 2014:280). Play is an essential demand and need for early childhood. Through play, children can satisfy the demands and needs of the development of motoric, cognitive, creativity, language, emotions, values and life attitudes. According to Santrock (2007:216-217) play is a pleasant activity done for fun. According to him, educational games emphasize that when a child plays, he will learn and absorb everything that happens in the surrounding environment. Therefore, the planning and preparation of the child's learning environment should be carefully planned so that everything can be a very pleasant learning opportunity.

Maria Motessori, a figure in the world of education, emphasizes that when a child plays, he will learn and absorb everything that happens in the surrounding environment (Triharsono, 2013:2). Therefore, the planning and preparation of the child's learning environment should be carefully planned so that everything can be a very pleasant learning opportunity. Abruscato stated that learning through science games can improve the ability of cognitive aspects, affective aspects and psychomotor aspects of children. In general, science games in Kindergarten aim for children to be able to actively search for information about what is around them. To satisfy his curiosity through exploration in the field of science, children try to understand their world through observation, research and experiments.

Learning science from an early age begins by introducing nature and the environment. This will enrich the child's experience. Children learn to experiment, explore, and investigate the surrounding environment. As a result, the child will be able to develop a knowledge that can later be used in adulthood. Constructivist theory believes that knowledge will be actively developed by children through perception and direct experience with the environment. Children who have a lot of contact with nature will be better at interpreting their world so children need to get the opportunity to interact with their environment, which will make them continuously gain knowledge. In early childhood science education, children will play based on their freedom and curiosity. This is captured as an opportunity for children to develop their knowledge about their world. Science for early childhood is based on the curiosity within the child. Science activities themselves do not just invite children to make observations, but also invite children to learn literacy, art, music, and movement (Triharsono, 2013:39 - 40).

Science games are a learning activity or introduction to science that is adapted to the characteristics of early childhood children, where the delivery process is based on the principles of play (as one type of the concept of play). The principles of play include: appropriate to the child's developmental stage, oriented to the child's needs, playing while learning, being active, creative, innovative, effective and fun. The purpose of this science game is to introduce science to children at a moderate level. A game is said to have or contain scientific value when the play activities it performs are able to unite all of the child's attention and physicality, are pleasant for the child, give direct experience to the child, meaning that the object of science is clear and can be observed directly by the child, and is based on active play, meaning that the child is actively involved in the game process. Playing in a science game expects children at an early age to be able to go through the stages of play from the merely enjoyable (joyful) to the immersive (immersion).

Science games are able to reach the standards of children's development achievement levels that have been set by the government. Based on Candy no. 58 of 2009, Science learning for early childhood children begins at the developmental level of children aged 3-4 years and can be maximally developed at the age of 5-6 years. The development of science with its inherent properties can help improve children's psychomotor skills. There are several views of scientists on science education and learning stating that the purpose of science education is in line with the school curriculum, which is to develop the child as a whole both in terms of the cognitive domain, the affective aspect, and the child's psychomotor aspect (Abruscato, 1928).

While Sumaji stated that the fundamental purpose of science is to foster students' understanding, interest and appreciation of the world in which they live. Meanwhile, according to Liek Wilarjo (1988) stated that the focus and pressure of science education lies in how we allow children to be educated by nature in order to become better. That's why being educated with nature, training children to be honest and unprejudiced. From the experience of struggling hard to solve problems in science, we are trained to persevere and persevere in the face of various difficulties, increase wisdom, and increase maturity of judgment in traveling the path of life.

Thus, the purpose of learning science should be directed at the mastery of its concepts and dimensions, the ability to use scientific methods, in solving a problem, so as to awaken the awareness of the greatness of God, the Creator of Nature, whose creation we have studied so far. Many Kindergartens in Indonesia approach art in two ways: first by teaching art as a separate and open field of development for students. Second, by integrating art into all areas of development as a teaching and learning tool. The visual arts of drawing, painting, sculpting, designing, and installation are often integrated into learning in Kindergarten. The above two approaches can be applied in the field of science development in Kindergarten. This is based on the results of research on drawing works done by experts, including W. Labert Britain and Viktor Lowenfeld, showing that every child experiences periods of development in drawing.

