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The Role of Teachers in Developing Children's Creativity through Science in Islamic-Based Early Childhood Education

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Abstract
The stimulation of young children's creativity in Islamic-Based early childhood education institutions still faces serious challenges, mainly because teachers tend to rely on conventional methods and have not yet optimized science learning as a medium for developing creativity aligned with Islamic educational values. This study aims to describe the role of teachers, analyze the strategies employed, and identify the factors that support and inhibit the implementation of creative science learning in Islamic-based early childhood education institutions. The study employed a descriptive qualitative approach using semi-structured interviews, observations, and document studies of four teachers at Raudhatul Athfal (RA) and Kelompok Bermain (KB) institutions in the West Aceh and Nagan Raya Regencies. The findings show that teachers play a multidimensional role as facilitators, motivators, and mediators, which, from an Islamic education perspective, represents the fulfillment of the teacher's function as a murabbi. Four main strategies are applied, namely simple experiments, science-based role play, mini science projects, and direct nature exploration, each of which opens space for tafakkur, particularly through nature exploration and the awakening of tauhid consciousness. The primary supporting factors are institutional leaders' support and children's enthusiasm, while the greatest obstacles are teachers' limited scientific competence and a lack of training. This study contributes to the development of Islamic Early Childhood Education by showing that spiritual awareness can grow as an integral part of the scientific inquiry process itself, rather than as a value component added separately from science activities..

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Introduction

Creativity is one of the crucial 21st-century competencies that urgently needs to be developed from an early age to face rapid social change and increasingly complex future challenges (S. A. Sari & Fauziyah, 2022). Developing this competency during the preschool period is essential for children to grow into skilled, innovative individuals capable of solving the various life problems they will encounter (Suhayati & Watini, 2024). However, empirical evidence in the field indicates that the stimulation of creativity in early childhood education remains suboptimal, as teachers tend to emphasize only cognitive, motor, and affective abilities, leaving insufficient space for children's creative capacity (Handayani, Hidayati, & Khotimah, 2023). Many observed learning practices

remain conventional, with teachers relying solely on textual instruction, books, and uniform assignments, which make children passive and bored (Siadari & P, 2023). In addition, teachers' limited competence in designing innovative activities often results in children's classroom activities remaining restricted, with children merely following instructions rather than having the courage to explore new ideas (Magasida, 2017).

The importance of developing this creativity becomes increasingly relevant, considering that early childhood lies within the (*golden age*) of rapid brain development. Theoretically, Jean Piaget, as cited in Warmansyah et al. (2023), explains that children aged 4-6 years are in the pre-operational stage, moving toward the concrete operational stage, in which they require stimulation through real objects to gain direct experience in constructing knowledge. Piaget emphasized that children are active learners who build their understanding of the world through concrete interaction with their environment. In line with this, Lev Vygotsky's theory, from a social constructivist perspective, emphasizes that children's cognitive development is inseparable from interactions with more knowledgeable adults or peers (Kurniati, 2025). Through the concept of the *Zone of Proximal Development* (ZPD), Vygotsky asserted that the teacher's role in providing appropriate assistance, or scaffolding, is crucial for bridging what children can already do independently toward their potential ability to imagine and generate original ideas (Anjani, Setiana, & Turahmat, 2025). This synergy between natural cognitive maturation and social environmental support forms the primary foundation for children's creative potential to grow optimally and sustainably.

Within the framework of Islamic education, the impetus to develop these potentials rests on a strong theological foundation. The Qur'an refers to human beings as khalifah fil ardh (Q.S. Al-Baqarah: 30), that is, beings entrusted with the responsibility of managing and cultivating the earth through reason, creativity, and innovation. The Qur'an also explicitly encourages human beings to continually engage in tafakkur, namely reflecting upon and observing the phenomena of the universe as a form of faith consciousness, as stated in Q.S. Ali Imran: 190-191, which praises the ulul albab, those who continually remember Allah while contemplating the creation of the heavens and the earth. This character of ulul albab reflects the integration of faith and scientific-creative thinking, which constitutes the primary goal of tarbiyah Islamiyah (Darnanengsih et al., 2026). Accordingly, developing children's creativity from an early age is not merely a modern pedagogical demand but part of the tarbiyah mission that guides children to recognize and give thanks for the creation of Allah SWT. From this perspective, science learning in Islamic-based early childhood education institutions serves as a vehicle that unites scientific inquiry with the Islamic spirit, which encourages believers to continually reflect on and observe the universe (Ridlo, 2023).

