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The Role of the IGRA DIY Professional Organization in Strengthening RA Teachers' Science Literacy in the Era of the Merdeka Curriculum

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ABSTRACT
Science literacy is an important competency for Raudathul Athfal (RA) teachers because it supports the implementation of exploratory learning in the Merdeka Curriculum. This study aims to analyze the role of the Yogyakarta Special Region IGRA in strengthening RA teachers' science literacy. The study uses a qualitative approach with a case study design, involving one IGRA administrator and three RA teachers selected purposively. Data were collected through interviews, observations, and document analysis, then analyzed using thematic analysis techniques. The results of the study indicate that IGRA DIY facilitates the development of teacher competencies through continuous training, peer collaboration, and professional mentoring. Although science literacy programs are still limited, various strategies such as tiered training, demonstrations of simple science activities, and the development of Islamic value-based materials help teachers implement inquiry-based science learning. The implications of this research confirm that professional organizations have a strategic role in encouraging the improvement of RA teachers' science literacy and strengthening value-based and contextual learning practices.

Keywords: *Science Literacy of RA Teacher; IGRA Professional Organization; Merdeka Curriculum; Teacher Professional Development*

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1. INTRODUCTION

Teachers' science literacy is one of the most important professional competencies in early childhood education. Science literacy is not only defined as the ability to understand scientific concepts, but also encompasses the ability to use scientific knowledge to explain natural phenomena, develop scientific thinking processes, evaluate information based on evidence, and design learning experiences that encourage children to actively observe, explore, and investigate. In the context of early childhood education, teachers with strong science literacy are able to transform various simple phenomena that children encounter in their daily lives into meaningful learning experiences through activities such as observing, asking questions, experimenting, and drawing conclusions (Fitri, 2024; O'connor et al., 2021; Roy et al., 2025; Zamalloa et al., 2025). Therefore, teachers' science literacy is not only an indicator of professional competence but also a key foundation for creating science learning experiences that align with the developmental characteristics of young children.

Teachers' science literacy has a significant impact on the quality of learning and children's development. Various studies show that teachers with strong science literacy are better able to create a learning environment that fosters curiosity, critical thinking, creativity, problem-solving, and a

positive attitude toward science in children from an early age (Bjerknes et al., 2024; Yilmaz, 2024). Through inquiry-based learning, children have the opportunity to observe various natural phenomena, ask questions, make predictions, conduct simple experiments, and communicate their observations. These experiences not only develop scientific thinking skills but also foster active learning habits that will serve as a foundation for academic development in subsequent educational levels. In Islamic-based educational institutions such as Raudhatul Athfal (RA), science education also has its own distinct characteristics because teachers are required to integrate scientific concepts with Islamic values so that children not only understand natural phenomena scientifically but also appreciate the spiritual meaning contained within them (Hosic et al., 2025; Latjompoh et al., 2025).

Nevertheless, various studies indicate that efforts to strengthen science literacy among early childhood education teachers still face numerous challenges. Teachers often have a limited understanding of scientific concepts, lack proficiency in inquiry-based learning strategies, have minimal experience in designing simple experiments, and face limitations in access to science learning materials and resources (Goosen, 2022; Maraisane et al., 2024; Schmitt et al., 2023; Taşdemir & Yıldız, 2024). These challenges have become even more apparent following the implementation of the Merdeka Curriculum, which emphasizes active, contextual, project-based, and exploration-oriented learning. Teachers are required not only to master the subject matter but also to be able to facilitate children in constructing knowledge through the scientific inquiry process (Agustini et al., 2024; Munawwarah, 2025). In RA educational institutions, these challenges become even more complex because teachers must also integrate Islamic values into science instruction without compromising the essence of the scientific approach, which is rooted in curiosity and exploration. This situation underscores that improving the science literacy of RA teachers is an urgent need to support the optimal implementation of the Merdeka Curriculum.

