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Science literacy through the Tadabbur Alam approach: Exploring Qur'anic values in nature-based elementary schools

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Abstract
This article discusses the integration of science literacy and the Tadabbur Alam (nature contemplation) approach at Sekolah Dasar Alam Ungaran (SAUNG), aiming to explore educational values contained in the Qur'an through science literacy. Science literacy is deemed essential in preparing students for global challenges and provides a foundation for understanding scientific phenomena. This explanatory qualitative study employed observation, interviews, and document analysis, analyzed using NVivo software. The findings suggest that science literacy can be understood through three interrelated aspects: context, content, and process, which collectively enhance students' comprehension of environmental issues and their responsibilities as khalīfah on earth. In the context aspect, students are encouraged to apply scientific knowledge in daily life and engage with environmental issues. The content aspect includes understanding scientific phenomena linked with moral and ethical values derived from the Qur'an. Meanwhile, the process aspect fosters critical thinking and reflection, where students are guided to contemplate creation and observe nature firsthand. Therefore, integrating science literacy and Tadabbur Alam is expected to nurture environmentally responsible character while internalizing Qur'anic values in daily life. The relevance of science literacy in the context of Qur'anic contemplation is reinforced through contemporary interpretations of Surah al-An'ām (6:38) in Tafsīr al-Munīr and al-Miṣbāḥ, which highlight ecological interdependence and human responsibility as khalīfah, as well as Surah al-Baqarah (2:164), which invites reflection upon natural phenomena as signs of Allah's greatness.

Keywords: science literacy; tadabbur alam; Qur'an; nature-based school

Introduction

Scientific literacy is a highly essential skill in education, particularly in today's era of globalization. It provides a crucial foundation for students to comprehend scientific issues in depth. According to the Organisation for Economic Co-operation and Development (OECD), scientific literacy refers to an individual's ability to actively engage with and understand scientific information to make informed decisions (Pratiwi et al., 2019). This literacy extends beyond the academic environment and plays a significant role in daily life, including understanding natural phenomena, addressing environmental challenges, and utilizing technology effectively (Fuadi et al., 2020).

Therefore, strengthening scientific literacy at the elementary level is critical as it serves as the foundational stage of education. Students' science literacy capabilities are closely related to the outcomes of the Computer-Based National Assessment (*Asesmen Nasional Berbasis Komputer*, ANBK), which evaluates the extent to which students have mastered relevant skills in the context of Indonesian education.

ANBK is an evaluation program organized by the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) to map the quality of primary and secondary education systems in Indonesia. It aims to measure students' proficiency in reading literacy, numeracy, and character through the Minimum Competency Assessment (*Asesmen Kompetensi Minimum*, AKM), which serves as the main tool for assessing literacy and numeracy. The AKM results are analyzed to track educational development and are presented in the national education report. Based on the 2024 education report, the average AKM literacy score for elementary schools is 62.67%, with public schools scoring 70.62%, Ministry of Religious Affairs schools scoring 56.93%, and equality-based elementary schools scoring 60.46% (Kemdikbudristek, 2024). Although ANBK does not directly assess scientific literacy, reading literacy and numeracy are fundamental components that support the development of scientific literacy (Dewida et al., 2023). The suboptimal achievement in literacy reflects challenges in fostering students' critical thinking skills, which are also crucial for scientific literacy.

Scientific literacy plays a vital role in preparing the younger generation to face global challenges such as climate change and health issues. This need is further illustrated by results from the Trends in International Mathematics and Science Study (TIMSS), conducted every four years by the International Association for the Evaluation of Educational Achievement (IEA), which measures the mathematics and science competencies of students aged 9–10 (Grade 4) and 13–14 (Grade 8). According to TIMSS 2015 data (IEA, 2015), Indonesian students had an average science score of 397, as shown in Figure 1, significantly below the international average of 500 and far behind countries such as Singapore, South Korea, and Japan. These results highlight the serious challenges Indonesia faces in improving students' scientific literacy, and underscore the need to enhance the quality of science education so that students can better understand and apply scientific concepts in their daily lives.