Science was chosen as the primary vehicle for developing creativity in this study because its explorative, experimental, and inquiry-based nature closely aligns with the learning characteristics of young children, who are active and full of curiosity, while also resonating with the spirit of *tafakkur* encouraged by Islam (Izzuddin, 2019). Through science, children are invited to interact directly with concrete objects to construct their own understanding of how the world around them works (Handayani et al., 2023). In line with the *National Science Education Standards*, science enables children to develop scientific process skills that form the primary foundation for critical and creative thinking abilities (Assessment, Education, Education, & Council, 1995). Isbell & Raines and Conezio & French, as cited in Budiarti (2024), also assert that discovery-focused science learning can stimulate children's imagination, generating unique and innovative ideas. This synergy between natural curiosity, the scientific method, and the values of tarbiyah Islamiyah makes science an ideal medium in Islamic-based early childhood education institutions, providing children with

the courage to try without fear of failure, while also fostering the awareness that every natural phenomenon is a sign of Allah, worthy of contemplation.

Several previous studies have demonstrated the effectiveness of science in stimulating children's development, including the study by Churiyah & Fitri (2024), which asserts that discovery-based science education is crucial for fostering young children's natural curiosity and creativity. The implementation of innovative models, such as the ASYIK model, which utilizes the surrounding environment, has also proven effective in creating an enjoyable learning environment that encourages children to explore more creatively (Suhayati & Watini, 2024). Furthermore, Sari & Fauziyah (2022) and Yunesti (2023) show that simple science experiments, such as ecoprint activities and constructive play, have a significant effect on improving children's creative thinking ability and originality. Nevertheless, Wijaya & Dewi (2021) note that science learning in the field is often suboptimal because teachers still tend to rely on conventional methods and textual assignments. Khaeriyah, Saripudin, & Kartiyawati (2018) also reveal that the success of the science experiment method greatly depends on the teacher's ability to optimize the delivery of material and classroom management. Based on this review, it is apparent that most research still focuses on the effectiveness of a particular method or medium on children's learning outcomes, whereas research that deeply analyzes the specific role of teachers as facilitators, motivators, and mediators in optimizing science for creativity development, particularly in Islamic-based early childhood education institutions, remains limited. This gap forms the starting point of the present study.

Although prior studies as reviewed above have examined the relationship between science learning and young children's creativity, as well as the role of Islamic education in shaping children's character, research that explicitly integrates the three dimensions of science learning, creativity development, and Islamic values within a single conceptual framework remains very limited. As Subhan (2022) shows, integrating science with a Qur'anic perspective into early childhood learning remains a major challenge, requiring the conceptualization of a foundational framework that appropriately positions science, Islamic values, and the characteristics of young children. Hidayati et al. (2021) also emphasize the importance of the teacher's role in introducing science to young children, yet do not specifically link it to the development of creativity or to a comprehensive Islamic value framework. From this standpoint, the process of scientific exploration and experimentation in children can, in fact, be interpreted as a means of cultivating *tafakkur*, namely, a contemplative cognitive instrument whose object is empirical reality (Sholahudin, Farisi, & Supriadi, 2025), while simultaneously serving as a vehicle for the development of children's creativity. This framework of Islamic science learning constitutes the theoretical gap that this study seeks to address.

The context of this study comprises four Islamic-based early childhood education institutions in West Aceh and Nagan Raya Regencies, namely RA Nurul Falah, KB Al Bunayya, RA Qurrata A'yun, and KB An-Najah, which operate under the auspices of the Ministry of Religious Affairs of the Republic of Indonesia and local Islamic foundations. As Islamic educational institutions, these four institutions carry a dual mandate: developing children's cognitive intelligence while instilling Islamic values as the foundation of character. This dual mandate positions the teacher not merely as a science educator but also as a *murabbi* (character educator), expected to connect children's scientific experiences with their spiritual awareness. This study thus addresses this need while contributing to the development of the *Islamic Early Childhood Education* (IECE) discourse through a science-tarbiyah integration model.

Based on the overall background described above, this study aims to: (1) describe the forms of teachers' roles in utilizing science learning for the development of children's creativity at Islamic-based early childhood education institutions; (2) analyze the strategies teachers use to optimize science as a medium for developing children's creativity; and (3) identify the supporting and inhibiting factors in implementing creative science learning at these institutions.