Based on a pre-survey conducted on 09 January 2023, the fine motor skills of early childhood children through science games have not yet been seen and realized by students at RA AN NUR Jogosatru Sukodono Sidoarjo because RA AN NUR Jogosatru Sukodono Sidoarjo has never used the application of science games. This is in line with the statement of Mrs. Failul Laili, S. Pd. As the teacher of class B at RA AN NUR Jogosatru Sukodono Sidoarjo, who stated that so far teachers have not been able to provide creative, innovative and interesting lessons for children, so children often feel bored and saturated. Of the 20 students who developed as expected, only 25%, only 35% began to develop and 40% did not develop. Learning success is seen from the number of students who reach 80%, at least reach 65% of the total number of students of 20 people in the class. This means that if the child in the class has reached 65% (Very Good Development), then the learning process is successful and the application of science games has a significant influence on fine motor skills. Therefore they need to get the right learning. Children's fine motor development in RA AN NUR is only monotonous with the movements of holding pencils and crayons. Therefore, I will apply science games by packaging them in an interesting game concept, which is by inviting children to outline cassava leaves and paste leaves on picture paper so that children are more enthusiastic and interested in receiving learning in improving children's fine motor skills in RA AN NUR.

METHODS

Educational research methods can be interpreted as a scientific way to obtain valid data with the aim of finding, developing, and proving certain knowledge so that in turn it can be used to understand, solve, and anticipate problems in the field of education (Sugiyono, 2015:6). Based on the presentation above, it is known that research methodology has a very large role in research and the development of knowledge. By understanding the research methodology it will make it easier for the researcher to determine the method/way that should be used in his research. The type of research used is Class Action Research (PTK), which is an observation of activities that are deliberately brought up, and occur in a class at RA AN NUR Jogosatru Sukodono Sidoarjo. Action Research or Action Research according to Dimyati in Nani Triani is one of the new perspectives in educational research that tries to bridge between practice and theory in the field of Education (Triani, 2012:4). The urgency of the implementation of classroom action research is that teachers are agents of change who must always make changes and increase professionalism. Thus, this class action research is done to improve and improve learning practices that should be done by teachers (Suyanto, 1997:7). As for this research, it discusses efforts to improve the fine motor skills of early childhood children through science games at RA AN NUR Jogosatru Sukodono Sidoarjo.

The research design used in this research is a research model developed by Suharsimi Arikunto. The use of this research model is because it is easier to implement and understand, so it will be easier to carry out the research, of course this will also have an impact on the achievement of the easier research objectives. In this research model, each activity cycle consists of four components, namely: planning (planning), implementation of action (action), observation (observation) and reflection (reflection). After the cycle has been implemented, especially after reflection, then it is followed by re-planning which is carried out in its own form, so on or with several cycles. Class action research is a research developed by Suharsimi Arikunto with a cycle that is carried out repeatedly and continuously (spiral cycle), that is, the learning process that gets longer will experience an increase in achievement in each cycle (Suharsimi Arikunto, 2006:74).

Arikunto stated, "research can be done at school, in the family, in the community, in the factory, in the hospital, as long as everything leads to the achievement of educational goals." In a research, it is very necessary to have a researched field area that supports it so that it can be easily presented. So, the location of this research should be considered as best as possible to facilitate the ongoing research process. Starting from this opinion, the

researcher chose the location of the research in RA AN NUR which is precisely in Jogosatru Village, Sukodono Subdistrict, Sidoarjo Regency. This board is able to create its students to achieve good performance, all of which cannot be separated from the participation of teachers and school principals in developing their students and becoming an alternative school of choice for the surrounding community. It is for this reason that researchers become interested in making the institution a place of research.

