

Development of Science Learning Models Based on Islamic Values for Strengthening Scientific Literacy and Religious Character of Elementary School Students

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ABSTRACT

This study aims to develop an Islamic values-based science learning model to strengthen scientific literacy and religious character among elementary school students. The study employed a Research and Development (R&D) approach using the ADDIE development model, consisting of analysis, design, development, implementation, and evaluation stages. The research participants included science education experts, Islamic education experts, elementary school teachers, and students selected purposively according to the research objectives. Data were collected through expert validation sheets, observations, interviews, questionnaires, scientific literacy tests, and religious character assessment instruments. The data were analyzed using descriptive statistics, effectiveness testing, and qualitative thematic analysis. The findings revealed that the developed model was valid, practical, and effective for elementary science learning. The model integrates scientific inquiry activities with Islamic values through five learning stages: orientation toward natural phenomena, scientific exploration, evidence-based explanation, Islamic value reflection, and application of scientific concepts in daily life. The implementation of the model improved students' scientific literacy, particularly in explaining phenomena, interpreting evidence, analyzing information, and making scientific conclusions. In addition, the model strengthened students' religious character through honesty, responsibility, environmental awareness, gratitude, and collaborative attitudes. This study contributes a comprehensive instructional framework that integrates scientific competence and Islamic character development within elementary science education.



Introduction

The rapid development of science and technology requires schools not only to teach scientific facts, concepts, and formulas but also to develop students' abilities to understand phenomena, evaluate information, use evidence, and make responsible decisions (Nurhayati, Latif, & Anwar, 2024). These abilities constitute essential dimensions of scientific literacy because contemporary issues related to health, energy, environmental degradation, climate change, and technological development require scientific reasoning

accompanied by ethical and social considerations. Therefore, science education needs to connect scientific concepts with real-life contexts so that students are able to analyze problems, evaluate alternatives, and determine appropriate actions based on reliable evidence (Ke, Sadler, Zangori, & Friedrichsen, 2021).

Scientific literacy at the elementary school level plays a fundamental role because this stage shapes students' initial understanding of nature and scientific processes. Scientific literacy is not limited to the ability to memorize scientific concepts. Instead, it includes the ability to explain phenomena scientifically, formulate questions, conduct simple investigations, interpret data, evaluate evidence, and communicate scientific conclusions. Research on elementary preservice teachers' understanding of scientific literacy indicates that scientific literacy concepts, the nature of science, and the relationship between science, technology, and society still require significant improvement. This condition highlights the importance of strengthening scientific literacy from the elementary level through appropriate instructional models supported by teachers' pedagogical competence (Al Sultan, Henson, & Lickteig, 2021).

Science learning at the elementary level should provide opportunities for students to observe, question, investigate, analyze information, and communicate findings. Learning approaches that rely mainly on teacher explanations tend to position students as passive recipients of knowledge. In contrast, inquiry-based learning, project-based learning, and problem solving approaches encourage students to construct knowledge through meaningful experiences. Previous studies have demonstrated that STEAM project-based learning improves elementary students' scientific literacy because students actively engage in applying concepts, designing products, collaborating with peers, and solving contextual problems (Suryanti, Nursalim, Choirunnisa, & Yuliana, 2024).

Previous research also demonstrates that socio-scientific issues (SSI)-based learning can strengthen scientific literacy. Socio-scientific issues expose students to problems involving scientific concepts, environmental concerns, social dimensions, ethical considerations, and decision-making processes. Through SSI-based learning, students are encouraged not only to understand what happens scientifically but also to analyze why phenomena occur, identify supporting evidence, consider affected communities, and determine responsible actions. A systematic review of 61 studies revealed that environmental socio-scientific issues have been widely used to develop scientific argumentation and decision-making skills. However, the influence of cultural and religious values in shaping students' understanding of scientific issues remains insufficiently explored, particularly in developing countries (Kumar, Choudhary, & Singh, 2024).

The implementation of socio-scientific inquiry also demonstrates that scientific knowledge and everyday life can be connected through meaningful learning experiences. The use of multiple representations enables students to understand scientific phenomena from various perspectives, levels, and forms of evidence. Such abilities are essential for addressing complex problems that do not always have simple solutions. Therefore, science learning aimed at developing scientific literacy should integrate conceptual understanding, scientific practices, modeling, argumentation, reflection, and decision-making processes (Hermawan, Arjaya, & Diarta, 2022).