Method

This study employed a descriptive qualitative approach, considered appropriate for describing and analyzing the phenomenon in depth as it naturally occurs in the field (Luthfiyah, 2018). This design was chosen because the study aims to understand the teacher's role contextually, rather than to measure or test statistical hypotheses.

The study was conducted at four Islamic-based early childhood education institutions located in two regencies in Aceh Province, namely: (1) KB An-Najah, Al-Azhar Kindergarten Foundation (Drien Rampak Village, Johan Pahlawan District, West Aceh Regency); (2) RA Nurul Falah (Jalan Imam Bonjol, Grand Mosque Complex, Seuneubok Village, Johan Pahlawan District, West Aceh Regency); (3) KB Al Bunayya Alue Waki (Gunong Kong, Darul Makmur District, Nagan Raya Regency); and (4) RA Qurrata A'yun (Karang Anyar Village, Darul Makmur District, Nagan Raya Regency). The locations were selected *purposive*ly, based on the consideration that all four institutions had integrated science activities into their daily learning process. The research subjects consisted of four early childhood education teachers selected through *purposive sampling* based on the following criteria: (a) actively teaching for at least 2 years, and (b) having conducted science activities with children. The four teachers serving as informants were A.O. (KB An-Najah, 4 years of teaching experience), Z.I.M.B. (RA Nurul Falah, 9 years of teaching experience), N.R. (KB Al Bunayya, 7 years of teaching experience), and E.R. (RA Qurrata A'yun, 3 years of teaching experience).

Data in this study were collected through three techniques, namely: (1) semi-structured interviews with the four teachers, using an interview guide containing key questions regarding the teacher's role as facilitator, motivator, and mediator in science learning, while still allowing the researcher room to probe (*probing*) further according to each informant's answers and experiences; (2) observation of science learning sessions, focusing on teacher-child interaction, the use of media and learning materials, the strategies applied by teachers in optimizing science, and the implementation of experimental activities in the classroom; and (3) documentation studies of the Daily/Weekly Lesson Plans (RPPH/RPPM), the media or visual teaching aids used by teachers in science activities, and portfolios of children's work as supporting evidence of the learning process and outcomes.

Data were analyzed using the interactive model of Miles and Huberman (2014), which comprises three stages: (1) data reduction, namely sorting and focusing the raw data from interviews and observations relevant to the research questions; (2) data display, namely organizing the reduced information into descriptive narratives and thematic tables for ease of understanding; and (3) conclusion drawing and verification, namely formulating findings based on patterns that consistently emerge from the data.

Findings

Based on interviews, observations, and documentation studies conducted with four early childhood education teachers in West Aceh and Nagan Raya Regencies, findings were obtained

that address the three research questions of this study. The findings are presented in three sub-themes: (1) the forms of teachers' roles in utilizing science learning, (2) teachers' strategies in optimizing science as a medium for creativity development, and (3) the supporting and inhibiting factors in implementing creative science learning.

Forms of Teachers' Roles in Utilizing Science Learning

The findings show that the early childhood education teachers who served as subjects of this study performed multidimensional roles in science learning activities, consistently expressed in three main roles: facilitator, motivator, and mediator.

1. Role as Facilitator

The teacher's role as facilitator is realized through the careful preparation of science tools and materials as well as the arrangement of a learning environment conducive to children's exploration. All informants stated that they prepared materials for science activities well in advance, using readily available materials from the surrounding environment. Teacher A.O. from KB An-Najah stated:

> *"I usually prepare the tools and materials one day before the activity, or well in advance. The materials I use largely make use of the surrounding environment, such as turmeric, pandan leaves, flowers, used straws, plastic bottles, cardboard, twigs, leaves, and banana stems."*(A.O., interview, 2026).

Similarly, Teacher E.R. from RA Qurrata A'yun explained that all materials are prepared before the children arrive at school so that activities can proceed immediately without obstruction. In terms of environmental arrangement, most teachers prefer an open space as the venue for science learning. Teacher Z.I.M.B. revealed that when activities are conducted indoors, the tables are moved aside, and children sit in a circle to allow for freer interaction. This decision reflects the teacher's sensitivity in creating a space that allows children to move and experiment freely.

2. Role as Motivator

The teacher's role as a motivator is evident in how they encourage children who are hesitant or afraid to try science activities. At the KB level, Teacher A.O. from KB An-Najah described her approach:

> *"I provide motivation and encouragement so that children feel confident in trying. I also explain that the materials used are safe and can be cleaned, so children are not afraid of getting dirty."*(A.O., interview, 2026).

