

“SINAR” Learning Innovation (Reasoning and Engineering Learning Model)

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ABSTRACT

Learning in early childhood education needs to be conducted creatively and innovatively in order to foster children’s thinking abilities, curiosity, and problem-solving skills. One effort that can be implemented is through the innovation of Sinau and Nalar learning in kindergarten. This learning approach emphasizes activities that encourage children to think logically, explore, and discover knowledge through direct experiences. This study aims to examine how the Sinau and Nalar learning innovation is implemented and to identify its benefits for children’s cognitive development. The research employs a qualitative descriptive method with data collection techniques including observation, interviews, and documentation. The findings show that the implementation of Sinau and Nalar learning can improve children’s critical thinking, creativity, and self-confidence in solving simple problems. Therefore, this learning innovation can serve as an effective alternative teaching strategy in kindergarten.

Keywords: Early Childhood Education, Sinau and Nalar Learning, Cognitive Development, Critical Thinking, Problem-Solving Skills.

I. Introduction

The design of learning activities is developed by considering the specific needs and conditions of each child. Based on this perspective, I introduced a learning innovation called “SINAR” (Sinau Nalar dan Rekayasa – Learning through Reasoning and Design). The background for implementing this innovation is that TK Al Islam, as an early childhood education institution, is still in the initial stage of understanding and implementing Deep Learning-oriented pedagogy. In everyday practice, teaching often becomes constrained by administrative demands and expectations from parents who tend to prioritize visible learning outcomes. For instance, parents frequently measure children’s learning success through tangible products brought home, such as fully completed worksheets, neatly colored pictures, or the memorization of letters and numbers.

As a result, classroom learning frequently takes place in a classical, teacher-centered format, where activities are largely directed by the teacher. In such situations, children tend to become passive recipients of knowledge. Their opportunities to develop critical thinking, creativity in problem-solving, and deeper conceptual understanding are limited. Concepts that should ideally be explored through meaningful experiences such as understanding why water is important for life or how buildings can stand firmly often remain abstract and disconnected from the child’s real-world context. Consequently, learning has not yet fully supported the development of meaningful understanding or the ability to connect knowledge with everyday experiences (Fullan, 2018).

From the perspective of classroom practice, the diverse characteristics of learners require teachers to work harder in guiding them effectively. As a teacher, I realize that the children in our school possess different abilities, interests, and learning potentials, yet they all have equal rights to grow and develop according to their unique nature. Therefore, teachers are expected to understand the characteristics of each student because every child is unique. Recognizing this diversity requires educators to develop a deep understanding of several important aspects of their learners. These include the ability to manage the classroom in ways that address individual learning needs, awareness of students' prior learning backgrounds and their developmental progress, understanding students' interests, and recognizing their preferred learning styles and levels of readiness. Such knowledge is crucial for designing and implementing learning activities that truly support each child's development (Tomlinson, 2017).

Understanding individual learner characteristics enables teachers to create learning environments that are responsive, inclusive, and developmentally appropriate. Research in early childhood education emphasizes that children learn most effectively when learning experiences are meaningful, interactive, and connected to exploration and play (Hirsh-Pasek et al., 2020). In this context, teachers are encouraged to shift from teacher-centered instruction toward child-centered learning, where children actively construct knowledge through inquiry, experimentation, and collaboration. For this reason, I designed a joyful learning innovation by integrating the STEAM approach (Science, Technology, Engineering, Arts, and Mathematics) with the SINAR innovation pathway, which is implemented through project-based learning activities. The integration of STEAM encourages children to explore, ask questions, design simple solutions, and experiment with ideas through play-based inquiry. Such an approach not only strengthens cognitive development but also fosters creativity, communication skills, and collaboration among young learners (Bers, 2022). The integration of the STEAM approach into learning has been shown to not only enhance cognitive understanding but also foster students' creativity and contextual awareness of phenomena in their surrounding environment (Ali et al., 2025).

Through the SINAR learning innovation, classroom activities are designed as exploratory and project-oriented experiences where children observe real-life phenomena, discuss ideas with peers, and engage in simple design or construction activities. This approach helps children build connections between knowledge and real-world contexts, making learning more meaningful and memorable. Moreover, project-based learning in early childhood education has been shown to support deeper conceptual understanding, intrinsic motivation, and problem-solving abilities (Zosh et al., 2017). In conclusion, the SINAR innovation represents an effort to transform traditional classroom practices into more meaningful, participatory, and contextual learning experiences. By integrating STEAM and project-based learning principles, teachers can support children's holistic development while ensuring that learning is aligned with their natural curiosity and developmental needs. This innovation ultimately aims to cultivate children who are not only knowledgeable but also capable of reasoning, exploring, and creatively responding to the challenges of their world.