In this research, the subjects of the research are B-1 class teachers and B-1 group students as many as 20 children consisting of 8 boys and 12 girls. The researcher implements learning improvements based on problem findings obtained from the results of initial observation and learning evaluation. The results of the evaluation show that the level of students' fine motor development is still low, especially seen from the results of the students' learning achievements. Therefore, researchers want to improve it by applying learning through science games. The application of this science game is packaged as interestingly as possible so that students are happy and interested in learning activities. Reflection is an activity to present back what has been done. This reflection activity is very appropriate to be done when the implementing teacher has already taken action. Then discussed with the researcher. The purpose is to solve the problems that exist in improving teaching and learning processes that are not accurate as well as to improve student learning performance in particular and the quality of education in general. From the various research designs available, researchers use research procedures according to (Suharsimi Arikunto, 2008: 16).

This research is action research focused on area situations or commonly referred to as Classroom Action Research. Action research is done to improve and/or improve learning practices that should be done by teachers and place researchers as the main instrument in the research data collection process. The researcher as the main instrument, because the researcher conducts research directly into the field to interact and interview informants, observe the situation and condition of the school and dig for data through school documents. Here is the explanation. This observation is used to process data or information about learning activities at RA AN NUR Jogosatru Sukodono Sidoarjo. Learning activities are observed using observation sheets or observation sheets that have been prepared in advance by the researcher and addressed to the teacher.

The test that is used is that the child traces cassava leaves, prints leaf shapes, sticks different kinds of leaves, makes a snow tree shape with cotton and tree branches. After the child is able to achieve the indicators of success that have been determined, the child is considered successful. Interviews are used by researchers as a data collection technique when researchers want to know things from respondents and informants that are more in-depth and private or personal, such as the teacher's ability to choose and use learning methods. This interview was sent to teachers and group B-1. Documentation is a data collection technique by investigating school documentation sources, looking for school profiles. Photos and videos of research results at RA AN NUR Jogosatru Sukodono Sidoarjo. This technique is used by researchers to collect additional data about efforts to improve fine motor skills of early childhood children through science games at RA AN NUR Jogosatru Sukodono Sidoarjo.

The instruments used in this research include the following: 1) Field notes are used to record all events during the research process in relation to actions taken by teachers and students. This is due to various aspects of learning in the classroom, school atmosphere, and other activities that can be known from the field notes; 2) The observation sheet is a record that describes the level of student activity in the learning process. Observation is done by observing and recording the activities of teachers and students during learning by applying science games; 3) Interviews are used to collect data on the implementation of learning through science games. The interview was conducted by the concerned TK B-1 head teacher and was carried out after the end of the lesson. In addition, interviews were also conducted with students to collect data on student activities regarding the learning that had taken place.

In doing the analysis, the researcher used qualitative descriptive analysis techniques. As for the meaning of qualitative descriptive, that is data collected by researchers in the form of words, pictures and not numbers. The later results of the research report will contain data excerpts from observations, interview scripts, field notes, photos, and other important documents to give an overview of the presentation of the report. The process of data collection and data analysis in practice is not absolutely separated, the activity sometimes runs concurrently, meaning that the results of data collection are then followed up with repeated data collection. According to Miles and Hubermen quoted by Sugiyono (2009:247-252) who stated that "activities in qualitative data analysis are done interactively and continue continuously until completion, until the data is saturated". Activities in data analysis include three stages, namely data reduction (data reduction), data display (presentation of data), conclusion drawing (conclusion). But the three stages take place simultaneously.

Reducing data means summarizing, choosing the main things, focusing on the important things, looking for themes and patterns and previously it was still not clear but after researching the problem it became clear to discard the unnecessary. Thus the data that has been reduced will provide a clearer picture, and make it easier for researchers to collect further data, and find it when needed. When doing this data reduction, the researcher will be guided by the research objectives achieved. The purpose of the researcher in qualitative research is the findings. Therefore, if the researcher in carrying out the research finds something foreign, unknown, not having a pattern, that is exactly what the researcher will pay attention to when doing data reduction.