Teacher N.R. from KB Al Bunayya also prioritizes providing support and praise as the primary strategy for building children's self-confidence. A similar pattern was found at the RA level: Teacher Z.I.M.B. from RA Nurul Falah praises children who dare to express their own imagination, while Teacher E.R. from RA Qurrata A'yun approaches children personally and reassures them that dirty hands from play are not a problem because they can be washed, while also showing that other friends are trying and enjoying themselves. In addition, teachers also motivate children through provocative questions; Teacher Z.I.M.B., for example, redirects children's unexpected questions back to their peers, encouraging the entire class to actively participate in answering and thinking together.

The motivational strategies applied by the four teachers, comprising verbal praise, affirmative support, and the creation of psychological safety, align with Deci and Ryan's motivation theory (2000) on *Self-Determination Theory*, particularly the fulfillment of the basic psychological needs of

relatedness (a sense of being accepted and supported) and *competence* (a sense of capability), which drive children from *extrinsic motivation* toward *intrinsic motivation* in exploration. Interestingly, the motivational patterns used by teachers at both types of institutions, KB and RA, show relatively similar tendencies, with no explicit differentiation in this aspect of motivation-giving. This indicates that early childhood education teachers' motivational strategies are more strongly influenced by a universal pedagogical understanding of early childhood psychology than by institutional affiliation (RA or KB).

3. Role as Mediator

The teacher's role as a mediator is evident in efforts to link abstract scientific concepts to children's everyday experiences and lives. At the KB level, Teacher A.O. from KB An-Najah explains the phenomenon of rainfall through a diagram of the rain cycle drawn on cardboard while verbally describing each stage to the children. Teacher N.R. from KB Al Bunayya uses a simpler yet still contextual approach, for instance, linking onion peeling to counting activities, so that children learn care and independence while also becoming familiar with basic mathematical concepts. A similar pattern was found at the RA level: Teacher Z.I.M.B. from RA Nurul Falah links the rainbow-making experiment using food coloring and tissue to children's real experiences by asking whether they have ever seen a rainbow in the sky, so that the science concept connects directly with children's memories and experiences. Teacher E.R. from RA Qurrata A'yun even uses body movement as a bridge for mediation, directly demonstrating how a caterpillar moves before explaining the concept to the children. This mediation strategy makes science not merely a technical experiment but a meaningful experience that invites curiosity and encourages children's imagination to develop. As with the motivator role, the four teachers' mediation patterns at both KB and RA institutions show relatively similar tendencies in integrating Islamic values into the process of bridging science concepts with children's experiences.

Table 1. Summary of Teachers' Roles in Science Integration at Early Childhood Education Institutions

No	Form of Role	Description of Findings	Data Source
1	Facilitator	Teachers prepare science materials from the surrounding environment (leaves, used bottles, turmeric, etc.) one day before the activity; arrange open spaces or circular seating to support children's free exploration.	Interviews with Teachers A, B, C, D; Observation
2	Motivator	Teachers provide verbal praise, affirmative support, and psychological safety (safe to get dirty, safe to try), and encourage children to try different approaches through appreciation of children's initiative.	Interviews with Teachers A, B, C, D
3	Mediator	Teachers connect science concepts with children's everyday experiences through a rain-cycle diagram, provocative questions about rainbows, and direct demonstration of caterpillar movement.	Interviews with Teachers A, B, C, D; Documentation

Source: Primary Data, 2026

Teachers' Strategies in Optimizing Science as a Medium for Creativity Development

From the interviews and observations, four main strategies were identified that teachers use to optimize science learning as a medium for developing young children's creativity: simple experiments, science-themed role play, mini science projects, and direct nature exploration.

1. Simple Experiment Strategy

Simple experimentation is the strategy most consistently applied by all informants. The activities most frequently conducted include color mixing, sink-and-float experiments, and growing mung beans. Teacher A.O. explained that these activities were chosen because they are easy to conduct, use readily available materials, and can significantly capture children's attention. Teacher Z.I.M.B. added variety by inviting children to make rainbows using water, food coloring, and tissue, as well as to grow medicinal plants such as turmeric, ginger, and lemongrass. Meanwhile, Teacher N.R. developed life-skills-based experiments, one of which was a batik-making activity using onions, involving peeling, coloring, and direct observation of patterns. In terms of creativity, these experimental activities directly stimulate the dimensions of *fluency* (fluency of ideas) and *flexibility* (flexibility of thinking) in children, as they are invited to predict, observe, and respond to outcomes that may differ from one child to another.

