



Application of Experimental Methods in Science Learning to Improve Early Childhood Thinking Skills

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Abstract

This study aims to: 1) provide a description of the application of experimental methods in science learning to improve early childhood thinking skills; 2) knowing the Supporting Factors and Inhibiting Factors in the Application of Experimental Methods in Science Learning to Improve Early Childhood Thinking Skills. The research subjects consisted of three information people, namely 2 teachers and 1 principal. The experimental method was chosen because it is considered to be able to provide direct experience that stimulates children's active involvement in learning, so that it can increase their understanding of science concepts in depth. This study uses a qualitative descriptive approach, collecting data through observation, interviews, and documentation. The results of the study show that the application of experimental methods in science learning is able to improve the ability to think critically, logically, and creatively in early childhood. The main supporting factors for the success of this method are the availability of adequate facilities and infrastructure, as well as the active involvement of teachers as facilitators. The obstacles faced include a lack of time in implementing the experiment and limited teachers' understanding of the use of this method.

Keywords: Early Childhood, Experimental Methods, Science Learning, Thinking Skills

Introduction

One of the main reasons for the importance of early childhood education is that this period is a period of high brain sensitivity. At this stage, the child's brain has the capacity to absorb information quickly and efficiently (Aeni & Setiasih, 2024). Good stimulation during this period can trigger the growth of brain synapses, forming neural pathways that will be the basis for future understanding and skills (Suminah et al., 2022). Therefore, good education at an early age can provide a solid foundation for further learning. In addition, early childhood education also plays an important role in developing children's social and emotional aspects

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(Pollarolo et al., 2024). Children learn to interact with peers, manage emotions, and understand social norms through a variety of activities and experiences in their educational environment. This helps form a balanced personality and prepare children to live in society (Bagu, 2012; Ismail, 2019; Sa'diyah, 2018).

Furthermore, early childhood education also helps in forming early academic skills such as reading, writing, and arithmetic (Metin et al., 2024). Through a creative and playful approach, children can develop an interest and motivation for learning, which is the basis for more complex learning skills in the future (Pangestu, 2024). Thus, early childhood education is not only an investment in the development of the individual child, but also an investment in the formation of a better society in the future. Through holistic education and focusing on children's needs in the early stages of their lives, a generation can be produced that has full potential to achieve achievements and contribute positively to society (Mustofa, 2020; Sa'diyah, 2018; Yunaini & Yuyun Winingsih, 2022).

In the context of teaching and learning, understanding the thinking skills of 5-6-year-olds is key to designing appropriate learning experiences and providing optimal support. Through an approach that takes into account these developmental dynamics, educators and parents can help children optimize their cognitive potential at this critical period in their lives. (Aslamiah et al., 2021) Science learning at an early age significantly contributes to children's holistic development. Through this approach, children explore the world around them and build an important foundation for a deeper scientific understanding in the future (Wiguna et al., 2023).

Through inquiry and experiment methods, children are invited to be directly involved in the process of finding knowledge, not just passively receiving knowledge from teachers. Children are given the opportunity to identify problems, formulate hypotheses, design experiments, collect and analyze data, and draw their own conclusions. (Leggett, 2024) This kind of learning is very suitable for the stage of early childhood development, in which curiosity is great for everything. Through inquiry and experiment methods, children's curiosity can be channeled to discover new facts and concepts and practice their scientific thinking skills. (Adanır et al., 2024)

Thus, science learning in RA/Kindergarten should involve more children in the process of actively discovering knowledge. So that children's critical, logical, and systematic thinking skills and science process skills can develop optimally from an early age.

Literature Review

Teachers are still teacher-centered where they explain and provide science concepts directly to children. Meanwhile, children just sit quietly, listening to the teacher's explanation and doing the assigned assignments. As a result, children's enthusiasm and curiosity for science learning decreased. They tend to be passive because they don't get the opportunity to explore and discover new facts or concepts about science on their own. Children's understanding and ability to think about science is still very low.

