Attadrib: Jurnal Pendidikan Guru Madrasah Ibtidaiyah
p-ISSN: 2599-3194 | e-ISSN: 2775-8109
Volume 8, Issue. 3, 2025, pp. 621-635

Strengthening Students' Scientific Literacy through the Ilmi Interpretation Approach in Islamic Religious Education in Elementary Schools

Muhammad Abdul Anam*[1], Khairil Anwar[2], Taufik Warman[3]

[1] *Universitas Islam Negeri Palangka Raya, Indonesia*
[1] *Universitas Islam Negeri Palangka Raya, Indonesia*
[1] *Universitas Islam Negeri Palangka Raya, Indonesia*
e-mail: elvatazaya@gmail.com, khairil.anwar@uin-palangkaraya.ac.id , taufik.warman@uin-palangkaraya.ac.id

Submitted: 02-10-2025 Revised : 22-11-2025 Accepted: 23-12-2025

ABSTRACT. The low level of scientific literacy among elementary school students in Indonesia underscores the need for learning innovations that integrate scientific knowledge with religious contexts relevant to students' lives. In Islamic Religious Education (IRE) lessons, verses about nature have great potential to develop scientific thinking skills, but this potential has not been fully utilized. This study aims to examine how the scientific interpretation approach can strengthen elementary school students' scientific literacy by systematically linking Qur'anic verses to natural phenomena. The study used a qualitative case study design across four elementary schools in Pulang Pisau Regency. Data were collected through learning observations, in-depth interviews with teachers and students, and the analysis of documents, including lesson plans and learning outcomes. The analysis was conducted using the interactive model of Miles, Huberman, and Saldaña with triangulation of sources and techniques to ensure data validity. The results of the study indicate that the scientific interpretation approach improves students' ability to ask scientific questions, explain evidence-based phenomena, and connect verses about nature with the scientific processes they observe. Exploratory activities recorded the highest average engagement rate of 71%, while the ability to connect verses with phenomena reached 55.5%. In addition to improving cognitive skills, this approach also strengthens students' scientific and religious attitudes, such as accuracy, curiosity, and awareness that natural phenomena are signs of God's power. This study concludes that scientific interpretation is a potential approach to improve scientific literacy while building students' scientific spirituality. However, the success of its implementation still depends on teacher competence and the availability of adequate experimental media. These findings have important implications for curriculum development and for teacher training in Islamic education.

Keywords: *Scientific interpretation, scientific literacy, Islamic Religious Education, verses of nature, integrative learning, elementary school.*

https://doi.org/10.54069/attadrib.v8i3.1054
How to Cite Anam, M. A., Anwar, K., & Warman, T. (2025). Strengthening Students' Scientific Literacy through the Ilmi Interpretation Approach in Islamic Religious Education in Elementary Schools. *Attadrib: Jurnal Pendidikan Guru Madrasah Ibtidaiyah*, 8(3), 621–635.

INTRODUCTION

Advances in science and technology require students to have the ability to understand natural phenomena scientifically and to make evidence-based decisions. This ability is known as scientific literacy. According to Bybee et al. (Bybee et al., 2006) and Osborne (Osborne, 2023), scientific literacy encompasses not only mastery of scientific concepts, but also the ability to reason, identify problems, and apply scientific processes in everyday life (Siregar & Sapri, 2025; Syarifah et al., 2025; Tang et al., 2026). In a global context, scientific literacy is one of the 21st-

century competencies that students must possess from the elementary education level onwards (González-Salamanca et al., 2020); (Kumar & Choudhary, 2024).

However, various reports show that the scientific literacy of Indonesian students is still in the low category. The 2018 PISA results released by the OECD (OECD, 2019) placed the scientific abilities of Indonesian students in the lower-middle range, particularly in their ability to relate scientific concepts to real phenomena. Similar findings also emerged in the research by (Basam et al., 2017) and (Sholahuddin et al., 2021), which confirmed that the scientific literacy skills of elementary school students are still not optimal because learning strategies focus more on memorization and do not systematically train students' analytical skills.