2. Science-Based Role Play Strategy

Three of the four informants reported having integrated science-themed role play into their learning activities. Teacher A.O. once invited children to role-play as farmers to learn about planting and caring for plants. Teacher Z.I.M.B. developed the farmer role-play activity more elaborately, in which children not only role-played planting rice but also made attributes such as a farmer's hat and hoe from newspaper, thereby genuinely stimulating the elaboration dimension of creativity (*elaboration*). Teacher N.R. also stated that she had implemented role play, though she did not specify the particular theme. Only Teacher E.R. from RA Qurrata A'yun reported never having implemented science-based role play, indicating variation in implementation across institutions. Science-based role play provides a rich imaginative context for children to explore scientific ideas while developing their narrative and symbolic creativity.

3. Mini Science Project Strategy

Mini science projects were implemented by three of the four informants and proved to be the strategy with the greatest impact on the development of creativity in the dimensions of *originality* and *elaboration*. Teacher A.O. invites children to make plant pots from used bottles step by step, up to planting seeds in them. She noted that the children appeared highly enthusiastic and felt a sense of ownership of the plants because they had made them themselves from the very beginning. Teacher Z.I.M.B. also implements a similar project, namely, making mini pots from mineral water bottles painted in colors chosen by the children, then filling them with soil and planting onions. Teacher N.R. has a more varied approach to projects, including making doll clothes from fabric scraps, origami birds, and flowers from pencil shavings. These mini-project activities encourage children to plan, execute, and complete a whole piece of work from start to finish, allowing their creative process to unfold holistically.

4. Direct Nature Exploration Strategy

All informants agreed that open nature exploration is the strategy most capable of arousing children's enthusiasm and creativity. Teacher A.O. often invites children to learn in the schoolyard, using leaves for *ecoprinting*, small stones for sink-and-float experiments, and mini-gardening activities. She also asks children to bring plants from home to be observed together at school. Teacher Z.I.M.B. invites children outside the classroom to observe butterflies, ants, and insects, reasoning that this prevents children from becoming bored with learning only indoors. Teacher

N.R. carries out exploration activities such as drying clothes and observing changes in leaves before and after being picked, which help develop observation skills and direct recording of differences. Teacher E.R. invites children to observe trees, leaves, and stones outside the school environment and guides them to arrange leaves according to their own creativity before pasting them onto paper as a collage. Direct experience with nature provides rich and unpredictable sensory stimulation, encouraging children to ask questions, experiment spontaneously, and generate original ideas that teachers cannot predict.

Supporting and Inhibiting Factors in the Implementation of Creative Science Learning

The implementation of science learning as a medium for creativity development at the early childhood education institutions studied cannot be separated from various influencing factors, both supporting and inhibiting.

1. Supporting Factors

The first and most dominant supporting factor reported by all informants is institutional support from the school principal. Three institutions (KB An-Najah, RA Nurul Falah, and RA Qurrata A'yun) regularly hold evaluation meetings to encourage teachers to avoid monotony in their teaching. Teacher Z.I.M.B. stated that the principal consistently directs teachers to create interesting and innovative learning. Interestingly, all informants also reported the existence of a policy by institutional leaders supporting the integration of science, including Teacher A.O., who explicitly mentioned an *obligation* on the part of the school to carry out science learning. Nevertheless, this support is largely manifested as routine direction and evaluation from the principal. Based on the teaching modules/lesson plans used (following the structure of the Kurikulum Merdeka, comprising Learning Outcomes, Learning Objectives, and Graduate Profile Dimensions), science learning does not yet appear to be explicitly and consistently integrated as a distinct topic/theme within the formal lesson plans, so that its implementation in the classroom still depends heavily on each teacher's individual creativity and initiative.

The second supporting factor is children's high enthusiasm, especially when activities are conducted outside the classroom. All informants reported very positive responses from children when learning science, as they feel free to move and explore. The third factor is the availability of affordable local materials. Teachers have successfully optimized simple materials from the surrounding environment, such as leaves, stones, used bottles, and kitchen ingredients (turmeric, onions, mung beans), into effective science media at low cost. The fourth factor is positive parental response. Teacher Z.I.M.B. noted that parents support science activities because children return home cheerful and eager to share their learning experiences, while Teacher N.R. mentioned that parents strongly support the science activities carried out at school.