Figure 1 . TIMSS 2015 Results

Scientific literacy is especially relevant in the context of nature-based elementary schools, which integrate environmental elements as an essential part of the learning process (Savika et al., 2024). Previous studies support the effectiveness of nature-based learning approaches. For example, the Nature School of Muara Bungo successfully developed students' science literacy and character through the *Belajar Bersama Alam* (BBA) method, which facilitates direct interaction with nature (Rahmi et al., 2021). Research by Johar Alimuddin and Eli Istingayatun Yatmi found that activities such as *outing*and *live-in* programs at Sekolah Alam Lukulo Kebumen successfully fulfilled the components of contextual learning, contributing to students' science literacy (Ummah, 2019). A collaborative study at a nature-based elementary school in Palembang also reported that implementing Contextual Teaching and Learning (CTL) improved science learning outcomes, although its effect on scientific attitudes was less pronounced (Suryawati & Osman, 2018). Furthermore, Christopher Speldewinde emphasized that nature-based education programs, such as forest schools in Australia, significantly support the development of scientific literacy through direct experiential learning (Speldewinde, 2024). Mira Purnamasari Safar's study highlighted how nature school curricula foster both character development and scientific literacy through daily life–integrated learning activities (Safar, 2016).

Education in nature-based elementary schools focuses on the concept of *Tadabbur Alam*, which encourages students to contemplate the creations of Allah SWT through direct observation of their surroundings. This approach not only enriches students' scientific understanding but also connects their learning experiences to the values contained in the Qur'an. The Qur'an includes many verses that promote literacy and deep thinking, encouraging the pursuit of knowledge through reading, analyzing, and critiquing (Jayana, 2021). In this context, numerous Qur'anic references serve as foundations, especially those that stress the importance of reflecting on Allah's creations and humanity's responsibility as stewards (*khalīfah*) of the earth (Sari et al., 2021). This study seeks to explore how integrating science literacy and *Tadabbur Alam*in elementary education can shape students who are not only academically competent but also environmentally and spiritually conscious. Its novelty lies in combining science literacy with the *Tadabbur Alam* approach based on Qur'anic teachings—a topic that remains underexplored in prior research.

The research employed a case study model within a qualitative explanatory framework, including direct observation of teaching activities at SAUNG, interviews with teachers and students, and analysis of relevant documents. NVivo software was used to analyze data collected from observations and interviews (Miles & Huberman, 2014). The analysis revealed significant patterns connecting Qur'anic values with scientific concepts, emphasizing how context and learning processes can strengthen students' understanding of the relationship between science and spirituality. This study hypothesizes that integrating science literacy with a *Tadabbur Alam* approach enhances students' scientific understanding while reinforcing their spiritual and moral values. Consequently, this research is expected to contribute meaningfully to improving the quality of education in Indonesia.

Discussion and Analysis

The NVivo analysis revealed that science literacy through the *Tadabbur Alam* approach at the elementary level can be understood through three core aspects:

context, content, and process. In the context aspect, students are encouraged to apply scientific knowledge in their everyday lives, including understanding environmental issues and their responsibilities as *khalīfah* on earth, in accordance with the teachings of the Qur'an. The content aspect emphasizes comprehension of scientific phenomena—such as life cycles and ecosystems—while linking them with spiritual values in Islam, such as reverence for Allah's creations and the importance of maintaining ecological balance. The process aspect engages students in critical thinking and reflection, encouraging them to contemplate Allah's creations and directly observe natural phenomena. Together, these three components form a comprehensive framework for understanding and applying science literacy in real life (Utami et al., 2022).