One strategy that has the potential to strengthen teachers' competencies is through professional organizations. Professional organizations serve as platforms for continuous professional development, enabling teachers to gain learning experiences through training, workshops, peer discussions, mentoring, and reflection on teaching practices. Various studies indicate that professional learning communities can enhance teachers' pedagogical competencies, strengthen collaboration among teachers, foster learning innovation, and accelerate adaptation to changes in education policy (Bondurant, 2024; Peng et al., 2022; Potvin et al., 2024; Thi et al., 2024). Through these activities, teachers can share experiences, develop instructional materials, discuss various challenges faced in the classroom, and foster a culture of continuous professional learning. Thus, professional organizations play a strategic role in supporting the enhancement of teachers' science literacy.

In the context of Raudhatul Athfal (RA) education in Indonesia, the Association of Raudhatul Athfal Teachers (IGRA) is a professional organization that brings together RA teachers from various regions. IGRA not only serves as a forum for communication among its members but also plays a role in enhancing teachers' professional competencies through various training programs, seminars, workshops, teacher working groups, guidance on curriculum implementation, and the development of learning communities. IGRA's strength lies in its ability to bridge the gap between teachers' professional development needs and national education policies while preserving the Islamic educational characteristics that define Raudhatul Athfal. Through its structured organizational network, IGRA has great potential to promote the improvement of teachers' science literacy through continuous, collaborative, and context-specific competency development tailored to the needs of teachers in the field.

Numerous studies have been conducted on teachers' science literacy, professional development, and professional learning communities. Roy et al. (2025) examined science literacy in early childhood education with a focus on the implementation of science instruction, but did not address the role of professional organizations in enhancing teachers' competencies. Peng et al. (2022) studied professional learning communities in early childhood education, but their focus remained on curriculum implementation and did not link it to strengthening science literacy. Chan and Erduran (2023) discussed collaboration between science teachers and religious education teachers; however, their study was conducted at the secondary education level and thus does not reflect conditions in early childhood education. Potvin et al. (2024) explain the contribution of professional learning

communities to improving science teachers' instructional practices, but they focus on secondary school science teachers. Meanwhile, Hosic et al. (2025) examine the integration of religious values into STEAM learning, but they have not elaborated on how professional organizations play a role in building teachers' capacity. Based on this review, it can be concluded that research specifically analyzing the role of professional organizations in strengthening the science literacy of Raudhatul Athfal teachers through professional development integrated with Islamic values in the era of the Merdeka Curriculum remains very limited. It is this gap that constitutes the novelty of this study.

Based on the above discussion, this study aims to analyze the role of the Raudhatul Athfal Teachers' Association of the Special Region of Yogyakarta (IGRA DIY) in strengthening RA teachers' science literacy in the era of the Merdeka Curriculum. Specifically, this study identifies the professional development programs organized by IGRA DIY, analyzes the various challenges teachers face in improving their science literacy, and examines the organization's strategies for supporting the implementation of inquiry-based science learning integrated with Islamic values. The results of this study are expected to contribute theoretically to the development of research on science literacy among early childhood education teachers, while also serving as practical recommendations for professional organizations in designing more effective and sustainable teacher competency development programs.

2. METHODS

This study employs a qualitative approach using a descriptive case study design. This approach was chosen because the study aims to gain an in-depth understanding of the role of the Raudhatul Athfal Teachers' Association of the Special Region of Yogyakarta (IGRA DIY) in strengthening the science literacy of Raudhatul Athfal (RA) teachers in the era of the Merdeka Curriculum. The case study design allows the researcher to explore a phenomenon in a real-world context through various data sources, thereby enabling a comprehensive description of the process of teachers' professional development, the implementation of organizational programs, and the participants' experiences in taking part in competency-building activities (Yin, 2018).