II. Literature Review

Early Childhood Education (ECE) plays a crucial role in developing children's foundational cognitive, social, and emotional competencies. One important aspect of early childhood learning is the development of critical thinking, creativity, and problem-solving skills, which are considered essential competencies for the 21st century. Contemporary educational research emphasizes that young children learn most effectively through active exploration, play, and meaningful interaction with their environment rather than through passive instruction (Hirsh-Pasek et al., 2020). Therefore, learning environments in early childhood settings should be designed to encourage inquiry, experimentation, and collaborative learning experiences. In recent years, educational scholars have increasingly emphasized the concept of deep learning in education. Deep learning refers to a learning process that enables students to understand concepts meaningfully, connect knowledge with real-life situations, and apply their understanding in new contexts. Students' critical thinking skills can be effectively stimulated through a problem-based learning model integrated with visual aids, which

allows students to map out their thought processes in a more structured manner (Nurfadila et al., 2023). According to Michael Fullan, deep learning involves the development of key competencies such as critical thinking, collaboration, communication, creativity, and character building (Fullan et al., 2018). In the context of early childhood education, deep learning can be facilitated through learning activities that allow children to investigate real-world phenomena and construct knowledge through experience.

One pedagogical approach that supports deep learning in early childhood education is the STEAM approach (Science, Technology, Engineering, Arts, and Mathematics). STEAM education integrates multiple disciplines into a holistic learning framework that encourages children to observe, question, design, and create. Research shows that STEAM-based learning supports children's cognitive development, creativity, and problem-solving abilities through hands-on activities and inquiry-based exploration (Bers, 2022). Moreover, STEAM learning helps children develop interdisciplinary thinking by connecting scientific exploration with artistic expression and engineering design. In addition to STEAM, Project-Based Learning (PBL) is widely recognized as an effective instructional strategy for promoting active learning and deeper conceptual understanding. PBL encourages learners to engage in extended investigations where they explore real-world problems, collaborate with peers, and produce meaningful outcomes. Studies indicate that project-based learning enhances student motivation, engagement, and conceptual understanding because learners are actively involved in the learning process rather than merely receiving information from the teacher (Condliffe et al., 2017). In early childhood education, project-based learning is typically implemented through play-based investigations that allow children to explore topics that are relevant to their daily lives. Another important aspect in designing effective early childhood learning is the recognition of individual learner characteristics. Every child has unique interests, abilities, learning styles, and developmental readiness. Therefore, teachers must adopt differentiated instruction to ensure that learning experiences accommodate the diverse needs of students. Differentiated learning allows teachers to adapt content, processes, and learning products according to students' readiness levels and interests (Tomlinson, 2017). By understanding children's backgrounds and learning preferences, educators can create more inclusive and responsive learning environments.

Furthermore, research in developmental psychology emphasizes the importance of play-based learning as a central component of early childhood education. Play-based learning allows children to explore ideas, test hypotheses, and construct knowledge in ways that are developmentally appropriate and intrinsically motivating. According to Kathy Hirsh-Pasek and colleagues, playful learning environments support deeper conceptual understanding, social interaction, and language development among young learners (Hirsh-Pasek et al., 2020). Such environments encourage children to become active participants in their own learning. The implementation of the Project-Based Learning (PjBL) model, combined with an understanding of pedagogical technology (TPACK), can create a more interactive learning ecosystem and enhance students' active participation in the discovery process (Nurfadila et al., 2025). Technology integration has also become increasingly relevant in early childhood education. Digital learning tools, when used appropriately, can enhance children's engagement and support interactive learning experiences. However, researchers emphasize that technology should not replace hands-on experiences but rather complement them in ways that encourage exploration and creativity (Neumann, 2018). Therefore, the integration of digital tools must be aligned with pedagogical goals and developmental considerations. Overall, the literature indicates that effective early childhood learning should combine deep learning principles, STEAM integration, project-based learning, differentiated instruction, and play-based exploration. These approaches collectively promote active participation, creativity, and meaningful understanding among young learners