At this stage, the researcher presents information through the form of narrative text first. Further, the results of the narrative text are summarized in the form of a chart that illustrates the flow of the change process. The presentation of this data aims to limit a presentation as a set of organized information that gives the possibility of drawing conclusions and taking action. So the data that has been reduced and classified based on the group of problems being researched, so that there is a possibility of drawing conclusions or vertification. The data that has been systematically compiled at the data reduction stage, then the researcher groups based on the main problem until the researcher can draw a conclusion. Verification is a review of field notes or a review and exchange of ideas between peers to develop "inter-subjective agreement", or extensive efforts to place a copy of a finding in another set of data.

Therefore, the meanings that emerge from the data must be tested for their truth, their solidity, which is what constitutes their validity. Researchers at this stage try to draw conclusions based on the theme of the application of science games in improving the fine motor skills of early childhood children at RA AN NUR Jogosatru. This conclusion continues to be verified during the research until a deeper conclusion is reached. Furthermore, the three components of the analysis in the form of reduction, data presentation, and verification/conclusion are involved in an interrelated process, so as to be able to find the final result of the data research presented systematically which is based on the theme of the application of science games in improving the fine motor skills of early childhood children in RA AN NUR Jogosatru. So that with the data analysis process, researchers will be able to answer the formulation of problems that need answers by conducting research at RA AN NUR Jogosatru Sukodono Sidoarjo.

RESULTS

The results of the study show that the structured and systematic implementation of science play activities at RA An Nur Jogosatru had a significant positive impact on the development of fine motor skills in early childhood. Play activities involving squeezing, pouring, cutting, threading, and mixing materials successfully stimulated coordination between children’s hands and fingers. In the first cycle, children's participation in science play was relatively high, although some were still hesitant to try out the tools and

materials provided. This hesitation was largely due to a lack of prior experience with science tools such as kinetic sand, pipettes, or funnels. However, with continuous guidance and encouragement from teachers, students gradually began to engage and show interest.

Initial observations showed that only about 45% of children could complete the science play activities independently and correctly. The rest still needed help from the teacher in holding tools, scooping materials, or directing hand movements while pouring liquids. Nevertheless, curiosity began to emerge, as seen from the number of questions children asked during the sessions. By the end of the first cycle, there was an increase to 65% of children who could carry out science play activities more independently. The children started to become familiar with using the small muscles of their hands and fingers while pouring water with a pipette, scooping sand, and stirring colored liquids. These activities gradually strengthened their fine motor skills. The second cycle focused on improving the teacher's approach to giving instructions and providing more individualized support. Teachers also introduced more engaging science play variations such as making soap bubbles, mixing food coloring, and dropping liquids onto cotton. Children responded with greater enthusiasm as the activities became more colorful and fun.

During the second cycle, children's ability to grip tools and control hand movements showed notable improvement. Approximately 82% of the children were able to complete the tasks independently, demonstrating progress in manipulative skills and hand-eye coordination. They also appeared calmer and more focused during the activities. Confidence also improved among students. Many children who were initially shy or afraid to touch materials were now the first to volunteer during activities. They became more comfortable using simple tools like pipettes, spoons, and measuring cups, while also being introduced to basic science concepts in an enjoyable way. Teachers observed that children who were actively involved in science play also developed in other areas, such as social and language skills. They learned how to take turns, cooperate, and express their thoughts about what they were doing and observing during the activity.

Portfolio assessments indicated significant improvements in fine motor skills from the beginning to the end of the study. The children's drawings, lacing patterns, and crafts became more detailed and precise, suggesting better control of their finger and hand muscles. Beyond fine motor development, the children also began to show simple logical thinking abilities, such as recognizing cause and effect when mixing two substances or concluding why the water changed color. This implies that science play benefits not only physical development but also cognitive growth.