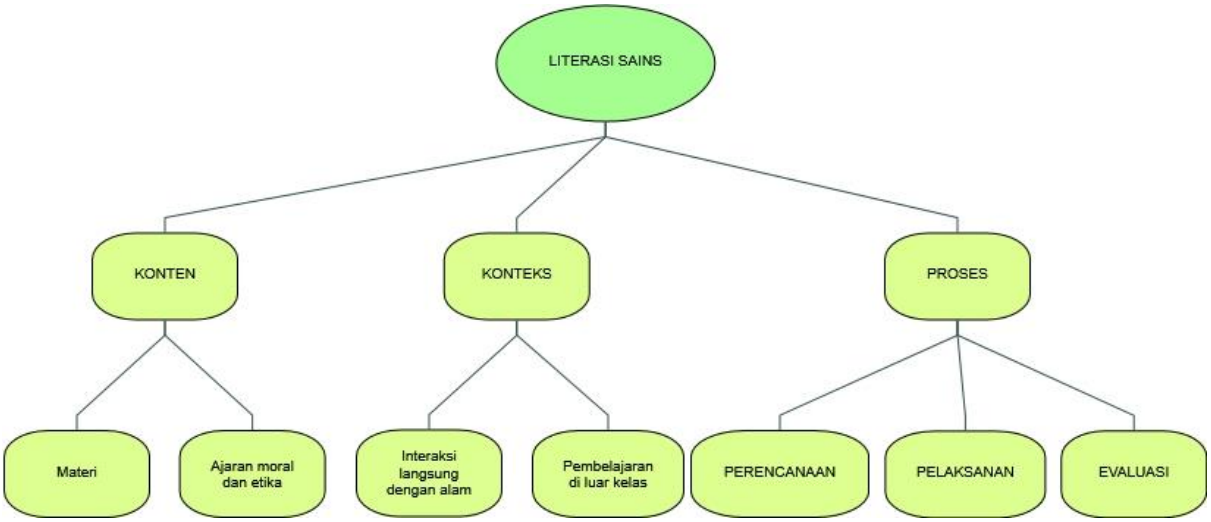

Figure 2 Mind Mapping of Science Literacy Aspects

This diagram illustrates the components of science literacy, presented as a tree with "science literacy" as its root. The three main branches are content, context, and process (Dewantari & Singgih, 2020). The content branch includes two sub-branches: scientific material and moral-ethical teachings. The context branch comprises direct interaction with nature and outdoor learning. The process branch includes four sub-branches: planning, implementation, and evaluation. Below is a more detailed explanation:

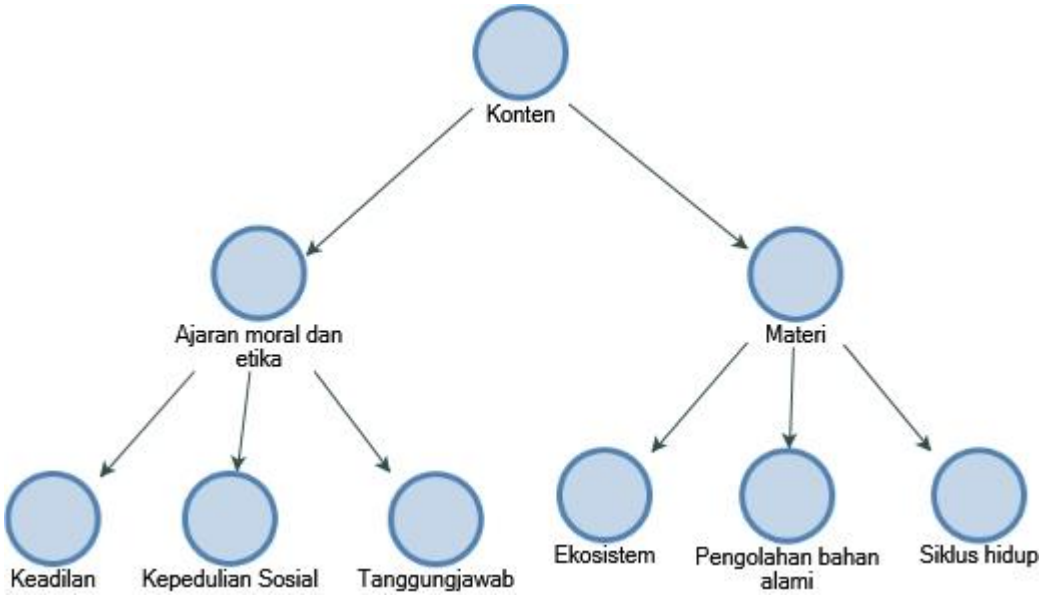

Figure 3 NVivo Coding Result: Content

Science literacy content integrates scientific concepts with spiritual values from the Qur'an. The study of life cycles, for example, introduces students to developmental stages in living organisms, prompting them to reflect upon Allah's creations (Rahmah et al., 2025) and appreciate the connection between science and spirituality, as reflected in Surah al-An'ām (6:38), which states that every living creature has its own path. In ecosystem lessons, students explore interdependent life systems, leading them to realize the importance of ecological preservation, echoing Surah al-Baqarah (2:164), which calls for contemplation of Allah's signs in nature.