III. Research Method

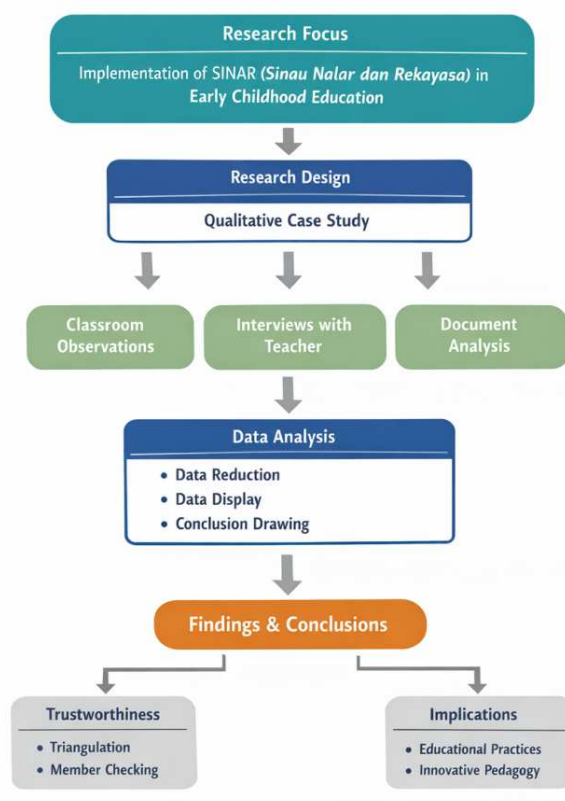
This study employed a qualitative case study approach to explore the implementation of the SINAR (Sinau Nalar dan Rekeyasa) learning innovation in early childhood education. Qualitative research is appropriate for understanding social phenomena in depth, particularly those related to educational practices,

classroom interactions, and participants' experiences. A case study design was chosen because it allows researchers to investigate a contemporary educational practice within its real-life context, enabling a comprehensive understanding of how the innovation is implemented and experienced by teachers and students (Yin, 2018). The research was conducted at TK Al Islam, an early childhood education institution that is in the early stages of adopting deep learning-oriented instructional practices. The study focused on examining how the SINAR learning innovation, which integrates STEAM-based exploration and project-based learning activities, is implemented in classroom practice. The qualitative case study approach enabled the researcher to analyze the process of learning innovation holistically, including classroom dynamics, teacher strategies, and children's responses during learning activities. Participants in this study consisted of one classroom teacher who implemented the SINAR innovation and a group of kindergarten students who were involved in the learning activities. The selection of participants was conducted using purposive sampling, a technique commonly used in qualitative research to select participants who possess relevant experience or knowledge related to the phenomenon under investigation (Creswell & Poth, 2018). In this case, the teacher was selected because of her active role in designing and implementing the SINAR learning approach, while the students were involved as participants in the classroom learning process.

Data were collected through several qualitative techniques, including classroom observations, semi-structured interviews, and documentation analysis. Classroom observations were conducted to examine how learning activities were implemented, how students interacted during project-based activities, and how the teacher facilitated exploration and reasoning processes. Observations also allowed the researcher to capture natural classroom interactions and children's engagement in the learning process. Interviews were conducted with the teacher to obtain deeper insights into the rationale behind implementing the SINAR innovation, the challenges encountered during its implementation, and the perceived impact on children's learning development. Meanwhile, documentation analysis involved reviewing learning plans, teaching materials, and records of children's learning products produced during project activities.

The data analysis process followed an interactive qualitative analysis model, which includes data reduction, data display, and conclusion drawing (Miles et al., 2019). In the first stage, data reduction involved selecting and organizing relevant information obtained from observations, interviews, and documentation. In the second stage, the data were displayed in the form of descriptive narratives and thematic categories in order to identify patterns and relationships among the findings. Finally, conclusions were drawn by interpreting the emerging themes related to the implementation of the SINAR learning innovation. To ensure the trustworthiness of the research findings, several strategies were applied, including data triangulation and member checking. Triangulation was conducted by comparing information obtained from different data sources, such as observation notes, interview transcripts, and documentation records. This process helped strengthen the credibility of the findings by verifying the consistency of the data across multiple sources. In addition, member checking was carried out by confirming the interpretation of interview data with the teacher to ensure that the researcher's interpretation accurately reflected the participant's perspectives (Creswell & Poth, 2018). Through this qualitative case study design, the research aims to provide an in-depth understanding of how the SINAR learning innovation supports children's reasoning abilities, creativity, and engagement in meaningful learning experiences. The findings of this study are expected to contribute to the development of innovative pedagogical practices in early childhood education, particularly those that integrate deep learning principles, STEAM exploration, and project-based learning in developmentally appropriate ways.