Empirical studies in Indonesia indicate that inquiry-based learning strategies and local-context approaches can enhance students' scientific literacy. The OE3C learning strategy, consisting of orientation, exploration, explanation, ethical discussion, and consolidation, has been shown to improve scientific literacy because it combines scientific inquiry with teacher guidance, conceptual explanation, and ethical reflection. These findings indicate that inquiry activities become more effective when teachers facilitate students in constructing explanations, interpreting evidence, and connecting scientific

findings with real-world issues. Although the study was conducted at the secondary education level, its instructional structure provides an important foundation for developing science learning models suitable for elementary school students (Saija, Rahayu, Fajarah, & Sumari, 2022).

Methods

This study employed a Research and Development (R&D) approach aimed at developing an Islamic values-based science learning model to strengthen elementary school students' scientific literacy and religious character. The R&D approach was selected because this study was not only intended to examine educational phenomena but also to produce an instructional product that is valid, practical, and effective for classroom implementation. The development procedure adopted the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), which consists of systematic stages including learning needs analysis, instructional design, product development, classroom implementation, and evaluation of the developed model. The ADDIE model is widely applied in educational development research because it provides a structured framework for producing instructional innovations based on empirical needs and continuous evaluation (Barus, Simanjuntak, & Ndruru, 2025).

The initial stage of the study involved a needs analysis to identify the existing conditions of science learning in elementary schools, students' scientific literacy levels, and the extent to which Islamic values were integrated into science instruction. Data were collected through classroom observations, interviews with teachers, curriculum document analysis, and examination of existing instructional materials. Based on the findings from this stage, the researchers designed a science learning model that integrated scientific inquiry, contextual science learning, and Islamic value reflection. The developed model consisted of several learning phases, including orientation toward natural phenomena as scientific objects and signs of God's creation, scientific exploration and investigation, evidence-based explanation, Islamic ethical reflection, and application of scientific concepts in daily life. This integration was developed based on the perspective that scientific literacy involves not only understanding scientific concepts and applying scientific evidence but also using scientific knowledge responsibly in social, ethical, and environmental contexts (Ke et al., 2021).

The research participants consisted of science education experts, Islamic education experts, elementary school teachers, and elementary school students selected through purposive sampling based on their relevance to the research objectives. Expert validation was conducted to evaluate the feasibility of the learning model, including content accuracy, instructional design, integration of Islamic values, and applicability in elementary science classrooms. After revision based on expert feedback, the developed model was implemented in classroom settings to examine its practicality and effectiveness. Data were collected through observations, interviews, validation questionnaires, teacher and student response questionnaires, scientific literacy tests, and religious character observation instruments. Scientific literacy was measured through students' abilities to explain scientific phenomena, use evidence, interpret information, analyze data, and draw conclusions based on scientific inquiry processes (Al Sultan et al., 2021). Meanwhile, students' religious character was assessed through indicators including scientific honesty, responsibility, gratitude, environmental awareness, discipline, and collaboration as manifestations of Islamic values in learning activities (Alanazi & Alghamdi, 2024).

Data analysis was conducted using both quantitative and qualitative approaches. Data from expert validation, teacher responses, and student responses were analyzed using descriptive statistics to determine the validity and practicality levels of the developed

learning model. The effectiveness of the model was analyzed by comparing students' scientific literacy scores and religious character development before and after the implementation of the instructional model. Statistical analyses included appropriate tests such as the paired sample t-test and normalized gain (N-Gain) analysis to determine learning improvement (Riwanda, Abdurrohim, Widiyati, & Pranajaya, 2026). Qualitative data obtained from observations and interviews were analyzed through data reduction, thematic categorization, data presentation, and conclusion drawing to understand the process of integrating Islamic values into science learning. Data credibility was ensured through methodological and source triangulation by comparing findings from observations, interviews, questionnaires, and learning assessments. This approach aligns with previous studies indicating that science and religion integration requires systematic instructional design to develop not only conceptual understanding but also students' moral awareness and religious attitudes (Chan & Erduran, 2023).