2. Inhibiting Factors

The most frequently mentioned inhibiting factor is limited time. Teacher Z.I.M.B. explained that time for science activities is often cut short by other agendas that must be completed first, so science activities cannot always be carried out for their ideal duration. Teachers N.R. and E.R. also confirmed that the time available for science activities is very limited.

The second inhibiting factor is teachers' limited scientific competence. Three of the four informants acknowledged that although confident with basic science concepts, they feel inadequately prepared to explain more advanced concepts. Disparities in access to professional

development among teachers were also found: only one informant (A.O.) had attended a workshop themed on scientific learning, one informant (Z.I.M.B.) had attended a webinar from the Ministry of Religious Affairs, one informant (E.R.) had attended training in Banda Aceh, while Teacher N.R. had never attended any science training at all. This disparity indicates the absence of a standardized science professional-development curriculum at either the foundation or the early childhood education cluster level, meaning that improvement in teacher competence still depends heavily on individual initiative and opportunity rather than on institutionally planned programs.

The third inhibiting factor is the limited availability of tools and learning media. Teacher A.O. cited limited tools and media as the main obstacle at her institution. In addition, a small number of parents still question the benefits of science and complain about children's uniforms getting dirty, although this obstacle is not dominant.

Table 2. Supporting and Inhibiting Factors in the Implementation of Creative Science in Early Childhood Education

Supporting Factors	Inhibiting Factors
Active principal support through evaluation and innovative direction	Limited time for science activities, often cut short by other agendas
High enthusiasm of children, especially during outdoor activities	Teachers' limited scientific competence and scarcity of specialized training
Availability of affordable, simple local materials	Limited tools and media for science learning
Positive response from most parents	A small number of parents still question the benefits of science

Source: Primary Data, 2026

Based on these findings, the researchers offer three main recommendations. First, Islamic-based early childhood education foundations or clusters need to develop a standardized, evenly distributed program to build teachers' science competence, rather than relying solely on individual teachers' initiative to access training. This recommendation is in line with the findings of Noviandari et al. (2025), which show that although early childhood education teachers generally hold positive attitudes toward science learning, limited time and training remain the main obstacles to its implementation, making the provision of sustainable science-learning training an urgent need for early childhood education teachers. Second, given that the lesson plans (RPP) used by teachers essentially follow the structure of the Kurikulum Merdeka but do not yet explicitly include science as a theme or topic, the planned integration of science activities into RPP documents needs to be encouraged, so that implementation no longer depends entirely on individual teacher creativity. Third, given that limited time is the most frequently cited barrier, institutional leaders need to consider allocating a specific time slot for science activities within the weekly learning structure, rather than treating it as an additional activity that can easily be displaced by other agendas.

Discussion

Teachers' Role in Utilizing Science Learning

The findings of this study confirm that early childhood education teachers at the four institutions studied serve as facilitators, motivators, and mediators in science learning activities. This finding aligns with Mulyasa's (2021) conception, which asserts that teachers are not merely deliverers of material but are responsible for creating learning conditions that enable children to develop optimally. In the context of science, the facilitator role realized through the preparation of

materials from the surrounding environment and the arrangement of open learning spaces is consistent with the findings of Suhayati & Watini (2024), which show that optimal use of the surrounding environment creates an enjoyable learning atmosphere and encourages creative exploration.

What was further examined is how the motivator and mediator roles actually function at the level of the child. When Teacher A.O. reassures a child that the material they are holding is safe even though it may be messy, or when Teacher E.R. approaches a child personally while showing that other friends are also trying and enjoying it, what is actually occurring is the reduction of the emotional burden that hinders children from beginning to explore, such as the fear of being wrong, fear of getting dirty, or self-doubt regarding capability. Only once this psychological barrier eases can space open for children to try, fail, and try again. This is what, within Vygotsky's framework, is termed *scaffolding*, whereby the teacher does not directly teach the science concept but rather creates conditions that allow children to move confidently from what they can already do independently toward something previously beyond their reach (Anjani et al., 2025; Irshad, Maan, Batool, & Hanif, 2021).