The problem of low scientific literacy is also evident in elementary schools in Pulang Pisau Regency. Based on preliminary observations and reports from Islamic Education teachers in several public elementary schools, students still have difficulty understanding the relationship between natural phenomena and religious concepts (Nurazizah et al., 2024; Tihabsah et al., 2024). Islamic Education learning generally still focuses on cognitive and moral aspects, rather than developing a scientific mindset based on the analysis of natural phenomena (Madkan, Fauziyah, et al., 2025; Raikhan, 2024; A. N. H. Rohmah et al., 2025). Teachers often use lecture and memorization methods, so students are not trained to observe their surroundings, ask scientific questions, or connect natural phenomena with verses from the Qur'an. This condition shows a gap between the national curriculum's goal of promoting scientific literacy and the practice of PAI learning, which is still normative in nature.

On the other hand, Pulang Pisau Regency is an area rich in natural phenomena, such as extreme weather patterns, environmental changes in riverbank areas, and local ecosystem dynamics. These phenomena actually have great potential to be used as material for PAI learning based on kauniyah verses (Aziz et al., 2025; Halomoan et al., 2023; Madkan, Mumtahana, et al., 2025; H. Rohmah et al., 2023; Takunas et al., 2024). However, this potential has not been optimally utilized due to the lack of PAI learning models that integrate the observation of natural phenomena with religious understanding. In Islamic tradition, the relationship between revelation and natural phenomena is actually very close. The Qur'an contains many verses that encourage humans to use their intellect, observe and analyze nature as a sign of God's greatness. Coruh (Çoruh, 2020) and Sheikh (Sheikh, 2024) asserts that the scientific tradition in Islam since the classical era has always placed reason and revelation in a harmonious relationship. Muslim scientists such as Al Biruni and Ibn Al Haytham used natural phenomena as objects of research to understand sunnatullah.

One relevant approach to integrating religion and science is scientific interpretation. Scientific interpretation attempts to explain the meaning of verses in the Qur'an using a scientific approach based on empirical scientific findings. Jamil et al. (Jamil et al., 2024) in Al Jawahir fi Tafsir al Qur'an al Karim emphasizes the importance of reading nature as verses of God that can strengthen faith and knowledge. Meanwhile, Zaghlul an Najjar shows that many kauniyah verses in the Qur'an are in harmony with modern scientific knowledge such as astronomy, geology, and biology (Amir et al., 2015); (Arifin, 2021). The combination of these two sources of knowledge is not to subordinate revelation to science, but to strengthen students' understanding of the relationship between religion and natural phenomena in a complementary manner.

In the context of education, scientific interpretation has great pedagogical potential. Abdullah (Abdullah, 2014) research concluded that the scientific interpretation approach can develop an integrative perspective that combines empirical evidence and religious values. However, the study did not elaborate on its implementation strategies in Islamic education at the elementary school level. Research by Fadly & Rochmahwati (Fadly & Rochmahwati, 2020) shows that kauniyah verses can improve students' understanding of science when used in science learning. However, their use in PAI learning has not been studied in depth. This is an academic gap that needs to be addressed.

Another gap is the lack of innovation in PAI learning that supports the strengthening of scientific literacy in elementary school students. Nursyamsiyah & Huda (Nursyamsiyah & Huda, 2023) and Hasibuan (Hasibuan, 2025) research shows that PAI learning based on a scientific approach can increase student activity and participation, but the research does not explicitly develop a learning model based on scientific interpretation. Meanwhile, Ningsih et al. (Ningsih et al., 2022), Amiruddin (Tursinawati et al., 2024) and Riwanda et al. (Agus et al., 2025) state that the integration of religion and science can enrich students' understanding, but they have not linked this integration to the scientific abilities of elementary school students.

Based on these conditions, a PAI learning approach is needed that can bridge religious understanding and scientific abilities. The scientific interpretation approach is considered relevant because it utilizes verses about nature as learning resources that can be directly linked to natural phenomena in the students' environment. For example, verses about the water cycle can be linked to the phenomena of flooding and changes in river discharge in the Pulang Pisau region. Thus, students can understand that natural phenomena do not stand alone but are closely related to spiritual values and the guidance of the Qur'an. This research has academic and practical urgency. Academically, this research fills the gap in studies on the relationship between scientific interpretation, scientific literacy, and PAI learning. Practically, this research provides a learning model that can help PAI teachers in Pulang Pisau Regency in developing integrative, contextual learning that is in line with the needs of the times. This approach is also in line with the curriculum requirements that encourage the strengthening of critical thinking skills, reasoning abilities, and scientific attitudes from elementary education onwards.