Moreover, learning about the processing of natural materials offers insights into sustainable resource use, aligning with Islamic teachings that emphasize environmental stewardship and human accountability (Mursalin et al., 2024). Through this approach, students gain scientific knowledge while also cultivating environmentally conscious behavior and strong spiritual awareness. Following this, the context aspect is further elaborated.

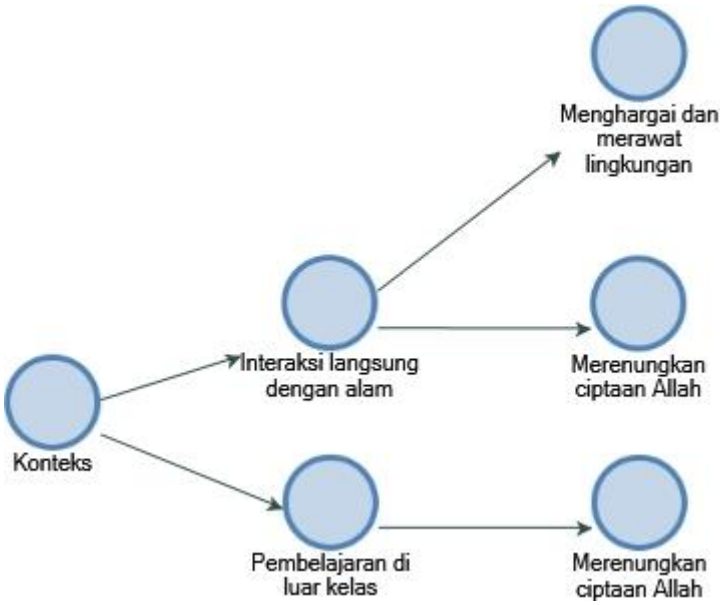

Figure 4 NVivo Coding Result: Context

Science literacy in contextual learning, particularly through outdoor education, provides students with direct experience in observing natural phenomena, enabling deeper understanding of scientific concepts. As illustrated in Figure 4, this hands-on learning is complemented by reflections on Allah's creations during environmental exploration. For instance, while studying ecosystems and life cycles, students are encouraged to reflect upon the greatness of Allah's creations and the interactions among living organisms. Islamic teachings emphasize the role of nature as a trust (amānah) from Allah, guiding students to respect and care for the environment (Hamdani, 2024). This approach helps science literacy foster both cognitive and affective domains, shaping students who are environmentally responsible and spiritually aware, in accordance with the messages of Surah al-An'ām (6:38) and Surah al-Baqarah (2:164).

Beyond content and context, science literacy at SAUNG also involves a well-integrated learning process where students engage directly with the surrounding environment through observation and hands-on activities that support their comprehension of scientific concepts. The process also involves collaboration between teachers and students and leverages natural resources as effective learning media. This approach ensures that students acquire both theoretical knowledge and practical skills while developing environmental awareness and responsible attitudes (Safar, 2016). The NVivo coding for the process aspect is presented as follows:

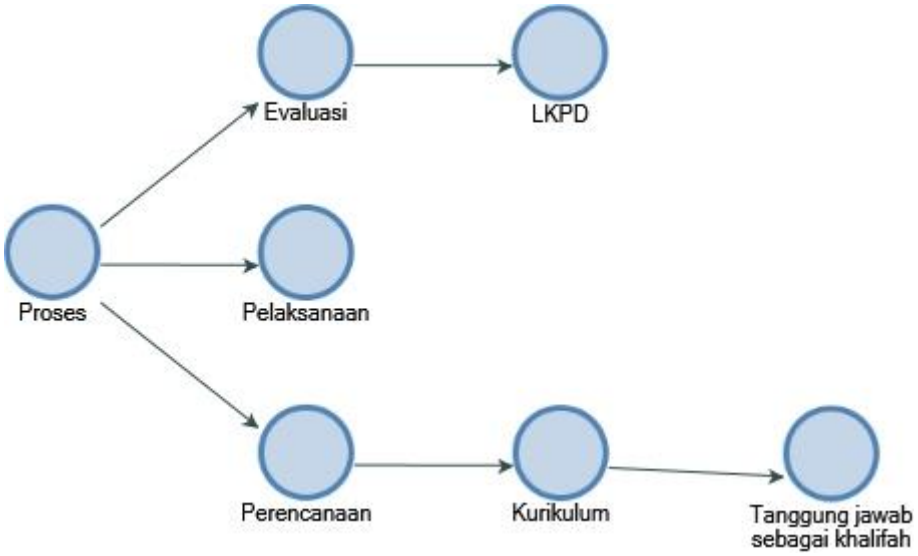

Figure 5 NVivo Coding Result: Process

The branching diagram for science education at Sekolah Dasar Alam Ungaran (SAUNG) includes three major stages: planning, implementation, and evaluation. During the planning phase, the curriculum is designed to reflect students' roles as khalīfah on earth, integrating moral values and environmental awareness into learning materials (Tamedia, 2023). The BBA (Belajar Bersama Alam) and lesson plan (RPP) structures promote reflection on Allah's creations. Islamic values such as stewardship and accountability are incorporated across themes, emphasizing the moral and ethical dimensions of education.

