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IMPLEMENTATION OF SCIENCE, ENVIRONMENT, TECHNOLOGY, AND SOCIETY (SETS) IN NATURAL SCIENCE LEARNING BASED ON ISLAMIC VALUES IN ELEMENTARY SCHOOLS

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Abstract

This study aims to examine the urgency and implementation of the Science, Environment, Technology, and Society (SETS) approach in elementary science education through the integration of Islamic values as a foundational framework. The research seeks to address common challenges in science learning, such as students' low science process skills, limited scientific literacy, and weak environmental awareness. The study employed a qualitative descriptive design with an analytical orientation. Data were collected through classroom observations, document analysis, and semi-structured interviews involving teachers and students from elementary schools implementing SETS-based learning. Data were analyzed using Miles and Huberman's interactive model, which includes data reduction, data display, and conclusion drawing to ensure analytical rigor, credibility, and validity. The results reveal that integrating Islamic values within the SETS framework enhances students' conceptual understanding of science, science process skills, and literacy. It also strengthens students' environmental awareness, scientific reasoning, and positive attitudes toward learning. The SETS model creates meaningful connections between science, technology, environment, and society, aligned with Islamic principles. The findings imply that SETS-based learning integrated with Islamic values can serve as a transformative pedagogical model to improve the quality of elementary science education by nurturing students' scientific competence, environmental ethics, and spiritual awareness as integral components of holistic education.

Keywords: Science learning, SETS approach, Islamic values, science literacy, environmental education, elementary education

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INTRODUCTION

Rapid advancements in science and technology continue to transform contemporary society, requiring education systems to respond with learning models that prepare students for the increasingly complex demands of the twenty-first century. As technological innovation accelerates, science education is expected not only to strengthen conceptual understanding but also to cultivate advanced competencies such as critical thinking, creativity, digital literacy, collaboration, scientific reasoning, and problem-solving. In Indonesia, this direction is reinforced by Government Regulation No. 4 of 2022, which mandates that basic education develop learners who believe in and are devoted to God Almighty, demonstrate noble character, internalize Pancasila values, and possess essential literacy and numeracy competencies for lifelong education (Government of Indonesia, 2022).

Although the Merdeka Curriculum provides flexibility for teachers to implement differentiated, inquiry-oriented, and context-responsive instruction, field observations show that many elementary school teachers still face significant obstacles in adapting their practices to twenty-first-century learning expectations. Specific challenges include limited teacher proficiency in facilitating inquiry-based learning, low integration of digital tools in science lessons, insufficient development of higher-order thinking skills (HOTS), and weak connections between scientific concepts and students' real-life contexts. In addition, students often demonstrate low engagement, difficulties in interpreting data, limited environmental awareness, and minimal opportunity to participate in collaborative problem-solving activities. These conditions are consistent with previous studies indicating that science learning in elementary schools is hindered by inadequate materials, insufficient facilities, limited student scientific process skills, and weak teacher–student interaction (Uswatun & Widiyanto, 2018). Consequently, many students struggle to achieve twenty-first-century competencies that are essential for scientific literacy and responsible citizenship.

The Science, Environment, Technology, and Society (SETS) framework offers a promising approach to addressing these challenges by helping students understand science as an interconnected system that influences and is influenced by ecological realities, technological innovation, and sociocultural dynamics. SETS-based learning encourages scientific inquiry, systems thinking, environmental sensitivity, and responsible decision-making—key competencies for twenty-first-century learners. In Islamic educational settings, the SETS approach gains further depth when integrated with core Islamic values such as *tawhid* (the unity of God), human responsibility as *khalifah* (stewards of the Earth), and ethical conduct in pursuing and applying scientific and technological knowledge. Islamic teachings promote *nazhar* (careful observation), *tafakkur* (deep reflection), and moral responsibility, all of which align naturally with inquiry-based SETS learning.

Integrating Islamic values into SETS-based science instruction therefore offers a holistic model capable of strengthening students' cognitive abilities, environmental ethics, and spiritual awareness. Such an approach positions science learning not merely as conceptual acquisition

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but as an avenue to appreciate the signs of God in nature, exercise ethical judgment in using technology, and contribute positively to society. Strengthening this integrated model in elementary schools is crucial to preparing young learners with the competencies, character, and worldview needed to navigate twenty-first-century challenges while remaining grounded in Islamic ethical principles.