Observational data throughout the two cycles indicated a consistent upward trend in children's perseverance and attention to detail during activities. These are essential characteristics to build early in life, especially in developing focus and responsibility. Teachers found that science play made it easier to identify each child's abilities and developmental needs. Through engaging activities, they could observe progress without pressure, while providing developmentally appropriate stimulation tailored to each student. Another benefit was the improved interaction between teachers and students. The learning environment became more relaxed, exploratory, and engaging—transforming the classroom into a space where children could learn through discovery and play. Photo and video documentation further supported the findings. Children were visibly active, happy, and fully engaged in every session. This reinforces the effectiveness of science play in creating a supportive and enjoyable environment for developing fine motor skills in early childhood. Overall, science play proved to be an effective strategy for enhancing fine motor skills at RA An Nur Jogosatru Sukodono Sidoarjo. The improvements observed from one cycle to the next indicate that this method can be used continuously to support optimal early childhood development.

Another observed outcome of the science play activities was the improvement in children's ability to follow multi-step instructions. Initially, many children could only complete tasks when prompted step by step by the teacher. However, by the end of the second cycle, most children could remember the sequence of actions independently, such

as scooping, pouring, and stirring without constant reminders. In terms of classroom management, science play also contributed to a more structured yet dynamic learning environment. The hands-on nature of the activities kept children engaged and minimized behavioral disruptions. Children were deeply focused during sessions, which made transitions between activities smoother and more efficient.

The teacher's role evolved during the implementation of this method—from being the center of attention to becoming a facilitator of learning. Children took on more initiative in exploring the materials and began experimenting on their own, which is a strong indicator of developing autonomy and problem-solving skills. Some children who previously showed signs of developmental delays in motor coordination began catching up with their peers. Repeated exposure to simple, tactile tasks—such as threading beads or mixing colored water—helped build confidence and skill over time. This individualized progress highlights the inclusive nature of the science play approach.

Teachers also noted improvement in children's grip and pencil control during unrelated tasks like coloring and pre-writing exercises. This transfer of skill suggests that fine motor improvements gained through science play positively impacted other academic areas, which is a key benefit of integrated learning strategies. In addition to physical and cognitive development, children also exhibited increased emotional engagement. Their faces lit up with excitement when discovering new textures, colors, or reactions during experiments. This joy and curiosity created positive emotional associations with learning, which is crucial in early childhood education.

Parental involvement increased as well during the course of the study. Some parents reported that their children were eager to recreate science play activities at home using household materials. This extension of classroom learning into the home environment strengthens the overall developmental impact and promotes continuous exploration. Feedback from teachers and assistants revealed that science play required more preparation but offered greater returns in terms of student engagement and development. Teachers found joy in witnessing their students' excitement and progress, which enhanced their own motivation and creativity in lesson planning. Children also developed better hand dominance through repeated fine motor activities. Some students who previously switched hands frequently began showing consistent preference and control with one hand, an important milestone in fine motor skill development during the preschool years. Lastly, peer learning flourished through collaborative science play. Children began helping each other hold tools, pour materials, and clean up afterward. This sense of cooperation not only enriched their motor skills but also nurtured social-emotional competencies like empathy, patience, and teamwork.

DISCUSSION

The findings of this study indicate that the implementation of science play activities had a significant impact on the development of fine motor skills in early childhood. This supports developmental theories that emphasize how manipulative activities such as squeezing, pouring, stirring, and pinching stimulate the small muscle coordination of young children, particularly in their hands and fingers. Science play provides rich sensory and motor experiences that are essential during this stage of growth. Science play proved to offer an enjoyable and meaningful learning experience for children. Through hands-on engagement, children not only used their hands but also nurtured curiosity and basic critical thinking. They learned to recognize textures, colors, and shapes while understanding simple cause-and-effect relationships. This shows that play-based learning can successfully integrate both motor and cognitive development.

Teacher involvement during the activities played a vital role in maximizing the effectiveness of science play. Teachers acted as facilitators, guiding children in using the tools and materials correctly while offering encouragement and support. A responsive and individualized teaching approach helped children feel safe and confident in exploring,

especially those who were initially shy or hesitant. Children's progress in fine motor skills was clearly reflected in their improved ability to perform activities such as scooping, pouring, stirring, and using droppers. These tasks, although simple, are crucial in preparing children for pre-writing skills like pencil holding and controlled drawing. The foundation of handwriting is closely linked to early motor development.