Results and Discussion

1. Development of an Islamic Values-Based Science Learning Model

The findings of this study indicate that the developed Islamic values-based science learning model produced an integrative instructional model that connects scientific processes with the development of students' religious character at the elementary school level. The developed model consists of five main stages: (1) orientation toward natural phenomena based on the concept of divine awareness, (2) scientific exploration through inquiry activities, (3) evidence-based analysis and explanation, (4) reflection on Islamic values, and (5) application of scientific concepts in daily life. This model positions science not merely as a process of understanding natural phenomena but also as a means of developing spiritual awareness, moral responsibility, and environmental concern among students. This finding supports previous research indicating that integrating Islamic values into science learning can create a more holistic educational experience by connecting cognitive, affective, and spiritual dimensions of learning (Sutiana & Nugraha, 2025).

The expert validation results showed that the developed learning model achieved a high level of feasibility in terms of instructional design, scientific content accuracy, Islamic value integration, and applicability in elementary school classrooms. The experts confirmed that the learning stages were able to connect scientific activities with religious values proportionally. Islamic values were not merely positioned as additional messages at the end of learning activities but were integrated into students' thinking processes during observation, experimentation, data analysis, and decision-making. This finding confirms that science and religion integration requires systematic pedagogical design so that religious values become part of students' learning experiences rather than simply symbolic additions (Saija et al., 2022).

2. Improvement of Students' Scientific Literacy

The implementation results demonstrated that the Islamic values-based science learning model significantly improved students' scientific literacy. The improvement was reflected in several scientific literacy indicators, including students' ability to explain scientific phenomena, use scientific evidence, interpret data, construct arguments, and connect scientific concepts with real-life problems. Students showed a transformation from a learning pattern dominated by memorization toward a more inquiry-oriented learning process based on observation, investigation, discussion, and reflection.

The improvement in scientific literacy occurred because the developed model provided opportunities for students to actively participate in scientific processes through

observation, simple experiments, collaborative discussions, and reflection activities. These learning experiences enabled students to understand that science is not merely a collection of facts but a process of constructing knowledge through evidence and reasoning. This finding supports Ke et al. (2021), who emphasized that scientific literacy develops effectively when students engage in scientific modeling, inquiry processes, and contextual problem-solving activities that require the interpretation and application of evidence (Ke et al., 2021).

The findings also strengthen previous research by Ismail and Wardi (2025), which demonstrated that science learning materials integrated with Islamic values could improve elementary students' scientific literacy because learning becomes more contextual and meaningful (Ismail & Wardi, 2025). However, unlike previous studies that primarily focused on instructional media or modules, this study contributes by developing a comprehensive learning model that integrates instructional syntax, learning activities, teacher roles, student experiences, and assessment systems to simultaneously enhance scientific literacy and religious character.

3. Strengthening Students' Religious Character

The observation results revealed that the implementation of the Islamic values-based science learning model positively influenced students' religious character development. Improvements were identified in students' scientific honesty during experiments, responsibility in completing group tasks, environmental awareness, gratitude toward natural phenomena, and respect for others' opinions during scientific discussions.

Religious character development occurred because students were not only engaged in understanding scientific concepts but were also guided to reflect on the meaning and values underlying scientific phenomena. For example, when learning about environmental systems, water, plants, and living organisms, students were encouraged to understand the relationship between humans and nature as a form of responsibility as stewards of the Earth. This reflective process enabled Islamic values to move beyond conceptual understanding and become observable behaviors in students' daily learning activities. This finding is consistent with Alanazi and Alghamdi (2024), who found that dialogue between science and religion in primary science classrooms enables students to connect scientific understanding with their beliefs, values, and personal perspectives (Alanazi & Alghamdi, 2024).

Previous studies have also shown that science learning integrated with Islamic values can enhance students' moral and spiritual awareness because learning is directed not only toward academic achievement but also toward developing responsible attitudes toward oneself, society, and the environment (Apriyani, Abidin, Irianto, Mulyati, & Sutini, 2025). Therefore, the model developed in this study contributes to expanding science education from a purely cognitive orientation toward the development of scientifically capable and ethically responsible individuals.