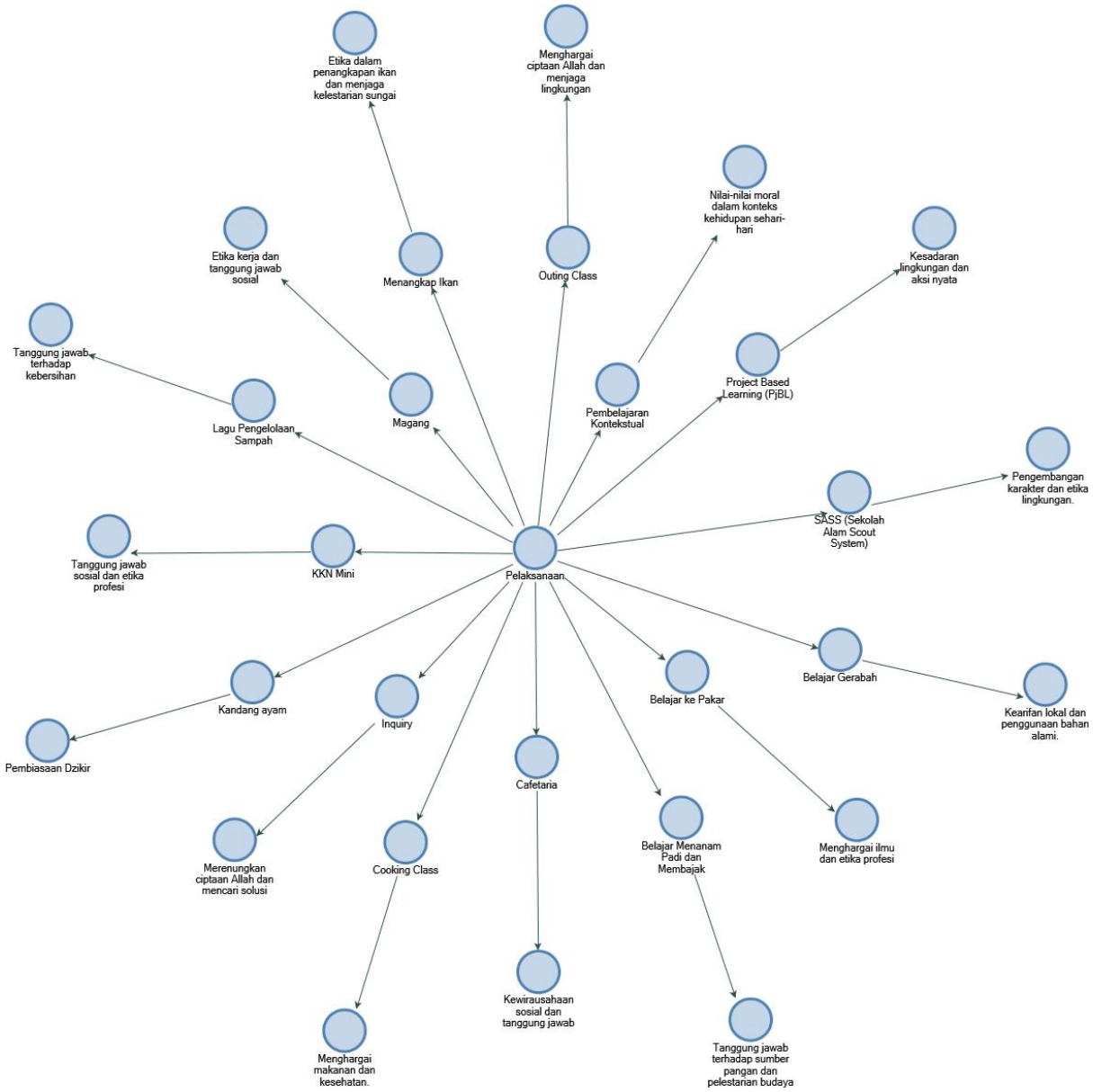

Figure 6 NVivo Coding Result: Implementation Details

The implementation phase at SAUNG includes a variety of interrelated aspects, such as ethical fishing practices and river preservation, where students are taught to respect and care for Allah's creations. Ethical work values and social responsibility are fostered through activities like waste management songs and mini community service (KKN Mini), encouraging students to actively contribute to environmental cleanliness. Spiritual responsibility is instilled through habitual remembrance (dhikr). Students also participate in projects like poultry farming, which teaches professional ethics and social responsibility. Inquiry-based learning and cooking classes encourage students to reflect on creation while exploring solutions to real-world problems and understanding the importance of health and gratitude through school cafeteria activities. Social entrepreneurship and responsibility are embedded in outing classes that convey moral values in daily life (Prince, 2019). The integration of Project-Based Learning (PjBL) and the Sekolah Alam Scout System (SASS) equips students with practical skills such as pottery, rice planting, and plowing, fostering both scientific inquiry and professional ethics. Environmental consciousness and tangible actions are instilled through

sustainable food practices and cultural preservation, while character and environmental ethics are nurtured through local wisdom and the use of natural materials, fostering a generation that is mindful and responsible toward their environment and community.

Each activity encourages students to reflect on their use of natural resources and appreciate Allah's creations, while actively participating in conservation efforts. For instance, in lessons on plant life cycles and paddy field ecosystems, students learn about their roles in sustainable food systems and cultural preservation (Suryawati & Osman, 2018). In the evaluation phase, students document the life cycle of chickens and their role in ecosystems, which fosters direct reflection on Allah's creations. This process evaluates not only scientific comprehension but also builds students' environmental and spiritual awareness, aligning with Islamic teachings on stewardship and care for creation.

SAUNG employs student worksheets (Lembar Kerja Peserta Didik, LKPD) tailored to each lesson's context and objectives. These worksheets emphasize both academic and Islamic values, reinforcing the importance of safeguarding Allah's creation (Zamri et al., 2024). In every activity, students are invited to conduct tadabbur alam—reflecting on the beauty and harmony of creation—while recognizing their roles as khalīfah of the earth (Hadziq, 2016). For example, during lessons on river ecosystems, the LKPD includes questions prompting students to critically consider the impact of human activity on the environment and how they can contribute to its preservation. Thus, evaluation goes beyond knowledge assessment and becomes a tool for shaping students' character and environmental awareness in accordance with Islamic principles of gratitude and stewardship.

Qur'anic Interpretation on Science Literacy through the *Tadabbur Alam* Approach

Surah al-Anʿām [6]: 38

وَمَا مِنْ دَابَّةٍ فِي ٱلْأَرْضِ وَلَا طَٰٓئِرٍ يَطِيرُ بِجَنَاحَيْهِ إِلَّآ أُمَمٌ أَمْثَالُكُم ۚ مَّا فَرَّطْنَا فِى ٱلْكِتَٰبِ مِن شَىْءٍ ۚ ثُمَّ إِلَىٰ رَبِّهِمْ يُحْشَرُونَ

Translation:

"And there is no creature on earth or bird that flies with its wings but they are communities like you. We have not neglected anything in the Book. Then unto their Lord they will be gathered."

Tafsīr al-Miṣbāḥ and al-Munīr Interpretation

In this verse, the term *umam* (أُمَمٌ), plural of *ummah* (أُمَّة), carries multiple meanings according to linguist Ibn Manẓūr, including: (1) a generation of people, (2) followers of a prophet, and (3) a group associated with a prophet. Some scholars further expand *ummah* to include all living beings, such as animals and non-human life forms. The convergence point between humans and animals here lies in shared attributes like instinct and growth, as elaborated in *Tafsīr al-Miṣbāḥ* (vol. 3, p. 413).