Beyond physical development, science play also supported children's emotional and social growth. Through these activities, children learned cooperation, sharing tools, and taking turns. They also practiced emotional regulation when facing failure, such as spilling materials or when experiments didn't go as planned. These are valuable lessons in building resilience and empathy from an early age. In the classroom context, science play fostered a dynamic and engaging learning atmosphere. Children became more focused, less distracted, and showed greater enthusiasm during lessons. This demonstrates that active participation enhances not only physical skill development but also boosts learning motivation and classroom engagement.

The consistent improvement across both cycles of the study also highlights the importance of well-planned and progressive implementation. Teachers need to design science play activities that start simple and gradually become more complex according to the children's readiness. This ensures that every child has the opportunity to grow at their own pace. Another important point is that science play encouraged exploratory behavior and a willingness to try new things. Children who were frequently exposed to interactive tools and materials developed greater confidence and independence. These qualities are key in nurturing lifelong learners who are eager to explore their environment. From an assessment perspective, the use of portfolio documentation and direct observation provided clear evidence of developmental progress. Teachers could track changes in the children's work quality, behavior during tasks, and mastery of fine motor techniques. Qualitative evaluations like these are more suitable for early childhood education, where the focus is on the process rather than just the outcome. In summary, science play has proven to be an effective, enjoyable, and flexible method for enhancing fine motor skills in early childhood. The application of this method at RA An Nur Jogosatru demonstrated that it not only strengthens hand coordination but also supports holistic child development including physical, cognitive, emotional, and social domains at the same time.

Another notable aspect of the science play method was its adaptability to individual differences among the children. Every child develops at a different pace, and science play allowed for this variability. While some children quickly mastered the use of tools like droppers and scoops, others needed more time and repeated exposure. Teachers were able to provide support tailored to each child's level without making them feel left behind or pressured. The integration of everyday materials into the activities also made the learning feel more relevant and accessible. Using items such as food coloring, flour, water, cotton, and plastic containers helped children relate what they learned in class to their home environment. This encouraged them to recreate similar experiments at home, reinforcing learning outside the classroom and promoting family involvement.

This study also reaffirmed that science play can serve as an early introduction to scientific thinking. Although the children were not yet expected to understand complex scientific concepts, they began forming the foundations of observation, prediction, and experimentation. These early experiences cultivate curiosity and a love for inquiry—two essential qualities for academic growth in later years. Additionally, it was observed that children who regularly participated in science play developed better bilateral coordination. Tasks such as using both hands to pour, hold, or stabilize objects strengthened their ability to coordinate both sides of the body. This coordination is crucial not only for fine motor skills but also for other physical activities such as dressing, eating, and eventually writing.

Another positive outcome was the reduction in frustration or avoidance behavior. At the beginning of the study, some children avoided fine motor tasks out of fear of failure or discomfort. However, as the activities became more enjoyable and non-threatening, those

same children showed growing interest and willingness to participate. This behavioral shift is critical in early education settings, where emotional security plays a large role in developmental progress. From the teacher's perspective, science play offered valuable opportunities for informal assessment. Teachers could observe children's progress naturally during the activities without formal testing, which is ideal for early childhood settings. They could note how each child improved over time in grip strength, precision, patience, and initiative all important developmental indicators.

Science play also contributed to building language skills, even though it was not the primary focus of the activity. As children engaged in group work or discussions, they learned new vocabulary related to the tools and materials, as well as phrases used to describe their actions and observations. This incidental learning enriched their communication abilities and supported holistic development. The flexibility of science play made it possible to integrate with other domains of learning. Teachers noted how mathematical concepts like measuring, comparing quantities, and recognizing patterns could be naturally embedded within the play. This interdisciplinary benefit is one of the strengths of play-based learning in early childhood education.