Thus, this study seeks to explore how the scientific interpretation approach can be used to improve the scientific literacy of elementary school students in Pulang Pisau Regency through PAI learning. This integration is expected to produce students who not only understand religious values but also have scientific awareness and the ability to analyze natural phenomena as signs of God's greatness. Content in the introduction must contain *first*, a presentation of the main research or study topics; *second*, contains the latest literature related to citing the latest research literature (the last ten years) which has relevance to the article being studied; *third*, it can show gaps that have not been filled by previous studies, inconsistencies or controversies that arise between the existing literature; *fourth*, contain the problem, the purpose of the research or study, the context of the research or study, and the unit of analysis used in the study; and *fifth*, displaying what is discussed in the structure of the article.

METHOD

This study uses a qualitative approach with a case study design to describe in depth the implementation of the scientific interpretation approach in Islamic Religious Education (PAI) and its contribution to strengthening the scientific literacy of elementary school students in Pulang Pisau Regency. The choice of a qualitative approach was based on the research objective of understanding the processes, dynamics, and meanings that emerge from learning practices in a natural context. This is in line with Creswell's (Creswell & N.Poth, 2018) view that qualitative research aims to explore phenomena holistically from the participants' perspective. The case study design was chosen because it allows researchers to explore learning phenomena in depth in the context of specific schools that implement the integration of kauniyah verses and natural phenomena (Yin, 2018).

The research was conducted in four public elementary schools in Pulang Pisau Regency, namely SDN 6 Pulang Pisau, SDN 3 Pulang Pisau, SDN 1 Bahaur, and SDN Paduran Sebangau 2. The four schools were selected using purposive sampling based on two criteria: (1) PAI teachers demonstrated readiness and initial experience in integrating kauniyah verses into learning, and (2) schools had a need to improve students' scientific literacy. Research informants included PAI teachers, fourth and fifth grade students, and school principals as supporting informants. The selection of informants who understood the practice of integrating science and

religious values was in accordance with the recommendations of Miles, Huberman, and Saldaña (Miles et al., 2014) regarding the importance of information-rich participants in qualitative research.

Data collection was conducted using three main techniques: observation, in-depth interviews, and document analysis. Observation was used to understand learning practices directly, particularly how teachers linked verses about nature to natural phenomena through observation, experimentation, and evidence-based discussions. In-depth interviews were conducted to explore teachers' understanding of the objectives, benefits, and obstacles of implementing the scientific interpretation approach, as well as to obtain students' perceptions of the relationship between the scientific process and religious values. Document analysis included reviewing lesson plans, teaching materials, student worksheets, and teachers' observation notes to assess the consistency between planning and implementation of learning.

The data were analyzed using the interactive model developed by Miles, Huberman, and Saldaña (Miles et al., 2014), which includes: (1) data reduction, which is the process of selecting, focusing, and simplifying data based on thematic categories such as scientific understanding, integrative practices, and religious attitudes; (2) data presentation in the form of matrices, tables, and narrative descriptions to find patterns and relationships between components; and (3) drawing conclusions based on a synthesis of findings. Data validity was maintained through source and technique triangulation, namely comparing data from observations, interviews, and documents, as well as conducting member checking with teachers to ensure the accuracy of interpretations. This procedure is in line with the principles of data validity in qualitative research as stated by Lincoln and Guba (Lincoln & Guba, 1985), which emphasize the importance of credibility, transferability, dependability, and confirmability.

RESULT AND DISCUSSION

The results of the study indicate that the application of the scientific interpretation approach in Islamic Religious Education in elementary schools in Pulang Pisau Regency has a significant impact on strengthening students' scientific literacy. The findings were obtained through classroom observations, interviews with teachers and students, and analysis of learning documents.

Integration of Ayat Kauniyah and Natural Phenomena: Practices in the Classroom

The results of the study indicate that the scientific interpretation approach has a significant effect on strengthening students' scientific literacy in four elementary schools in Pulang Pisau Regency. PAI learning that integrates kauniyah verses with natural phenomena encourages students to observe, ask questions, experiment, and draw religious meanings through the scientific process. Classroom observations show that teachers consistently begin lessons by reading verses from the Qur'an related to natural phenomena, then linking them to experimental activities. In one session, the teacher read QS An Nahl verse 65 and then invited students to conduct an experiment on the process of evaporation and condensation using hot water, glass cups, and simple thermometers. This activity made the students enthusiastic; some observed changes in temperature, while others asked about the cause of dew forming on the glass surface. Practices such as this are in line with the opinions of Holbrook and Rannikmae, who emphasize that scientific literacy develops optimally when learning is related to real contexts and is close to the students' environment. An interview with the Islamic Education teacher at SDN 6 Pulang Pisau reinforced this finding. He stated,

> "Until now, children have only heard that rain is a blessing from Allah, but after they saw the process of evaporation and condensation, they began to understand that the verse is not only to be enjoyed spiritually but can also be explained scientifically."