The field study revealed several instructional and behavioral issues that demonstrate the limited effectiveness of current science learning practices in supporting the holistic competencies required by the Merdeka Curriculum. These issues include: (1) students' lack of responsibility in maintaining the school environment; (2) low environmental awareness related to cleanliness and orderliness; (3) insufficient use of the school environment as a learning resource; (4) persistent littering; (5) underdeveloped science process skills; (6) teacher-centered learning that restricts student participation; and (7) students' inability to achieve higher-order thinking skills (HOTS). One factor contributing to students' low HOTS is their limited conceptual understanding of scientific material. Field observations show that many fifth-grade students have not met the expected Learning Outcomes, as reflected in their low performance in summative assessments. According to Poedjiadi (2010), the characteristics of students with good concept comprehension skills are that they can display signs of concept comprehension in exams. Sumarmo, as cited in Rahayu and Pujiastuti (2018), identifies four indicators of conceptual understanding: (1) restating a concept; (2) providing examples; (3) explaining the characteristics or conditions of a concept; and (4) applying the concept to solve problems.

From an Islamic education perspective, these challenges also indicate the insufficient integration of core Islamic values such as *amanah* (responsibility), *ihsan* (excellence in action), and *khalifah* (human stewardship over the environment). These values emphasize the moral obligation to care for nature, engage ethically with scientific knowledge, and participate actively in learning as part of one's religious duty. The Science, Environment, Technology, and Society (SETS) approach has the potential to address these issues by linking scientific concepts with environmental stewardship, technological awareness, and societal responsibilities, all of which align closely with Islamic teachings. Conceptual understanding—students' ability to internalize essential ideas and apply them meaningfully—is a key foundation of this integration. Poedjiadi (2010) notes that students with strong conceptual understanding typically demonstrate this competence through academic performance. Sumarmo, as cited in Rahayu and Pujiastuti (2018), identifies several indicators of conceptual understanding: (1) restating a concept; (2) providing relevant examples; (3) explaining the characteristics or conditions of a concept; and (4) applying the concept to solve problems. Integrating Islamic values within the SETS framework therefore offers a holistic pathway to strengthen students' conceptual mastery, environmental ethics, and moral character simultaneously.

SETS-based science learning also provides opportunities for students to develop

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science-based solutions. They can design environmental projects, propose sustainable policies, and seek technological innovations to address real-world problems. This approach is not limited to transmitting knowledge; it also develops critical thinking, problem-solving, and creativity. NC State University (n.d.) emphasizes that science, technology, and society education helps learners understand environmental and social challenges and equips them to contribute to sustainable solutions. Science learning is therefore one of the principal means of addressing increasingly urgent environmental and social problems (Uswatun & Rohaeti, 2015). The SETS approach can motivate students because it guides them to analyze problems through the four interconnected SETS components (Amanda et al., 2018). It can also improve creative and inquiry skills by engaging cognitive, affective, and psychomotor dimensions (Suci & Taufina, 2020). Meaningful learning can foster students' concern for problems in their environment (Rudianto, 2017). Nevertheless, SETS-based learning may require substantial instructional time, may not be equally applicable to all topics, and requires teachers to possess sufficient readiness and broad contextual insight (Amin & Sumendap, 2022).

The SETS approach integrates four interconnected elements—science, environment, technology, and society—into learning activities supported by experiments and examples from everyday life (Amanda et al., 2018). In Indonesia, SETS is also known as Salingtemas, an acronym derived from sains, lingkungan, teknologi, and masyarakat. This approach encourages students not only to understand scientific content but also to examine its relationships with their natural and social environments (Suherman et al., 2019). The SETS approach is student-centered and helps students develop systems thinking and solve problems by integrating concepts from relevant disciplines (Moschovakis, 2025). In other words, the SETS approach can connect science learning in school with the environment, technology, and society. This is expected to encourage students to seek knowledge in the surrounding environment and apply it in their daily lives. With the SETS approach, students will gain a wide range of experience in relevant learning activities, which can help students develop science process skills.

This study is urgent because science learning in schools often remains theoretical and disconnected from students' real-life contexts. The SETS (Science, Environment, Technology, and Society) approach offers a relevant framework that aligns with twenty-first-century learning demands by linking science concepts to environmental issues, technological developments, and societal needs. Despite its potential, the SETS approach is still underutilized, especially in using the local environment as a meaningful learning resource. Investigating its implementation is therefore essential to strengthen scientific literacy, critical thinking, and problem-solving skills. The findings are expected to contribute to improving science pedagogy and guiding teachers in adopting more contextual, student-centered learning practices.