Research conducted by (Khaeriyah et al., 2018) "Application of experimental methods in science learning to improve early childhood cognitive ability" shows that the positive results of action research can be known from the observation of child development in each cycle, namely in the pre-cycle obtained a score of 44.38%, in the first cycle of 61.21%, and in the second cycle of 78.86%. The increase from cycle I to cycle II was 17.65%, so that the percentage of application of experimental methods in science learning to improve early childhood cognitive abilities reached the success indicator of 75%. In other words, the use of experimental methods in learning can improve early childhood cognitive ability.

A similar study by (Hasibuan & Suryana, 2022) "The Influence of Science Experiment Methods on the Cognitive Development of Children Aged 5-6 Years" also showed that the experimental class was higher than the control class, so it can be concluded that there is an influence of the experimental method on children's cognitive development. (Sari et al., 2021) "Implementation of Experimental Methods to Develop Science Process Skills and Early Childhood Science Literacy" also shows positive things. Some of the above studies show empirical evidence that science methods are the right alternative to develop various science-related abilities in children from an early age. So that the application of this method needs to be pursued in Raudhatul Athfal (RA)/Kindergarten so that science learning is more meaningful and empowers children.

Science learning must be adjusted to the child's developmental stage. At an early age, children think concretely, not yet able to think abstractly. They learn from the near to the far, from concrete to abstract. Therefore, science learning in kindergarten/PAUD should start from natural phenomena that are commonly encountered in everyday life. Suitable learning strategies at an early age include simple experiments and demonstrations, field trips, role-playing, observing and raising animals/plants, and using concrete media and teaching aids. Teachers act as facilitators and motivators so that children actively explore and discover the science concepts they have learned.

Science learning assessments in kindergarten/PAUD tend to be qualitative descriptive, observing the process and progress of children's learning, rather than focusing on the final result. Assessment is carried out through observation, conversations, performances, and portfolios of children's works/activities. The essence of science learning in early childhood is a process that includes teaching and learning scientific concepts to children in the early stages of their development. This is a crucial period because during this time, children are experiencing very significant cognitive, social, and emotional growth. The importance of science learning at an early age is not only limited to the introduction of basic scientific concepts, but also lies in the way children understand the world around them. Through proper science teaching, children can develop logical thinking, problem-solving skills, and curiosity about environmental phenomena.

An appropriate approach in science teaching becomes crucial during the golden period of their cognitive, social, and emotional development. An engaging, playful, and experiential approach is essential in early childhood science learning. Children can gain a deeper understanding in an atmosphere that allows them to explore, ask questions, and try science concepts in a practical way. Science learning at an early age is about conveying scientific facts

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and building a strong foundation for critical thinking and future problem-solving. This is an important investment in forming a positive scientific attitude and a sustained interest in science throughout life.

Research Method

This type of research is qualitative research that is descriptive. Qualitative research was chosen to understand children's experiences and perspectives in depth and comprehensively regarding the phenomenon of applying experimental learning methods to science learning. Sukmadinata (2009) defines a qualitative method as research that aims to describe and analyze phenomena, events, beliefs, attitudes, and social activities both at the individual and group levels. This method is a series of approaches used to study and understand more deeply the meaning of a number of individuals or groups that are considered to be humanitarian or social problems, as expressed by Creswell (2015).

This qualitative research adopts the exploratory method, the initial stage in a study with a very wide scope. Its significance in exploratory research is very important because it can form a solid foundation for further research. Yusuf (2016) emphasized that the purpose of exploratory research is to explore detailed ideas related to the core problems faced as well as to develop existing hypotheses. Specifically, qualitative research procedures can be described in seven qualitative research steps, namely: problem identification, problem limitation, problem focus determination, research implementation, data processing and meaning, theory emergence, and research results reporting (Arikunto, 2013).

1. Identify the problem.

A problem is a situation that causes a person to wonder, think, and try to find the truth that exists. This problem occurs because something that is expected, thought, and felt is not the same as reality, so a "question" arises that challenges to find the "answer". On the basis of the principle of the problem, in identifying the problem, questions related to the what, why, and how can arise.