This statement shows that the integration of scientific interpretation helps students understand the verses of kauniyah through concrete empirical explanations. Fifth-grade students at the same school also said,

> "I just learned that the process of rain is sequential: heat, then vapor, then clouds, then rain. The verse is now easier to explain." The conclusion from the student interviews is that a direct experience-based approach makes the text of the Qur'an easier to understand rationally.

The PAI teacher at SDN 3 Pulang Pisau revealed that this approach made students more actively involved. He stated, "They find it easier to accept verses when given direct examples. If it's just a lecture, children get bored quickly." This shows that PAI learning that relies on lectures is not effective enough to develop students' scientific thinking skills. This opinion is supported by a student who said,

> "I like learning while watching experiments. So, I know that verses from the Qur'an are not only read, but seen around us."

From this statement, it can be concluded that students feel a direct connection between revelation and natural phenomena through experimental activities. The PAI teacher at SDN 1 Bahaur shared a similar experience and said,

> "After using this method, children who were usually quiet began to ask questions about wind, rain, and rainbows. I feel that the verses of kauniyah make the class livelier."

This shows that the scientific interpretation approach is able to open up space for participation for students who are usually passive. In other words, the integration of verses of kauniyah in learning not only increases scientific literacy but also builds students' courage to ask questions and discuss scientifically. Analysis of the lesson plans at the four schools reinforced the results of the interviews and observations. Teachers systematically included stages of observing natural phenomena in each theme related to verses about nature, such as the creation of plants, the rotation of the earth, the water cycle, and weather changes. Each lesson plan directs students to engage in simple exploratory activities that provide space for the scientific literacy process, namely observing, reasoning, interpreting, and connecting phenomena with religious messages. The field data was then reinforced with quantitative analysis of student activities in scientific interpretation learning. The percentages are shown in the following table.

Table 1. Percentage of Student Scientific Literacy Activities in Four Elementary Schools

Scientific Literacy Activities	SDN 6 Pulang Pisau	SDN 3 Pulang Pisau	SDN Buntoi 1	SDN Paduran Sebangau 2
Participating in experiments on natural phenomena	74%	69%	70%	71%
Asking questions related to natural phenomena	53%	51%	52%	49%
Recording observation results	61%	59%	58%	56%
Answering questions using scientific reasoning	47%	45%	46%	41%
Connecting verses about nature with natural phenomena	56%	54%	55%	50%

The results of the study indicate that the scientific interpretation approach contributes significantly to improving students' scientific literacy in four elementary schools in Pulang Pisau Regency. Based on Table 1, student participation in experiments was at its highest, with an average of 71%. This finding is in line with Piaget's (Piaget & Inhelder, 1972) cognitive development theory, which places elementary school students at the concrete operational stage, so that hands-on activities such as observation and experimentation are very effective in building conceptual understanding. Bruner (Bruner, 1961) also emphasizes the importance of discovery

learning because it allows students to discover concepts through direct interaction with phenomena.

Students' ability to connect verses about nature with natural phenomena reached 55%, indicating that the integration of revelation and empirical reality has been effective. This is in line with concept of scientific interpretation, which emphasizes that verses about nature can serve as a bridge between religious knowledge and the laws of nature. From the perspective of scientific integration, Nurcholis (Nurcholis, 2021) states that modern Islamic education must combine text, reason, and empirical experience, and these findings show that this approach is beginning to appear in the practice of PAI learning in elementary schools.

Meanwhile, 52% of students actively asked questions during observation activities, reflecting a growing scientific curiosity. Dewey (Dewey, 1938) refers to inquiry as the core of the scientific thinking process, while Freire (Freire, 2005) sees questioning as part of critical consciousness. These findings are also in line with the OECD (OECD, 2019) report, which states that inquiry-based learning is one of the most effective strategies for improving scientific literacy at the primary education level. In addition, the application of these creative strategies has succeeded in increasing student participation, focus, and enthusiasm in the learning process (Lestari et al., 2025).