The flow of this research can be seen in the following image:



Figuer 1. Research Flow

IV. Result and Discussion

4.1 The Fundamental Concept of Sinau Nalar dan Rekayasa Learning

Sinau Nalar dan Rekayasa learning represents an innovative pedagogical approach that emphasizes the development of logical reasoning, critical thinking, creativity, and problem-solving skills through exploratory activities and hands-on practices. The term *sinau nalar* refers to a learning process that encourages children to use reasoning to understand causal relationships, connect experiences, and make simple decisions. Meanwhile, *rekayasa* refers to activities involving designing, constructing, arranging, and modifying objects or tools through direct experimentation. These two concepts complement each other in the learning process. Reasoning enables children to analyze problems, predict outcomes, and plan actions, whereas engineering activities provide opportunities for children to translate their ideas into tangible forms through creative construction and experimentation. In early childhood education, this integrated approach supports the development of higher-order thinking skills, even at an early developmental stage.

The concept of reasoning-based learning aligns closely with the constructivist learning theory developed by Jean Piaget, which emphasizes that children actively construct knowledge through interaction with their environment. According to constructivist principles, children learn most effectively when they engage in exploration, experimentation, and discovery rather than receiving information passively (Piagetian constructivism). When children are encouraged to ask questions, test ideas, and observe outcomes, they develop deeper conceptual understanding. Similarly, engineering-based activities in early childhood learning can be linked to the constructionism theory proposed by Seymour Papert, which highlights the importance of learning through designing and creating meaningful artifacts. Through building structures, assembling

objects, and experimenting with materials, children not only develop cognitive skills but also enhance their creativity and persistence (Bers, 2022).

At the early childhood education level, *Sinau Nalar dan Rekayasa* learning is closely aligned with the principle of learning through play, which is widely recognized as a fundamental approach to children's development. Play-based learning allows children to explore ideas freely while simultaneously developing cognitive, social, and emotional skills. According to research by Kathy Hirsh-Pasek and colleagues, playful learning environments stimulate curiosity, encourage problem-solving, and support deeper conceptual understanding among young learners (Hirsh-Pasek et al., 2020). Furthermore, this approach is consistent with the STEAM education framework, which integrates science, technology, engineering, arts, and mathematics into interdisciplinary learning experiences. STEAM-based learning encourages children to observe phenomena, design simple solutions, experiment with materials, and express ideas creatively (Bers, 2022). By combining reasoning (*nalar*) with engineering (*rekayasa*), children engage in authentic inquiry processes that reflect real-world problem-solving practices.

In the context of early childhood education policy in Indonesia, this learning model is also aligned with the principles promoted by the Ministry of Education, Culture, Research, and Technology, which emphasize child-centered, active, and contextual learning experiences. These principles encourage educators to design learning environments that allow children to explore their surroundings, develop curiosity, and build knowledge through meaningful activities. Overall, *Sinau Nalar dan Rekayasa* learning represents an integrative pedagogical approach that combines constructivist learning principles, play-based exploration, and STEAM-oriented inquiry. By providing opportunities for reasoning and engineering activities, this approach supports children's holistic development and prepares them to become creative thinkers and problem-solvers in the future.

4.2 Implementation of Learning Innovation Activities at TK Al Islam

The implementation of *Sinau Nalar dan Rekayasa* learning at TK Al Islam is carried out through various activities designed according to children's developmental characteristics. One of the first changes implemented in the classroom environment involved transforming the traditional classroom arrangement of rows of tables and chairs into a more flexible learning environment that encourages exploration and creativity. The classroom was redesigned to include loose parts areas and inquiry corners. Loose parts refer to open-ended materials such as wooden blocks, recycled cardboard boxes, bottle caps, twigs, stones, and other everyday objects that children can manipulate and combine in various ways. According to research in early childhood education, loose parts materials encourage creativity, problem-solving, and imaginative thinking because they allow children to construct and reconstruct ideas through experimentation (Nicholson, 2017).