The study was conducted at the IGRA Special Region of Yogyakarta (DIY) professional organization, one of the professional organizations for RA teachers that actively organizes various teacher competency development programs. Research participants were selected using purposive sampling, based on the consideration that they had experience and direct involvement in teacher competency-building programs organized by IGRA DIY. The participants consisted of one IGRA DIY board member responsible for implementing professional development programs and three RA teachers who actively participated in training sessions, workshops, and academic forums organized by the organization. Participants were selected to obtain information-rich insights regarding the organization's strategies for improving teachers' science literacy.

Research data were collected through semi-structured interviews, observations, and a document review. Interviews were conducted to explore participants' experiences regarding the implementation of the IGRA program, their perceptions of science literacy, the challenges faced by teachers, and the strategies for strengthening competencies implemented by the organization. Observations were conducted on the implementation of professional development activities and learning activities related to strengthening teachers' science literacy. Meanwhile, a document review was conducted on various organizational documents, such as work programs, training modules, workshop materials, activity reports, and other supporting documents to corroborate the findings from the interviews and observations.

The research instruments were designed based on the research objectives and indicators of teachers' science literacy and professional development, which were derived from a literature review. The interview guide was designed to be semi-structured to allow the researcher to explore participants' experiences in greater depth, while the observation sheet was used to identify teaching practices, teachers' facilitation strategies, and the implementation of inquiry-based activities. Document analysis was conducted using a document review sheet to identify program formats, training materials, and organizational policies related to strengthening teachers' science literacy. Details of the data collection techniques and research instrument indicators are presented in Table 1.

Table 1. Data Collection Methods and Research Instrument Indicators

Data Collection Techniques	Instruments	Indicator
Semi-structured interview	Interview Guidelines	Teachers' understanding of science literacy, their experiences participating in the IGRA program, the implementation of inquiry-based learning, the challenges they face, strategies for developing competencies, and the integration of Islamic values into science instruction.
Observation	Observation sheet	Professional development activities, science teaching practices, the use of instructional media, the application of the inquiry-based approach, teacher-student interactions, and participant engagement in IGRA activities.
Documentation study	Document Review Sheet	Organizational work programs, training modules, workshop materials, activity documentation, organizational policies, and documents supporting the implementation of the Merdeka Curriculum.

The data were analyzed using thematic analysis, as developed by Braun and Clarke (2006), because this method allows researchers to systematically identify, organize, and interpret patterns of meaning that emerge from the data. The analysis was conducted in six stages: (1) reading and understanding all the data (familiarization with data), (2) generating initial codes for relevant information (generating initial codes), (3) grouping codes into main themes (searching for themes), (4) reviewing the alignment of the themes with the overall data (reviewing themes), (5) defining and naming each theme (defining and naming themes), and (6) compiling the research report (producing the report). The entire analysis process was conducted iteratively to ensure that the resulting themes truly represented the phenomena observed in the field.

To ensure the credibility of the research findings, methodological triangulation was conducted by comparing data from interviews, observations, and documentation. In addition, member checking was conducted by asking participants to review summaries of their interview results to ensure that the researcher's interpretations were consistent with the experiences they had described. This procedure was carried out to enhance data validity, reduce interpretive bias, and strengthen the trustworthiness of the research findings. The research process, from the planning stage to the formulation of conclusions, is presented in Figure 1.

Figure 1 presents an overview of the research procedures used in this study. Each stage was systematically designed to ensure that the processes of data collection, analysis, and validation were carried out in a logical sequence, thereby yielding credible findings. This research flowchart also clarifies the relationships between the various stages of the research—from planning to drawing conclusions—making it easier for readers to understand the research process as a whole.

3. RESULTS AND DISCUSSION

The results of the study show three main findings related to the role of IGRA DIY in strengthening RA teachers' science literacy, namely: (1) distribution of professional development programs, (2) main challenges in implementing science literacy, and (3) organizational strategies in strengthening teacher capacity. The detailed distribution of these programs across different competency areas is presented in Table 1.