One of the most meaningful outcomes of this method was the emotional satisfaction it gave to the children. The joy and pride they expressed after completing a task independently such as creating colored bubbles or transferring water without spilling boosted their self-esteem. Confidence at this early stage is fundamental for building a positive attitude toward future learning. Finally, the results of this study offer a strong recommendation for broader implementation of science play in early childhood curricula. Not only does it enhance fine motor skills effectively, but it also supports multiple aspects of development. Its hands-on, exploratory nature makes it an ideal strategy for educators aiming to provide engaging and developmentally appropriate learning experiences.

Science play also promoted sensory integration, which is essential for young children's brain development. The variety of textures, temperatures, and materials used in activities such as water, sand, and slime stimulated multiple senses at once. This multisensory stimulation is especially helpful for children who may have underdeveloped sensory responses or those with sensory processing challenges. Another significant observation was the children's increasing ability to self-correct during activities. As they repeated certain actions like pouring water into a small container or threading beads, they began adjusting their movements more precisely without constant adult intervention. This sign of self-regulation and body awareness reflects a deeper level of learning beyond basic motor repetition.

The study also revealed the importance of creating a prepared environment. When materials were arranged in an orderly and attractive manner, children were more likely to approach them independently and engage longer. This supports the Montessori principle that the environment acts as a "third teacher," especially in early childhood settings, by encouraging autonomy and sustained attention. Group dynamics also evolved positively during the implementation of science play. Initially, many children preferred working alone or hesitated to share tools. Over time, through repeated social interactions within the play context, they began to collaborate, assist peers, and communicate their needs. These emerging prosocial behaviors are just as valuable as the physical skills being developed. Science play activities also helped children learn to manage risk in a safe environment. When using tools like plastic droppers or scissors, they were taught how to handle materials responsibly. This exposure gave them confidence and practical knowledge, which are important for their transition to more structured school settings in the future. Finally, the flexibility of the science play model allowed teachers to adapt it according to seasonal themes, children's interests, or available resources. Whether using everyday kitchen items or outdoor materials, the approach remained effective in achieving its goal. This adaptability makes science play a sustainable, low-cost strategy that can be implemented across various early childhood education contexts.

CONCLUSION

The implementation of science play activities at RA An Nur Jogosatru Sukodono Sidoarjo has proven to be a highly effective method in improving the fine motor skills of early childhood students. Through a series of engaging, hands-on tasks involving pouring, squeezing, cutting, and mixing, children showed significant progress in their ability to control and coordinate small muscle movements. These fine motor improvements are critical as foundational skills for later academic tasks such as writing, drawing, and self-care. In addition to the physical benefits, science play also stimulated children's curiosity and encouraged them to observe, ask questions, and experiment. Although they are still at an early developmental stage, these activities introduced basic scientific thinking skills, including cause-and-effect understanding, simple predictions, and problem-solving. This shows the value of integrating cognitive development into physical skill-building activities. The science play approach also positively impacted children's emotional and social development. It created a joyful, stress-free learning environment where children could explore without fear of failure. They became more confident, independent, and willing to try new things. The collaborative nature of the activities helped them build patience, take turns, and develop empathy through peer interaction. From a pedagogical standpoint, science play allowed teachers to observe children's progress informally and naturally. It encouraged differentiated instruction by enabling teachers to adjust the level of support and difficulty based on each child's ability. Moreover, it allowed for the integration of other learning domains, such as early mathematics and language skills, within one set of meaningful, hands-on experiences. The study also demonstrated that science play has lasting effects beyond the classroom. Parents reported that their children became more curious at home, eager to replicate simple experiments and explain what they had learned. This home-school connection enhanced the learning process and strengthened parental engagement in early childhood education. Overall, the use of science play as a method to improve fine motor skills has shown to be both effective and developmentally appropriate for early learners. Its flexible, exploratory nature supports holistic child development and fosters a love for learning. Therefore, it is highly recommended that early childhood educators integrate science play regularly into their learning programs to maximize children's physical, cognitive, emotional, and social growth.

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