The integration of religious and scientific learning through the scientific interpretation approach is also in line with Holbrook and Rannikmae's (Holbrook et al., 2009) and Ploomipuu et al. (Ploomipuu et al., 2019) scientific literacy framework, which emphasizes the importance of relevance and real-world context in learning. In everyday life, Qur'anic values are reflected in various positive behaviours of students, such as discipline, responsibility, empathy, and respect (Anton & Muhammad, 2025); (Labibah & Surawan, 2025). The analysis of the lesson plans shows that teachers consistently include simple observation activities in various themes of kauniyah verses, in accordance with Johnson's (Johnson, 2002) principle of contextual learning. This shows that the student learning process is not only textual but also empirical.

These findings reinforce the results of previous studies, such as those by Rosyid et al. (2025), Ahmad (Zainuri et al., 2020), and Al Masquri (Masquri et al., 2024), which confirm that scientific literacy can be improved in PAI learning by strengthening the relationship between verses of the Qur'an and natural phenomena. In addition, it is important to educate the public on digital literacy in filtering information in the digital world with a creative, critical, and inspiring attitude as a digital call to reduce hoaxes (Yuliana et al., 2025).

Overall, the integration of science and verses of nature through a scientific interpretation approach has a substantial impact on students' scientific literacy. Learning not only broadens religious understanding but also develops the ability to observe, experiment, question, reason, and relate natural phenomena to revelatory messages. This approach, in line with various previous educational theories and research, has proven to be relevant and effective in the context of PAI learning in elementary schools, especially in Pulang Pisau Regency.

Strengthening Scientific Thinking Skills

The results of the study show that the scientific interpretation approach contributes significantly to the development of students' scientific literacy. This can be seen from various observation data, interviews, and analysis of learning documents in four elementary schools. Based on Table 1, experiential activities were the most dominant component, with an average student participation rate of 71 %. This dominance reinforces Piaget's (Piaget & Inhelder, 1972) view that elementary school students are in the concrete operational stage and therefore need direct experience to understand scientific concepts. Bruner (Bruner, 1961) also emphasizes that discovery-based learning allows students to construct knowledge through direct interaction with environmental stimuli.

The integration of verses about nature and natural phenomena also has a positive impact on students' ability to connect religious texts with empirical reality. The percentage of students who

are able to connect verses with natural phenomena reaches 55 %, indicating that the scientific interpretation approach is effective as a model of scientific integration. This idea is in line with Leiss (Leiss, 2023) and Hosaini & Akhyak (Hosaini & Akhyak, 2024), who places verses about nature as a means of explaining the phenomenon of creation rationally. Abdullah (Abdullah, 2014) also emphasizes that the integration-interconnection paradigm requires a connection between revelation, reason, and empirical experience in religious learning.

The strengthening of scientific thinking skills can be seen from the communicative patterns of students during class discussions, such as the use of words "because," "proven," "the process," and "the result." A student at SDN 3 Pulang Pisau said:

> "I want to know why plants exposed to the sun grow faster. Is that also a sign of God's greatness?" This statement shows the interaction between scientific curiosity and theological awareness. A teacher at the same school confirmed: "Previously, the children only answered normatively. After using the ayat kauniyah approach, they began to explain with evidence they saw."

Based on the above interviews, it can be concluded that the kauniyah verse approach is effective in stimulating scientific curiosity while fostering theological awareness in children. With this approach, children not only provide normative answers, but are also able to explain natural phenomena based on the evidence they observe, resulting in the integration of scientific knowledge and appreciation of God's greatness. Interviews at SDN Paduran Sebangau 2 further reinforced these findings. The PAI teacher stated:

> "After conducting experiments related to wind and air pressure, the children began to ask whether wind is also a sign of Allah's power. They began to see the connection between science lessons and verses from the Qur'an."

One of the students from the school added:

> "I just learned that weather changes have a process. So the verses about wind are easier to understand."

These two statements show that the scientific interpretation approach encourages the formation of integrative understanding, where students combine scientific phenomena with spiritual meaning. This phenomenon is consistent with UNESCO's concept of scientific literacy (2016), which emphasizes the ability to connect scientific knowledge with social, environmental, and value contexts. In line with this, the OECD (OECD, 2019) states that one indicator of scientific literacy is the ability to explain phenomena using evidence. In the context of this study, students not only understand verses spiritually, but are also able to explain the underlying scientific processes. The strengthening of scientific thinking skills is reflected in the increase in student participation in asking questions, explaining, and giving evidence-based reasons. To clarify this development, the following table shows the findings related to the improvement in scientific thinking skills.