Table 1. Distribution of IGRA DIY Programs Based on Teacher Development Fields

Development Field	Number of Programs	Percentage	Target Competency
Classroom Administration	8	40%	Administrative skills, documentation
General Teaching Methods	7	35%	Pedagogical strategies, classroom management
Literacy & Numeracy	3	15%	Early literacy, basic numeracy skills
Learning Media Development	1	5%	Creative media, educational tools
Science Literacy	1	5%	Scientific inquiry, STEAM approach
Total	**20**	**100%**	-

Figure 1. Research flowchart illustrating the main stages of the research process.

Distribution of IGRA DIY Teacher Development Program

A document analysis shows that over the course of one year, IGRA DIY organized 20 professional development programs for Raudhatul Athfal (RA) teachers. As shown in Table 1, most of the programs focused on instructional administration (40%) and general teaching methods (35%), while only one program (5%) explicitly focused on strengthening science literacy. However, interviews with IGRA DIY officials revealed that elements of science literacy are not only delivered through specialized programs but are also integrated into various other activities, such as training in the development of learning media, basic STEAM workshops, and teacher competency-building activities. Observation results also showed that some training sessions included demonstrations of simple experiments and exploration-based learning practices relevant to the development of science literacy in early childhood. These findings indicate that science literacy has not yet become a central theme in IGRA DIY's professional development agenda, but has begun to be integrated into various teacher competency development programs.

The emphasis on instructional administration and teaching methods reflects IGRA DIY's response to the demands of implementing the Merdeka Curriculum. Changes in curriculum policy require teachers to understand the development of instructional materials, authentic assessment,

project-based learning, and more child-centered teaching strategies. Therefore, professional organizations prioritize programs that help teachers adapt to these policy changes before expanding into the development of more specific competencies, including science literacy. This situation indicates that the direction of professional development programs is influenced not only by teachers' needs but also by ongoing dynamics in education policy.

These findings are consistent with the research by Peng et al. (2022), which states that professional learning communities (PLCs) tend to prioritize programs that help teachers adapt to changes in the curriculum and teaching practices before developing competencies in specific subject areas. Similarly, Potvin et al. (2024) explain that continuous professional development for teachers needs to shift from meeting administrative requirements toward strengthening pedagogical competencies and gaining a deeper mastery of subject matter, including science literacy. Thus, the predominance of administrative and instructional methods programs in the DIY IGRA can be understood as part of the process of adapting to national education policy; however, it still needs to be balanced with more specific programs to enhance teachers' academic competencies.

On the other hand, although only one program was specifically labeled as science literacy, the results of interviews and observations showed that science content had been integrated into various training sessions through the STEAM approach, the development of learning materials, and inquiry-based learning practices. This approach indicates that IGRA DIY views science learning as an integral part of thematic learning in early childhood education. These findings support the results of a study by Roy et al. (2025), which states that the development of science literacy in early childhood is more effective when carried out through learning experiences integrated with play, exploration, and inquiry than through science instruction taught as a separate subject.

Nevertheless, the integration of science literacy into various general programs also has its limitations. Without programs specifically designed to strengthen understanding of scientific concepts and inquiry-based pedagogy, teachers may not yet have a deep grasp of how to design systematic and meaningful science learning experiences. Roy et al. (2025) emphasize that improving teachers' science literacy requires professional development programs that are ongoing, reflective, and practice-oriented, so that teachers not only understand scientific concepts but are also able to facilitate students' scientific thinking processes. Therefore, IGRA DIY has an opportunity to strengthen its contribution by implementing more structured science literacy programs without compromising its focus on the implementation of the Merdeka Curriculum.

Overall, these findings indicate that professional organizations play a strategic role as a bridge between the implementation of education policy and the improvement of teacher competencies. A balance between programs oriented toward instructional administration and those focused on strengthening science literacy will be a key factor in supporting RA teachers to implement inquiry-based science learning more effectively in the era of the Merdeka Curriculum.