From the questions that arise, the substance of the problem related to a particular approach or type of research is depicted. In other words, what type of research the researcher should use depends on the problem at hand. In research, a researcher should identify problems by revealing all problems related to the field to be studied.

2. Problem Limitation

Problem limitation in qualitative research is often called research formulation. A number of identified problems are studied and considered whether they need to be reduced or not. The considerations are based on the breadth of the scope of the study, among others. A too broad study allows for more obstacles and challenges (Arikunto, 2013). Studies that are too specific require special abilities to be able to conduct in-depth studies. Problem limitation is an important step in determining research activities. However, the restriction of qualitative research problems is not rigid/strict.

Based on the source of data collection, in this study the research will use primary data, namely data obtained directly from the object being researched through data collection procedures and techniques in the form of in-depth interviews, participatory observation and documentation studies in the form of lesson plans, photos, and learning videos as well as the use of other measurement instruments that are specifically designed in accordance with the researcher's objectives.

The data collection techniques that will be used in this study are:

1. In-depth interviews with subjects to explore their experiences and perspectives, namely: This technique involves direct interaction between the researcher and the research subject. Through in-depth interviews, researchers seek to explore the experiences, thoughts, and in-depth perspectives of subjects related to the research topic. Interviews are conducted face-to-face or through direct communication to gain a deeper understanding of the subject's experience in question.
2. Participatory observation during learning activities, namely: This observation technique involves the presence and active participation of the researcher in certain learning activities or situations that are intended to be observed. In this case, the researcher not only observes from a distance, but is also actively involved in the process being observed. This allows researchers to gain deeper insights into the context, interactions, and dynamics that occur in the observed situation.
3. Documentation studies in the form of lesson plans, photos, and learning videos, namely: This technique involves collecting data from various related documents, such as Learning Implementation Plans (RPP), photos, and learning videos. The lesson plan provides an overview of the planning and learning strategies that are being implemented, while photos and videos can be visual evidence that supports analysis related to the context and activities that occurred.

Data analysis is the most important step to obtain research findings. Data analysis is the process of collecting data so that it can be interpreted. Data analysis is carried out at the time of data collection and after data collection. The analysis method used in this study will be qualitative analysis, which aims to provide a comprehensive overview of the subject being researched and does not intend to test the hypothesis (Yuliani, W. 2018). According to Miles and Huberman, there are three activities carried out in conducting data analysis, including:

- a. Data Reduction, namely: The process of selecting, focusing, abstracting and transforming raw data that emerges from field records. The goal is to simplify complex data into meaningful information in accordance with the focus and objectives of the research.
- b. Data Presentation: The process of compiling information in the form of matrices, graphs, networks and tables to see the overall picture or certain parts of the research results. The goal is to organize the data and make it easier to understand.

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Result

Overview of the Application of Experimental Methods in Science Learning to Improve Children's Thinking Skills

Overview of the Application of Experimental Methods in Science Learning to improve early childhood thinking skills can be applied by means of experimental methods to achieve learning goals according to the learning curriculum used in schools.

The observation results show that the preparation for the application of experimental methods in science learning is prepared in the RPPH and the learning objectives to be achieved have been determined. Related to the Application of Experimental Methods in Science Learning to Improve Early Childhood Thinking Skills at Raudhatul Athfal UMDI Ujung Baru which states that:

"The experimental method is an active learning method that uses experiments and media to help children develop children's thinking skills such as color mixing experiments" (HD, May 16, 2024)

Furthermore (ST, May 16, 2024) explained that the experimental method is active learning, which uses experimental activities and media that emphasize the formation of thinking process skills in children.