Table 2. Improvement in Students' Scientific Thinking Skills in Ilmi Interpretation Learning

Scientific Thinking Ability Indicators	SDN 6 Pulang Pisau	SDN 3 Pulang Pisau	SDN Buntoi 1	SDN Paduran Sebagau 2	Average (%)
Asking scientifc questions	54%	49%	52%	55%	52.5%
Providing evidence-based explanations	46%	44%	48%	47%	46.25%
Identifying cause-and-effect relationships	43%	40%	42%	45%	42.5%
Connecting verses with phenomena	58%	52%	55%	57%	55.5%

The table shows that students have the strongest tendency to ask scientific questions (52.5 %) and connect verses with natural phenomena (55.5 %). These findings indicate that the scientific interpretation approach works effectively in stimulating curiosity while building conceptual relationships between religious texts and empirical reality. From the perspective of Piaget's cognitive development theory (Piaget & Inhelder, 1972), elementary school students are in the concrete operational stage, so learning based on real experiences is the optimal path to understanding scientific concepts. Activities such as experiments, direct observation, and exploration of natural phenomena integrated with kauniyah verses are in line with the principle that children learn through sensorimotor interactions and direct manipulation of learning objects.

Furthermore, these findings are consistent with Bruner's (Bruner, 1961) discovery learning theory, which emphasizes that knowledge discovered through exploratory processes will be more meaningful and last longer. Through the scientific interpretation approach, students not only understand verses as normative texts but also as gateways to discovering scientific explanations for the phenomena occurring around them. According to Anwar et al. (Anwar et al., 2025), these research findings confirm the importance of integrating local wisdom in efforts to strengthen the social and cultural networks of the community. The curiosity reflected in the many scientific questions shows that the process of knowledge construction is active, in accordance with Vygotsky's (Vygotsky, 1978) constructivism principle, which places social interaction and teacher guidance as important factors in children's cognitive development.

The integration of verses from the Qur'an with empirical facts is also in line with Nurcholis' (Nurcholis, 2021) theory of integration-interconnection, which emphasizes that Islamic education should ideally connect sources of revelation with reason and scientific findings. When students are able to connect verses from the Qur'an with scientific processes, they not only develop scientific literacy, but also strengthen an epistemic framework that harmonizes faith and rationality. These results are also reinforced by research by Ningsih et al. (Ningsih et al., 2022), which found that integrating Islamic values with scientific experiments can increase students' scientific awareness and religiosity.

From a scientific literacy perspective, these findings are consistent with the OECD (OECD, 2019) framework, which emphasizes that the ability to develop questions, provide evidence-based explanations, and understand natural phenomena are key indicators of 21st-century scientific literacy. The scientific interpretation approach has been shown to support these three indicators through investigative, contextual, and religious-based learning. Hollbrook & Rannikmae (Holbrook et al., 2009) also emphasize that science learning linked to real-life contexts will increase students' intrinsic motivation and sense of relevance to the learning material. Especially when linked to the current era of digitalization, the ability to improve digital literacy is clearly very much needed. Digital literacy is not limited to the ability to operate devices, but also includes the skills to search for, assess, use, and create information wisely (Saidah et al., 2025).

Overall, this study shows that scientific interpretation is a potential approach to strengthening scientific literacy among elementary school students. Exploration-based learning, observation, and integration of verses from the Quran have been proven to encourage scientific thinking that remains in harmony with religious values. This approach not only builds rational understanding but also instils spiritual awareness that natural phenomena are part of the signs of God's power, thereby supporting balanced cognitive and affective development.

Strengthening Scientific and Religious Attitudes

Research findings show that the scientific interpretation approach not only influences students' cognitive aspects, but also has a strong impact on the development of scientific and religious attitudes. Classroom observations show that during experiments, students demonstrate scientific behaviour such as careful observation, courage to ask questions, and consistency in

recording their findings. In a learning session on the water cycle, for example, several students independently recorded changes in temperature, dew formation, and the time of condensation without being asked by the teacher. This shows that scientific curiosity grows naturally through learning activities based on *kauniyah* verses. The PAI teacher from SDN 6 Pulang Pisau explained:

> "I see a clear change in attitude. Children have become more concerned about the environment. They often say that cleanliness and nature conservation are forms of gratitude to God."