Key Challenges in Strengthening Science Literacy Among RA Teachers

The results of interviews and observations revealed five main challenges faced by RA and IGRA DIY teachers, namely limited resources and funding, which made it impossible to conduct science training on a regular basis; variations in teachers' readiness and competence in designing inquiry activities; the perception that science is difficult to teach to young children, as seen in two teachers who admitted to being hesitant to use simple experiments; a lack of science facilities and teaching aids, resulting in teachers more often using whatever media they had available; and a limitation of science teaching materials that integrated Islamic values, even though all participants acknowledged the importance of this. Table 3 summarizes these challenges and the strategies that IGRA DIY has implemented to overcome them. These findings are consistent with reports on science training for early childhood teachers, which emphasize the importance of resource availability and tiered mentoring in improving inquiry skills (Subayani & Bakhtiar, 2023).

Table 3. Challenges and Strategies of IGRA DIY in Strengthening Science Literacy

Challenge	Impact Level	IGRA DIY Strategy	Implementation Status
Limited resources and funding	High	Partnership with universities and government agencies	Ongoing
Varying teacher readiness levels	High	Tiered training programs (basic to advanced)	Partially implemented
Perception that science is difficult for young children	Medium	Contextual demonstrations using simple, everyday materials	Successfully implemented
Insufficient training facilities and equipment	Medium	Utilization of school venues and online platforms	Successfully implemented
Time constraints for busy teachers	High	Flexible scheduling, weekend programs, and micro-learning modules	Successfully implemented
Lack of culturally relevant science teaching materials	Medium	Development of Islamic values-integrated science resource library	In progress

IGRA DIY Strategy in Strengthening Teacher Science Literacy

Despite facing various limitations in implementing professional development programs, the results of interviews, observations, and document analysis indicate that IGRA DIY has implemented various strategies to strengthen the science literacy of Raudhatul Athfal (RA) teachers. One of the main strategies is the implementation of tiered training, designed in stages—from introducing basic science concepts and conducting simple experiments to integrating Islamic values into science instruction. This approach demonstrates that the development of teachers' competencies is not an instant process but rather a continuous learning process tailored to the teachers' readiness levels. Furthermore, observations of the training activities revealed that IGRA DIY places greater emphasis on using natural materials and simple tools easily found in the surrounding environment as science learning media. Various activities, such as planting, mixing colors, observing weather changes, and conducting simple experiments, are used to change teachers' perception that science learning is a complex activity requiring expensive laboratory equipment. This contextual approach aligns with the findings of Bjerknes et al. (2024) and Yilmaz (2024), who emphasize that science learning for early childhood students is more meaningful when linked to everyday experiences and environments close to the children's lives.

Another strategy is to strengthen collaboration among teachers through Teacher Working Groups (KKG) and various discussion forums facilitated by IGRA DIY. Interview results indicate that these forums serve as spaces for teachers to share experiences, discuss learning challenges, and provide feedback to one another regarding the implementation of inquiry-based science activities in the classroom. This collaborative process demonstrates that the development of teacher competencies is achieved not only through formal training but also through ongoing peer learning. These findings support the concept of Professional Learning Communities (PLCs) proposed by Astrup and Jerrim (2025), Denee (2024), Liu et al. (2024), and Mydin et al. (2024), who state that professional collaboration among educators is a key factor in improving the quality of teaching practices and fostering sustainable pedagogical change. In addition, IGRA DIY also utilizes online learning platforms via video conferencing applications to address limitations in time, cost, and the reach of training. Teachers stated that online training offers greater flexibility because it allows them to participate in activities without having to take time away from their teaching duties, while also providing opportunities to learn from experts from various regions. These findings are consistent with research by Gu et al. (2025), Singh et al. (2022), and Stavermann (2025), which shows that the use of digital technology can expand teachers' access to ongoing professional development.