Based on this information, it can be seen that the experimental method is a learning method that provides opportunities for students to carry out environmental exploration activities and conduct experiments to observe an object or phenomenon of the experimental method, children can interact directly with the activities given by the teacher and make experiments, especially in the field of science. That way, it is hoped that children can understand the process of experimental activities, understand science concepts, and of course support children's cognitive abilities in science learning skills. In addition to the use of experimental methods, it also makes it easier for teachers because they can use media in the surrounding environment, such as food coloring. Introducing the experiment of mixing colors at an early age is a world of play. Therefore, children will feel more fun learning new things while playing. Including when learning about color mixing experiments. The media include crayons and color paints, so children can remember it more easily. Experimental methods in science learning are applied to improve children's learning ability, and they are compiled in the program and described in the lesson plan. They evaluate the results of children's activities and prepare implementation steps so that learning runs effectively. To obtain the validity of the data, the researcher then conducted triangulation by conducting an interview with the principal of Raudhatul Athfal UMDI Ujung Baru, who explained:

"The experimental method is one of the methods or methods of teaching teachers carry out to their students. In this method, later the teacher will observe students who conduct experiments on something, observe, and also experience the process themselves, and later students can prove what they have learned. (HB.16 May 2024).

Based on the results of the interview with the principal, it can be seen that the experimental method is a way of presenting learning in which students or students are involved directly to be able to prove the theory of the learning material that they have obtained. Using this method, the child will wake up and be able to bring various new breakthroughs with discoveries as a result of experiments that are expected to be beneficial for the child himself.

Regarding the results of interviews about science learning (HD, May 16, 2024), it was explained that science is an activity that develops developmental aspects and children's potential. Science learning trains children's ability to recognize various phenomena of objects and phenomena of events. Children are trained to see, touch, smell, feel, hear and taste.

Furthermore, the results of the interview (ST, May 16, 2024) revealed that science is knowledge that is systematically organized and obtained from a series of experiments and observations. Science is very important to be introduced to early childhood because science can invite children to think critically and creatively. Furthermore, the results of the interview (HB, May 16, 2024), as the principal explained, show that science is one of the sciences that is very closely related to living things, be it humans, animals, or plants. All aspects of life on earth are related to science. Based on the interview results above, science is an effort to discover something through a certain process that aims to develop knowledge.

Regarding children's thinking skills, teacher Raudhatul Athfal UMDI Ujung Baru explained that: Cognitive is a person's ability or intelligence in learning new ideas and concepts, understanding what is happening, as well as skills in remembering and solving the problems faced. (HD, May 16, 2024) Furthermore, the results of the interview (ST, May 16, 2024) explained that cognition is related to the process of knowing where a person digests information and stimulation received by the five senses, then manages information and knowledge to solve problems for everything a person faces. Furthermore, the results of the interview (HB, May 16, 2024) as the principal of Raudhatul Athfal UMDI Ujung Baru, that cognition is the ability to think, where children are able to explore objects around them.

Based on the results of the interview above, cognitive development in children includes the ability to coordinate various ways of thinking to solve problems by designing, remembering, and finding alternative solutions. Furthermore, indicators regarding the application of experimental methods in science learning in improving children's thinking skills are recognizing colors and knowing the process of mixing colors

Based on the results of the observations and interviews above, it is seen in the application of playing color mixing experiments. Children try to mix colors and produce new colors. In the process of color mixing activities, children are active and enthusiastic because children practice directly. Here the child concentrates, how the color can change. Color mixing experiments can improve the ability to recognize colors, increase children's thinking and creativity, provoke children's visual sensitivity, help children develop their imagination, and improve children's cognitive skills.

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Supporting Factors and Inhibiting Factors in the Application of Experimental Methods in Science Learning to Improve Early Childhood Thinking Skills

This study identifies several factors that affect the effectiveness of applying experimental methods in science learning at Raudhatul Athfal UMDI Ujung Baru. Through in-depth interviews with teachers and principals, observation of the learning environment, and analysis of school documents, several main supporting and inhibiting factors were revealed:

1. Supporting Factors
 - a. Teacher Competence and Motivation
 - b. Principal Support
 - c. Facilities and Infrastructure
 - d. Parent Involvement
2. Inhibiting Factors
 - a. Time Constraints
 - b. Teacher-Student Ratio
 - c. Budget Limitations
 - d. Child Readiness
 - e. Security Concerns

Discussion

Based on the observation results from the results of research that have been conducted through research instruments in the form of observation sheets and interviews, it provides an overview of the Application of Experimental Methods in Science Learning to improve children's thinking skills and supporting and inhibiting factors.