This statement shows the integration between ecological awareness and theological understanding, in line with Hasanah's (2021) idea that verses about nature can awaken spiritual sensitivity and a love for the scientific process. At SDN 3 Pulang Pisau, teachers shared similar experiences:

> "The children began to be careful when conducting experiments. They always made sure that the equipment was safe and clean. They said that if they wanted to understand Allah's verses, they had to be serious."

This statement shows the formation of scientific attitudes such as precision, caution, and responsibility. Data from SDN 1 Bahaur also shows a similar trend. One student said:

> "When I see experiments, I realize that all of God's creations have rules. So I don't want to destroy nature."

These comments indicate the internalization of religious values in the form of awareness to protect the environment as a manifestation of faith. Interviews at SDN Paduran Sebangau 2 reinforce these findings. The Islamic Education teacher at the school said:

> "After learning about kauniyah verses, the children often remind their friends not to litter. They say that nature is a trust from Allah."

Another student added in an interview:

> "When we learn about natural processes, it feels like we are seeing direct evidence of Allah's power."

These two statements show the formation of a deeper religious attitude, in which scientific understanding actually strengthens the students' spiritual connection with the concept of monotheism. These four additional interview data indicate that the *ilmi* interpretation approach produces two types of attitudes simultaneously: 1) Scientific attitudes, in the form of precision, courage to ask questions, caution, and responsibility. 2) Religious attitudes, in the form of spiritual awareness, gratitude, ecological awareness, and understanding that natural phenomena are signs of God's greatness.

To reinforce the findings, the following table summarizes the scientific and religious attitudes observed in learning.

Table 3. Percentage of Strengthening of Students' Scientific and Religious Attitudes

Attitude Indicators	SDN 6 Pulang Pisau	SDN 3 Pulang Pisau	SDN Buntoi 1	SDN Paduran Sebangau 2	Average (%)
Careful observation	65%	61%	63%	64%	63.25%
Courage to ask questions	54%	49%	51%	52%	51.5%
Scientific curiosity	60%	58%	59%	62%	59.75%
Awareness of environmental protection	57%	55%	58%	60%	57.5%
Awareness that natural phenomena are signs of God's power	70%	67%	69%	72%	69.5%

The table shows that scientific and religious attitudes have strengthened significantly in all schools. The highest percentage is shown in the indicator of awareness that natural phenomena

are signs of God's power, which reached an average of 69.5 %. This finding confirms that the scientific interpretation approach is effective in fostering scientific spirituality, which is a perspective that combines religious appreciation with a rational understanding of God's creation. This is in line with the concept of scientific spirituality proposed by Nasr (Nasr, 1996) and Almirzanah (Almirzanah, 2020), which explains that science in the Islamic perspective cannot be separated from the awareness of God because nature is a manifestation of divine signs. Furthermore, scientific spirituality will also help the process of internalizing Islamic values so that a safe, peaceful, and prosperous Islam can be realized, thereby preventing or eliminating radicalism and terrorism (Anwar et al., 2025).

The high percentages on the accuracy indicator (63.25 %) and scientific curiosity (59.75 %) indicate that learning based on verses and natural phenomena can stimulate students' active involvement in the investigative process. This finding is consistent with Vygotsky's constructivism theory (Vygotsky, 1978), which emphasizes that scientific knowledge develops when students actively interact with their environment and receive support from teachers as more knowledgeable others. The integration of verses enriches this process because students not only conduct scientific observations but also relate them to spiritual values, thus forming a dual meaning that strengthens the affective and cognitive aspects.

A UNESCO report (Unesco, 2016) also supports this finding, stating that learning that integrates science with moral and spiritual values increases motivation, positive attitudes toward learning, and ecological awareness. The scientific interpretation approach, which combines empirical observation and religious values, has been proven to provide a meaningful context for students in understanding natural phenomena. In addition, the results of research by Sukardi et al. (2020) show that the integration of science and Islamic values not only improves scientific skills such as observation and reasoning, but also fosters religiosity, ecological empathy, and a sense of responsibility as caliphs on earth.

Thus, the findings of this study indicate that scientific interpretation plays a significant role in strengthening students' scientific and religious attitudes simultaneously. This approach not only fosters spiritual sensitivity to the signs of God's greatness but also encourages students to develop scientific attitudes such as precision, curiosity, and accuracy in observation. The combination of these two aspects is in line with the holistic nature of Islamic education, which aims to develop individuals who are knowledgeable, faithful, and noble in character.