In addition to loose parts materials, simple tools that support basic engineering activities—such as tape, safe scissors, strings, and flashlights—are also provided. These tools enable children to experiment with constructing objects and testing their ideas. Through such activities, children develop an understanding of scientific principles, material properties, and cause-effect relationships. The learning innovation is implemented through the SINAR Project-Based Learning cycle, which consists of four main stages: *Ask (Tanya)*, *Design (Rancang)*, *Create (Cipta)*, and *Tell (Cerita)*.

a. Stage 1: Ask (Tanya)

At this stage, the teacher begins by posing a stimulating question to spark children's curiosity. For example, the teacher may ask, "Why can a bridge collapse?" Such open-ended questions encourage children to think critically about everyday phenomena. Children then engage in discussion with peers, share their experiences, and begin to reason about possible causes. This stage stimulates inquiry-based learning, where curiosity becomes the starting point of exploration. According to inquiry learning theory, questioning and discussion help children develop analytical thinking and conceptual understanding (Hmelo-Silver et al., 2017).

b. *Stage 2: Design (Rancang)*

During the design stage, children are encouraged to create simple drawings or plans representing their ideas for solving the problem. Through this activity, children learn to visualize their ideas and develop planning skills. At this stage, children are introduced to basic mathematical concepts such as measurement, estimation, and spatial reasoning. Even though these concepts are presented informally, they help children develop early numeracy and problem-solving skills. Research shows that integrating mathematics into hands-on activities improves children's conceptual understanding and engagement (Clements & Sarama, 2019).

c. *Stage 3: Create (Cipta)*

The creation stage involves building or constructing objects using loose parts materials. Children experiment with assembling different materials to create structures based on their designs. During this stage, children learn through trial and error, testing the stability of their constructions and modifying them when problems occur. This process reflects the engineering design cycle, which includes designing, testing, evaluating, and improving solutions. In addition to scientific exploration, children also incorporate aesthetic elements when building their creations. Artistic expression becomes an integral part of the learning process, allowing children to combine creativity with functionality.

d. *Stage 4: Tell (Cerita)*

The final stage involves presenting and explaining their creations. Children are encouraged to describe what they built, explain why they designed it in a certain way, and reflect on the process they experienced. This stage helps develop children's communication and language skills, as they learn to articulate ideas and describe problem-solving processes. According to research on early childhood learning, storytelling and presentation activities enhance children's cognitive and linguistic development (Zosh et al., 2017). Learning activities are implemented both individually and collaboratively. Group activities provide opportunities for children to collaborate, exchange ideas, and learn from one another. Meanwhile, individual activities support children's independence and personal responsibility. As a result, the classroom atmosphere becomes more active, creative, and enjoyable, encouraging children to participate actively in the learning process.

4.3 The Role of Teachers and the Learning Environment

The success of *Sinau Nalar dan Rekayasa* learning largely depends on the role of teachers and the management of the learning environment. Teachers act not only as instructors but also as facilitators and learning guides who support children's exploration and inquiry. In a constructivist learning environment, teachers play an important role in designing learning experiences, providing appropriate materials, and guiding children's thinking through meaningful questions. Rather than providing direct answers, teachers encourage children to explore possibilities and discover solutions independently. Teachers must also demonstrate creativity in utilizing simple and locally available materials. In many early childhood settings, limited resources can become an opportunity for innovation by using recycled materials or natural objects as learning tools. The learning environment itself plays a crucial role in shaping children's experiences. A flexible, open, and stimulating classroom environment enables children to move freely, interact with peers, and engage in different types of activities. The classroom layout includes several learning corners, such as:

- a. Construction corner
- b. Experimentation corner
- c. Art and creativity corner

These spaces allow children to choose activities according to their interests and developmental needs. Providing a variety of learning areas also supports child-centered learning, where children have

autonomy in selecting activities that interest them. Research indicates that well-designed learning environments significantly influence children's engagement, creativity, and cognitive development (OECD, 2019). Therefore, the organization of the classroom environment becomes a crucial factor in implementing innovative learning approaches.

4.4 Challenges and Solutions in Implementation

Despite its benefits, the implementation of *Sinau Nalar dan Rekayasa* learning faces several challenges. One of the primary challenges is the limited availability of learning media and resources. Many early childhood institutions operate with restricted budgets, making it difficult to provide specialized learning tools. However, this challenge can be addressed by utilizing recycled materials and everyday objects as engineering tools. Materials such as cardboard boxes, plastic bottles, bottle caps, and natural objects can serve as effective resources for creative construction activities. Another challenge relates to time constraints in classroom schedules. Project-based learning often requires extended time for exploration, experimentation, and reflection. Teachers must therefore manage time effectively and integrate project activities within the broader curriculum.