The same pattern appears in the mediator role: the rain-cycle diagram, the provocative question about rainbows, and the demonstration of caterpillar movement all present abstract concepts in a form that children can touch, see, or imitate directly, consistent with Piaget's view that young children's knowledge grows out of concrete interaction, rather than verbal explanation alone (Warmansyah et al., 2023). The exploratory space created by these two mechanisms, emotional safety and concrete engagement, serves as a prerequisite for children's creativity, such as *fluency* and *flexibility*, which are discussed further in the following section. It is worth noting that all four teachers apply this pattern, even though only one has attended science-specific training; the other three rely on their teaching experience and sensitivity to children's daily responses. The practice of *scaffolding* and concrete mediation observed here appears to arise not from formal mastery of child-development theory but from teachers' familiarity with the behavioral patterns of children in their own classrooms.

From an Islamic education perspective, these three roles essentially represent the fulfillment of the teacher's function as a *murabbi*, that is, an educator who shapes a child's personality holistically (P. R. Sari, 2022; Yudistira, Andriya, & Afandi, 2025). The Islamic scholarly tradition positions the teacher not merely as an instructor who transfers knowledge, but as a guide who leads students toward a deeper understanding of themselves and the universe (Arifin, 2018). Accordingly, the facilitator, motivator, and mediator roles carried out by the teachers at these four early childhood education institutions are not merely modern pedagogical practices but also expressions of tarbiyah values long-rooted in the Islamic educational tradition.

Strategies for Optimizing Science as a Medium for Creativity Development

The four strategies identified in this study, simple experiments, science-based role play, mini science projects, and nature exploration, can collectively be understood through the lens of Torrance's creativity theory, which encompasses four dimensions: *fluency* (fluency in generating ideas), *flexibility* (flexibility in changing approaches), *originality* (originality of ideas), and *elaboration* (ability to develop detail) (Rofi'ah, Khotimah, & Lestari, 2023). Simple experiments such as color mixing and sink-and-float experiments directly stimulate *fluency* and *flexibility*, as children are confronted with open situations in which each child can generate different predictions and interpretations (Churiyah & Fitri, 2024). Mini science projects, particularly making pots from used

bottles and collages from natural materials, more strongly stimulate elaboration and originality, as they require children to plan and complete a work in its entirety. This finding reinforces the study by Sari & Fauziyah (2022), which shows that simple science experiments and constructive play have a significant effect on children's creative thinking ability.

When compared with *best practices* in creative science learning for early childhood education reported in other studies, the nature-exploration strategy used by teachers at several institutions aligns with the nature-based learning approach widely recommended internationally (Azizah, Ismaiyah, & Nisa, 2023; Sobel, 2025). The use of local materials such as turmeric, banana stems, and river stones reflects local wisdom that enriches children's scientific experience by providing a familiar cultural context. This distinctiveness aligns with the spirit of Yunesti (2023), who demonstrates that *ecoprint* activities using natural materials positively impact children's creativity. One finding worth noting is that role-play and mini projects were not implemented by Teacher E.R. at RA Qurrata A'yun, indicating that variation in strategy in the field is influenced by factors such as teaching experience and access to training.

The two strategies above can also be read through a different lens when placed within the framework of Islamic education. Simple experiments such as color mixing and sink-and-float experiments essentially invite children to observe how a particular cause produces a particular effect before their very eyes. The process of observing, asking "why," and seeking patterns from empirical phenomena of this kind is, within the Islamic tradition, referred to as *tafakkur*, a contemplative cognitive instrument whose object is sensory reality rather than text (Sholahudin et al., 2025). A child who pauses to watch colors mix, within this framework, is not merely learning science but is also practicing one of the habits of thought most strongly emphasized within the Islamic scholarly tradition. Nature exploration carries a somewhat different, and perhaps deeper, dimension. When children plant a seed and observe it grow, or arrange leaves into a collage, the object they encounter is creation itself, in Qur'anic terms, *ayat kauniyah* (cosmic signs). Here, nature exploration has the potential to become an entry point for tauhid consciousness, where children, from an early age, begin to associate the order and beauty they observe in nature with something greater than themselves, in line with the aspiration of *ulul albab* referred to in Q.S. Ali Imran: 190-191. Of course, the extent to which this potential is truly realized depends on whether the teacher consciously directs such moments toward this kind of reflection, or allows them to remain merely a standalone science activity.

Supporting and Inhibiting Factors

The most dominant supporting factor in this study is the leadership support of institutional heads, who consistently encourage teachers to innovate in their teaching. This finding is consistent with several studies that assert that transformational leadership is an important prerequisite for the emergence of an innovative learning culture within educational institutions (Makmuriana, 2021; Siswadi, Yahya, Nuraziz, & Putri, 2025). The routine evaluation meetings held, and the direction given to avoid monotonous teaching prove to be significant structural drivers for teachers in implementing science activities. Children's high enthusiasm also reinforces teacher motivation, as positive feedback from children creates a mutually reinforcing cycle of engagement between teachers and learners.