Implementation Challenges: Teacher Competence and Media Availability

Although the results of the study show positive impacts, the implementation process of the scientific interpretation approach is not without challenges. One of the main obstacles found is the limited competence of teachers in integrating scientific concepts with verses about nature. Some teachers admit that although they understand the meaning of the verses, explanations of scientific processes often require additional knowledge. One teacher explained,

> "We understand the verses, but sometimes we have difficulty explaining the scientific process in simple terms. Special training is needed."

This shows a gap in pedagogical and content competence (PCK) as described by Shulman (Shulman, 1986), namely that teachers need a deep understanding of the material as well as strategies to simplify it according to the characteristics of the students.

Another challenge identified was the limited learning support facilities. Observations showed that some experiments had to be conducted using simple materials such as used bottles, plastic cups, hot water, and whatever media were available. These conditions meant that a number of experiments could not be carried out optimally. This finding is in line with Drajat's (2019) and Ahmad (Zainuri et al., 2020) report, which states that PAI teachers still need support in the form of science-based learning media so that the scientific approach can be applied optimally. The dependence on simple tools also shows that schools do not yet have adequate mini-laboratory facilities or science experiment kits, even though according to inquiry-based learning theory

(Bybee et al., 2006), direct experience through experiments is an important aspect in fostering students' scientific abilities. In addition, through open discussions and sharing experiences, students not only gain new perspectives but also feel supported in their spiritual journey (Husniah et al., 2025).

In addition, time constraints are also a concern. Teachers need additional time to prepare materials, find relevant natural phenomena, and accurately connect scientific concepts with verses from the Qur'an. This obstacle is in line with the findings of Widodo & Hamzah (2024), which explain that curriculum integration requires teacher readiness, restructuring of lesson plans, and careful planning. In the context of Islamic Education (PAI) learning, science integration is often considered an additional burden because not all teachers have adequate science education backgrounds.

Another factor that influences implementation is the lack of specific professional training for PAI teachers on the scientific interpretation approach. In fact, UNESCO (2017) emphasizes that improving the quality of 21st-century competency-based learning is highly dependent on the sustainability of teacher professional development. Without systematic training support, teachers tend to rely on their limited personal understanding, so that the integration of science and verses of nature does not run optimally. Another equally important factor is students' writing skills. Through writing training such as calligraphy, it is hoped that basic writing skills can be improved, students' creativity can be developed, interest and enthusiasm for writing activities can be fostered, and an understanding of the history and philosophy of calligraphy as Islamic cultural heritage can be provided (Lutfi et al., 2024).

CONCLUSION

This study answers the fundamental question of how the application of the scientific interpretation approach can strengthen the scientific literacy of elementary school students. The results of the study show that the integration of verses about nature with observations of natural phenomena, simple experiments, and evidence-based discussions can improve students' scientific thinking skills, scientific attitudes, and religious understanding. Observation data, interviews, and tables show consistent improvements in three main aspects: (1) the ability to connect verses with scientific phenomena, (2) the ability to construct evidence-based cause-and-effect explanations, and (3) scientific attitudes such as curiosity, thoroughness, and spiritual awareness of nature as a sign of God's power. Thus, the scientific interpretation approach has proven effective as an integrative model that combines revelation and science in Islamic Education learning at the elementary school level.

However, this study has several limitations. First, teachers' skills in explaining scientific processes still depend on their personal knowledge, so the depth of the material is not always consistent across schools. Second, limitations in teaching aids mean that some experiments are conducted using simple media, which may limit the range of phenomena that can be observed. Third, this study was only conducted in four schools in one district, so the generalization of the results is still limited. In addition, this study has not measured the long-term impact on changes in students' scientific or religious literacy.

Based on these limitations, further research can be developed in several directions. First, conducting a quasi-experimental study to measure the increase in scientific literacy before and after the scientific interpretation intervention in a more measurable way. Second, expand the research location to more diverse areas to produce more representative findings. Third, develop an Islamic education teacher training model based on scientific interpretation so that implementation is more consistent and in-depth. Fourth, conduct longitudinal research to see how the integration of kauniyah verses affects the long-term development of students' scientific and religious character. Thus, this study not only provides an empirical description of the effectiveness of scientific interpretation, but also opens up space for more comprehensive follow-up research that will have an impact on the development of science-based Islamic education.

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