Overview of the Application of Experimental Methods in Science Learning to Improve Children's Thinking Skills

To improve the quality of science learning and early childhood thinking skills, it is necessary to integrate experimental methods more widely in the curriculum. Currently, the application of experimental methods is still limited to science learning. Therefore, the development of a more comprehensive curriculum that includes various aspects of experiential learning will greatly help enrich the teaching and learning process. As the most basic level of education, early childhood education is expected to be a strong foundation to improve children's thinking skills in playing experiments.

The application of experimental methods in learning science to improve the thinking ability of early childhood at Raudhatul Athfal UMDI Ujung Baru. Teachers make learning

implementation plans, namely: RPPH, assessment and determine the learning goals to be achieved. Teachers prepare planning steps and implement experimental activities to make it easier for teachers to carry out the process of teaching and learning activities so that learning runs effectively. Otherwise, teachers do not have preparation before the teaching and learning process will not run effectively.

Supporting Factors and Inhibiting Factors in the Application of Experimental Methods in Science Learning to Improve Early Childhood Thinking Skills

Factors in the application of experimental methods in science learning to improve children's thinking skills, namely:

1. Supporting factors

Improving teacher competence through training and workshops is very important, especially in mastering science concepts and classroom management skills during experiments. With adequate training, teachers will be more prepared and confident in applying experimental methods effectively.

Teachers' competence and motivation are supporting factors in experimental methods to improve early childhood thinking skills because:

- a. The experimental method is an active learning method that emphasizes the formation of children's thinking skills.
- b. The experimental method provides an opportunity for children to actively conduct experiments on their own.
- c. Experimental methods can develop children's cognitive, affective, and psychomotor abilities.
- d. Experimental methods can help children learn to prove a theory's truth and develop new theories.

2. Inhibiting Factors

Science learning that is still limited, only from the necessary needs, is an obstacle that needs to be overcome. Provision of more complete facilities, such as simple laboratories and sufficient experimental equipment.

Effective time management also needs to be implemented to overcome the limitations of time allocated for experimental activities. Designing more efficient learning sessions and adjusting learning schedules that allow for all stages of experimentation, including discussion and reflection, are essential to ensure that children's understanding can be well consolidated. In addition, better classroom management is needed by lowering the teacher-student ratio or providing additional training for teachers to improve classroom management skills, especially during experimental activities involving large groups.

Adjusting safety policies is also important to ensure the safety of children during experiments. Better safety procedures will help reduce teachers' concerns about possible

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incidents, so they are more emboldened to adopt more complex and interesting experiments for children. By implementing these recommendations, it is hoped that the quality of science learning and early childhood thinking skills can be significantly improved.

Conclusion

Based on the research and discussion results, it can be concluded that the application of experimental methods in science learning at RA Umdi Ujung Baru, Parepare City effectively improves early childhood thinking skills, especially in color recognition and color mixing processes. Teachers have made good preparations before applying the experimental method, including compiling RPPH, determining learning objectives, and designing steps to implement activities. The learning process with the experimental method actively involves children, increases their enthusiasm, and helps develop observation skills and critical thinking skills. Through color mixing experiments, children can get to know primary and secondary colors and understand the process of new colors.

Experimental methods help improve children's cognitive abilities, including their thinking, creativity, and imagination. The main supporting factors in the application of this method include teacher competence and motivation, principal support, availability of facilities and infrastructure, and parental involvement. The inhibiting factors encountered included time constraints, high teacher-student ratios, budget constraints, child readiness, and safety-related concerns during the experiment. The application of the experimental method requires good classroom management skills from the teacher to ensure all children are actively engaged and safe during the learning process.

Declaration of conflicting interest

The authors declare that there is no conflict of interest in this work.

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