According to Shaykh Wahbah al-Zuḥaylī in *Tafsīr al-Munīr*, animals are granted equal status as creations of Allah SWT alongside humans, thus emphasizing the prohibition of injustice towards any creature. This interpretation aligns with the foundational principles taught at Sekolah Alam Ungaran, where students learn about the interconnectedness of life systems and are guided to cultivate environmental responsibility and spiritual consciousness.

Surah al-Baqarah [2]: 164

إِنَّ فِي خَلْقِ ٱلسَّمَٰوَٰتِ وَٱلْأَرْضِ وَٱخْتِلَٰفِ ٱلَّيْلِ وَٱلنَّهَارِ وَٱلْفُلْكِ ٱلَّتِي تَجْرِي فِي ٱلْبَحْرِ بِمَا يَنفَعُ ٱلنَّاسَ وَمَآ أَنزَلَ ٱللَّهُ مِنَ ٱلسَّمَآءِ مِن مَّآءٍ فَأَحْيَا بِهِ ٱلْأَرْضَ بَعْدَ مَوْتِهَا وَبَثَّ فِيهَا مِن كُلِّ دَآبَّةٍ ۖ وَتَصْرِيفِ ٱلرِّيَٰحِ وَٱلسَّحَابِ ٱلْمُسَخَّرِ بَيْنَ ٱلسَّمَآءِ وَٱلْأَرْضِ لَءَايَٰتٍ لِّقَوْمٍ يَعْقِلُونَ

Translation:

"Indeed, in the creation of the heavens and the earth, the alternation of the night and the day, the ships that sail the sea with what benefits people, what Allah sends down from the sky of rain giving life thereby to the earth after its lifelessness and dispersing therein every [kind of] moving creature, and [His] directing of the winds and the clouds controlled between the heaven and the earth are signs for a people who use reason."

Tafsīr al-Miṣbāḥ and al-Munīr Interpretation

In *Tafsīr al-Miṣbāḥ*, Prof. M. Quraish Shihab elaborates on the multilayered concept of reason (*ʿaql*), outlining five aspects. For instance, the phrase *khalqi al-samāwāt wa al-arḍ* (خَلْقِ ٱلسَّمَٰوَٰتِ وَٱلْأَرْضِ) can mean not only "creation" but also "precise measurement" or "systematic arrangement," reflecting a scientific structure governed by divine wisdom.

The contemplation of natural phenomena—such as the succession of night and day, the function of ships, rainfall, biodiversity, and weather systems—reflects the Qur'anic invitation to observe and understand the natural world. These themes correspond closely to science education practices at SAUNG, where students are taught to observe ecosystems and natural cycles critically, nurturing an awareness of divine wisdom in creation.

The concept of *zuhd* (asceticism), as quoted in classical Islamic literature such as *Naṣāʾiḥ al-ʿIbād*, emphasizes benevolence toward all living beings. This ethos parallels Quraish Shihab's interpretation that encourages believers to reflect on Allah's signs as a way of cultivating ethical and ecological consciousness.

Conclusion

This study concludes that the integration of science literacy with the *Tadabbur Alam* approach at Sekolah Dasar Alam Ungaran (SAUNG) significantly contributes to the development of students who are not only academically competent but also possess high levels of environmental and spiritual awareness. Through educational practices that interconnect scientific concepts with Qur'anic values, students are guided to contemplate the creations of Allah SWT and internalize their roles as *khalīfah* (stewards) on earth. Science learning thus becomes both an intellectual and spiritual endeavor.

The analysis reveals that the contextual, conceptual, and procedural aspects of science literacy reinforce one another in enhancing students' understanding of environmental issues and the importance of maintaining ecological balance. The use of varied and reflective student worksheets (*LKPD*) allows for formative evaluation that addresses not only cognitive outcomes but also the shaping of students' attitudes and environmental character.

This research underscores the significance of values-based educational approaches in promoting science literacy. The integration of *Tadabbur Alam* into science education provides a unique and holistic pedagogical model that aligns with Islamic educational values and responds to contemporary environmental challenges.

Therefore, this model holds strong potential for broader implementation in Islamic and nature-based schools across Indonesia and beyond, contributing to the cultivation of a generation that is intellectually enlightened, spiritually grounded, and socially responsible.

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