Additionally, differences in children's abilities and developmental readiness may affect participation in learning activities. Some children may quickly generate ideas and construct complex designs, while others may need more guidance and encouragement. To address these differences, teachers implement differentiated instruction, providing varying levels of support depending on each child's needs (Tomlinson, 2017). This approach ensures that every child has the opportunity to participate and succeed in learning activities. Finally, collaboration between teachers and parents is essential for sustaining the learning process beyond the classroom. Parents can support children's curiosity and creativity by providing opportunities for exploration at home. The findings of this study can be clearly seen in the following table:

Table 1. Research Findings

Stage of Learning	Teacher Activities	Student Activities	Learning Outcomes
Tanya (Ask)	The teacher provides stimulating questions related to real-life phenomena (e.g., "Why can a bridge collapse?") and encourages discussion.	Children express opinions, share experiences, and discuss possible causes.	Children begin to develop curiosity, reasoning skills, and the ability to identify cause-effect relationships.
Rancang (Design)	The teacher motivates children to draw or plan their ideas and guides them in thinking about possible solutions.	Children draw simple designs and plan how to build their structures.	Children develop early planning skills, spatial thinking, and basic mathematical concepts such as estimation and measurement.
Cipta (Create)	The teacher provides loose parts materials and facilitates children's experimentation during the construction process.	Children build structures using various materials, test their designs, and modify them if needed.	Children develop creativity, problem-solving skills, persistence, and understanding of basic scientific concepts.
Cerita (Tell)	The teacher encourages children to present and explain their creations to the class.	Children explain what they created, how they built it, and why they designed it that way.	Children improve communication skills, confidence, and the ability to reflect on their learning process.

Table 1 illustrates the implementation process of the SINAR (Sinau Nalar dan Rekayasa) learning innovation through four main stages: *Ask (Tanya)*, *Design (Rancang)*, *Create (Cipta)*, and *Tell (Cerita)*. The table shows that each stage involves active interaction between the teacher and students, where the teacher acts as a facilitator who stimulates curiosity, guides planning, and encourages reflection. At the *Ask* stage, students begin to develop reasoning skills by discussing cause-effect relationships. In the *Design* stage, children translate their ideas into simple plans, which helps develop early mathematical and spatial thinking. The *Create* stage allows students to experiment with materials through hands-on construction activities, fostering creativity, persistence, and problem-solving abilities. Finally, in the *Tell* stage, students communicate and reflect on their learning experiences by explaining the process and purpose of their creations. Overall, the table indicates that the SINAR learning cycle supports active, inquiry-based, and experiential learning, enabling children to develop cognitive, social, and communication skills in a meaningful and engaging learning environment.

V. Conclusion

Based on the discussion presented in the previous chapters, it can be concluded that the Sinau Nalar dan Rekayasa learning innovation implemented at Al Islam Kindergarten does not require expensive equipment, but rather relies on trust in children's reasoning abilities and the teacher's willingness to reduce excessive control in the learning process. This learning approach emphasizes logical thinking, exploration, experimentation, as well as designing and creating tangible works. Through such activities, children do not merely receive knowledge passively but actively construct their understanding through direct experiences. As a result, learning becomes more meaningful, enjoyable, and aligned with the developmental characteristics of young children who naturally enjoy playing and exploring. The implementation of Sinau Nalar dan Rekayasa activities has proven to enhance children's cognitive abilities, particularly in reasoning, problem-solving, and simple decision-making. Moreover, these activities also contribute to the development of creativity, imagination, fine motor skills, and socio-emotional competencies such as cooperation, responsibility, and self-confidence. Through both group and individual activities, children learn to interact, exchange ideas, and respect others' opinions. The role of the teacher as a facilitator is a key factor in the success of this learning innovation. Teachers are required to design varied activities, provide engaging learning materials, and create a supportive, child-centered learning environment. With appropriate learning environments and creative instructional strategies, the Sinau Nalar dan Rekayasa innovation can serve as an effective approach to improving the quality of early childhood education. Overall, this innovation not only supports children's developmental achievements but also plays an important foundation for nurturing critical, creative, and independent learners prepared for future educational challenges.

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