On the other hand, the most serious inhibiting factor is teachers' limited scientific competence and their minimal access to relevant training. This finding is consistent with Khaeriyah, Saripudin, & Kartiyawati (2018), who assert that the success of the science experiment method greatly

depends on the teacher's ability to optimize the delivery of material. Within the framework of national policy, this condition reflects a gap in the implementation of Ministerial Regulation (Permendikbud) No. 137 of 2014 on National Standards for Early Childhood Education, which requires teachers to possess adequate professional competence, including in science. Limited learning time is also an obstacle that reflects a broader structural problem: the dense daily agenda at early childhood education institutions, which leaves little room for adequate scientific exploration.

From an Islamic perspective, this limitation in competence can be linked to the principle of *itqan*, that is, the ethos of excellence and professionalism in one's work, a value strongly emphasized in Islam, as stated in the Prophet's hadith that *Allah loves a servant who, when performing a task, performs it with itqan* (narrated by Al-Baihaqi) (Al-Qazwini, 2013). This gap between the mandate of Islamic education and the reality of teachers' competence in the field represents both a challenge and an opportunity for Islamic-based early childhood education institutions to strengthen teachers' professional development, not only in the pedagogical dimension but also in the dimension of scholarly spirituality that forms the very spirit of Islamic education itself.

Practical Implications

The findings of this study carry a number of significant practical implications. For early childhood education teachers, this study underscores the importance of developing a diverse repertoire of science strategies rather than relying solely on simple experiments, enriching their approach with mini-projects and role-play, both proven effective in stimulating multidimensional creativity. For institutional leaders, the findings highlight the importance of maintaining routine evaluation policies and providing access to more specific science training for teachers, given that the lack of relevant training remains a tangible obstacle in the field. For policymakers at the local government and district education office levels, this study recommends organizing practice-based science training programs (rather than merely webinars) for early childhood education teachers, so that the science competence gap identified in this study can be addressed systematically and sustainably.

Within the context of Islamic education, the findings of this study also have implications for strengthening the identity of Islamic-based Raudhatul Athfal (RA) and Kelompok Bermain (KB) institutions as tarbiyah Islamiyah institutions inseparable from the mission of science development. Teachers at Islamic-based institutions need mentoring support to explicitly integrate Islamic values into science activities, for example, by inviting children to reflect on the wonders of Allah's creation in every nature-based experiment they conduct. The Ministry of Religious Affairs, as the authority overseeing these institutions, is advised to develop an integrated science curriculum that combines modern pedagogical competence with the goals of Islamic education, so that teachers are not only able to facilitate children's creativity scientifically but also become *murabbi* who guide children toward tauhid consciousness through the observation of nature. In this way, this study is expected to contribute to the development of a holistic, integrative, and contextual *Islamic Early Childhood Education* (IECE) in Indonesia.

Conclusion

This study concludes that teachers at Islamic-based Raudhatul Athfal (RA) and Kelompok Bermain (KB) institutions in West Aceh and Nagan Raya Regencies have played essential roles as facilitators, motivators, and mediators in the use of science learning to develop young children's

creativity. Within the framework of Islamic education, these roles can be understood as fulfilling the teacher's function as *a murabbi*, who transmits knowledge while guiding children to recognize and give thanks for Allah SWT's creation through concrete, meaningful science experiences. The implementation of these strategies is supported by such factors as active support from institutional leaders, children's high enthusiasm, and the availability of affordable local materials, yet it also faces obstacles in the form of limited learning time, teachers' limited competence and access to science training, inadequate availability of tools, and the lack of explicit integration of science into the formal lesson plans used by teachers on a daily basis.

These findings confirm that the teacher's role as *murabbi* and science facilitator simultaneously is a key determinant of success in creative science learning at Islamic-based early childhood education institutions, and that strengthening teachers' professional competence through targeted, practice-based science training programs oriented toward Islamic educational values needs to become a policy priority at the institutional level, within the Ministry of Religious Affairs, and at the local government level. Further research is recommended to expand the scope of subjects and use mixed methods (*mixed methods*) to validate these findings more representatively, while also exploring models for integrating science and Islamic values within a holistic *Islamic Early Childhood Education* (IECE) framework.

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