In addition to focusing on improving pedagogical competencies, IGRA DIY has also begun developing teaching materials that integrate Islamic values with science education, although implementation is still in its early stages. The development of these teaching materials aims to help teachers connect natural phenomena with Islamic values so that science education not only fosters scientific thinking but also strengthens children's spiritual awareness. This integration reflects the characteristics of Raudhatul Athfal education, which views scientific knowledge and religious values as two complementary aspects of the learning process. These findings support the research results of Hill et al. (2025) and Hosic et al. (2025), which affirm that integrating spiritual values into science

education can enrich students' learning experiences without diminishing the essence of the scientific approach. Overall, the various strategies implemented by IGRA DIY demonstrate that professional organizations function not only as training providers but also as capacity-building agents that facilitate the enhancement of teachers' competencies through continuous training, professional collaboration, the use of digital technology, and the development of contextual science learning aligned with the characteristics of Islamic education.

The Impact of Inquiry-Based Science Learning Implementation

Observations before and after the program implementation showed an improvement in children's learning behavior in five indicators: enthusiasm, frequency of asking questions, curiosity, active participation, and initiative to explore. For example, the enthusiasm score increased from 2.8 to 4.6, and the frequency of asking questions increased from 2.4 to 4.2. The average increase in all indicators reached 71%.

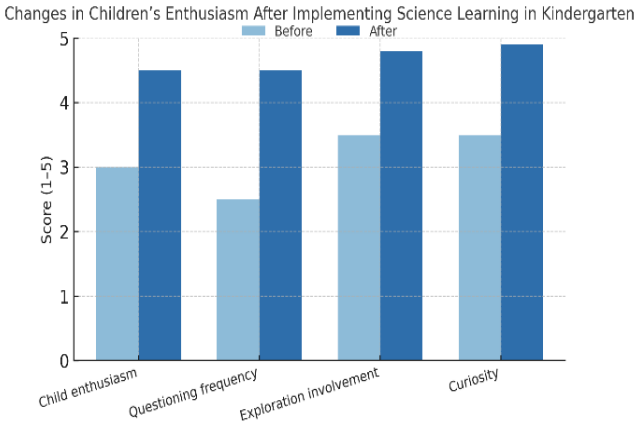

Figure 2. Changes in Children's Learning Behavior Before and After Science Learning Implementation

Teachers reported that simple science activities such as observing plant growth or color mixing experiments were easier to implement after participating in IGRA training. These findings are also consistent with research emphasizing the effectiveness of science games and experiments in increasing the interest and engagement of young children (Alotaibi, 2024; Henriksson et al., 2025; Sowmya & Rani, 2025; Training & Jambi, 2024).

4. CONCLUSION

This study examines the role of the Raudhatul Athfal Teachers Association of the Special Region of Yogyakarta (IGRA DIY) in strengthening the science literacy of early childhood teachers in the era of the Merdeka Curriculum. The results of the study show that IGRA DIY plays an important role as a professional organization that facilitates teacher competency development through continuous training, peer collaboration, and dissemination of contextual inquiry-based learning practices. Through workshops, mentoring, and reflective forums, IGRA DIY encourages teachers to integrate exploratory science approaches based on Islamic values into early childhood learning. In addition, the results of this study confirm that the integration of Islamic values in science learning in Raudhatul Athfal institutions can be carried out in harmony with scientific approaches based on curiosity and exploration. The role of IGRA DIY is not only to drive teacher professional development, but also to strengthen values- and character-oriented science education. Thus, the teacher association can serve a dual function, namely as a forum for improving professional competence and as an agent for shaping a faith- and morality-based science learning paradigm.

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literacy in their educational units. Thanks are also extended to the supervising lecturer and colleagues in the Early Childhood Education Study Program at Yogyakarta State University for their constructive input in the preparation of this article.

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