Discussion

The findings demonstrate that the Islamic values-based science learning model provides an alternative approach for addressing the separation between science education and character education. Conventional science learning often emphasizes cognitive aspects, such as conceptual understanding, scientific skills, and problem-solving abilities, while ethical and moral dimensions receive limited attention. The model developed in this study offers an integrative approach by positioning Islamic values as an ethical foundation in the process of acquiring and applying scientific knowledge.

The findings indicate that integrating Islamic values into science learning requires a structured instructional design. Religious values cannot be effectively implemented merely by adding Quranic verses or moral messages at the end of a lesson. Instead, values must be embedded within students' scientific activities. During experiments, students learn honesty through accurate data recording. Through group discussions, students develop responsibility, cooperation, and respect for others. Through observing natural phenomena, students develop gratitude and awareness of environmental responsibility. This approach supports Chan and Erduran (2023), who argued that meaningful relationships between science and religion can be developed through dialogue, reflection, and argumentation practices that encourage students to understand different perspectives critically.

The improvement of scientific literacy in this study also demonstrates that integrating religious values does not reduce the quality of scientific learning. On the contrary, value integration provides a meaningful context that helps students understand scientific concepts more deeply. Students not only learn how scientific phenomena occur but also understand why scientific knowledge is important and how it should be applied responsibly. This finding supports Kumar et al. (2024), who stated that contextual and socio-scientific approaches enhance students' ability to understand scientific phenomena and make responsible decisions related to real-life issues (Kumar et al., 2024).

The main contribution of this study lies in developing a learning model that integrates three essential dimensions: scientific literacy, Islamic values, and religious character formation within a single elementary science learning framework. Previous studies have mainly focused on developing instructional materials, modules, or media based on Islamic values, whereas this research develops a complete instructional model consisting of learning objectives, instructional stages, classroom activities, teacher roles, student learning experiences, and integrated assessment systems. Therefore, this study extends previous research on Islamic science integration by providing a more comprehensive pedagogical framework (Pratama, Suharsiwi, & Zakaria, 2026).

Theoretically, this research strengthens the perspective that twenty-first-century science education should develop individuals who are capable of scientific reasoning while maintaining ethical and moral awareness. Scientific literacy should not only be understood as the ability to comprehend scientific facts and concepts but also as the ability to use scientific knowledge wisely for human welfare and environmental sustainability. Practically, the developed model provides an alternative approach for Islamic elementary schools and other educational institutions seeking to implement science learning that is contextual, meaningful, and oriented toward character formation.

Conclusion

This study concludes that the development of an Islamic values-based science learning model provides an effective pedagogical approach for strengthening elementary school students' scientific literacy and religious character. The developed model successfully integrates scientific inquiry processes with Islamic values through structured learning stages, including the exploration of natural phenomena, scientific investigation, evidence-based reasoning, value reflection, and real-life application. This integration demonstrates that science learning can function not only as a means of developing scientific understanding but also as a medium for cultivating ethical awareness, spiritual reflection, and responsible attitudes toward the environment.

The implementation results indicate that the developed learning model contributes to improving students' scientific literacy, particularly in explaining scientific phenomena, interpreting evidence, analyzing information, and applying scientific concepts in everyday

contexts. The model also supports the development of religious character, reflected in students' honesty during scientific activities, responsibility in collaborative learning, environmental awareness, gratitude, and respect for others. These findings confirm that integrating Islamic values into science education does not reduce scientific rigor but instead provides meaningful contexts that help students understand the relationship between scientific knowledge, human responsibility, and religious values.

The novelty of this research lies in the development of a comprehensive learning model that simultaneously integrates scientific literacy, Islamic values, and religious character formation within elementary science education. Unlike previous studies that mainly focused on Islamic-based science materials or learning media, this research provides a complete instructional framework consisting of learning objectives, learning syntax, teacher facilitation strategies, student activities, and integrated assessment mechanisms. Therefore, the model offers a practical and theoretical contribution to the development of holistic science education that balances intellectual competence and moral-spiritual development.

The study recommends that elementary schools, particularly Islamic educational institutions, consider implementing value-integrated science learning models as part of efforts to achieve meaningful twenty-first-century education. Future studies are encouraged to examine the long-term impact of this model across different educational contexts, larger student populations, and diverse cultural backgrounds to further validate its effectiveness in developing scientifically literate and morally responsible learners.

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