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METHODS

This study employed a qualitative descriptive research design to explore the implementation of Science, Environment, Technology, and Society (SETS)-based science learning integrated with Islamic values in elementary schools. The qualitative approach was chosen to describe instructional practices, learning activities, and value integration in a natural classroom context (Bungin, 2015).

The research was conducted in five public elementary schools in Sukabumi City, Indonesia. The schools were selected purposively based on the following criteria: (1) implementation of the national curriculum at the elementary level, and (2) the application of science learning that incorporates environmental, technological, and social aspects. The research subjects consisted of science teachers and school principals, while the focus of the study was on the process of SETS-based science learning and the integration of Islamic values in classroom instruction.

Data were collected through document analysis, semi-structured interviews, and classroom observations. Document analysis was carried out on lesson plans, teaching modules, student worksheets, and assessment instruments to identify the integration of SETS components and Islamic values in science learning. Semi-structured interviews were conducted with teachers and school administrators to obtain information regarding teaching strategies, learning experiences, and challenges in implementing SETS-based instruction. Classroom observations were conducted using a non-participant approach to observe learning activities and teacher–student interactions during science lessons (Miles et al., 2014).

Data were analyzed using the interactive model of Miles et al. (2014), which involved data condensation, data display, and conclusion drawing, supported by qualitative content analysis (Schreier, 2012). The collected data were coded and organized into thematic categories related to science concepts, environmental awareness, technological application, social relevance, and Islamic values. Analysis was conducted continuously during data collection to maintain consistency between the empirical evidence and the research findings.

To ensure data validity, the study applied source and technique triangulation by comparing evidence obtained from documents, interviews, and observations. This procedure strengthened the credibility of the findings and supported a comprehensive understanding of SETS-based science learning integrated with Islamic values at the elementary school level (Miles et al., 2014).

RESULTS

The outcomes of SETS-based science learning were assessed in terms of scientific literacy, environmental care attitudes, science process skills, and conceptual understanding. The results for each variable are presented in the following tables.

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Scientific Literacy

Students' scientific literacy was supported through SETS-based digital teaching modules. Çepni and Lee, as cited in Ulfah et al. (2020), state that SETS can improve students' scientific literacy. This shows that it is important to have scientific literacy to respond to the various problems that develop in society. The modules were accessible through QR codes, enabling teachers and students to obtain lesson plans and student worksheets more easily. Digital modules can facilitate accessible and contextual learning when they are appropriately integrated into instructional activities (Feriyanti et al., 2019).

Table 1. Pretest and posttest results of students' scientific literacy in SETS-based science learning

No	Variable	Score
1	*N-Gain Score*	0.638
2	*Percentage of N-Gain*	63.8%
3	*Category*	Moderate
4	*Mean Pretest Score*	58
5	*Mean Posttest Score*	82

Students' scientific literacy improved after the implementation of SETS-based digital learning modules. Based on the pretest and posttest results (Table 1), the N-Gain score was 0.638, equivalent to 63.8%, and was classified in the moderate category. This result indicates that the SETS-based e-modules, supported by QR code access, were effective in enhancing students' ability to understand scientific concepts and relate them to environmental and technological contexts. The improvement reflects students' increased capacity to interpret scientific information and apply it to real-life situations.

Environmental Care Attitude

Table 2 presents the improvement of students' environmental care attitudes through SETS-based science learning (Science, Environment, Technology, and Society). The data were collected using two methods, namely observations and questionnaires, across three stages of implementation: pre-action, Cycle I, and Cycle II. The table illustrates the gradual development of students' environmental awareness attitudes as a result of the implementation of SETS-based learning.

Table 2. Improvement in students' environmental care attitudes through SETS-based science learning

No	Stage	Observation (%)	Questionnaire (%)
1	*Pre-action*	0	20
2	*Cycle I*	44	56
3	*Cycle II*	80	84

Students' attitudes toward environmental care showed a consistent increase from the

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pre-action stage to Cycle II. Observation data revealed an increase from 0% at pre-action to 44% in Cycle I and 80% in Cycle II, while questionnaire results increased from 20% to 56% and 84%, respectively (Table 2). Further analysis of observation and questionnaire indicators showed improvements in behaviors such as proper waste disposal, plant preservation, ecological cleaning activities, and the use of recycled materials. These results indicate that SETS-based learning contributed to the development of environmentally responsible behavior among students. This finding is consistent with Rudianto (2017), who reported that SETS-based learning can promote environmental care by creating a more active learning environment. Students were able to identify environmental cleanliness problems, discuss them in the classroom, and relate them to science, technology, the environment, and society, so that students can understand the importance of maintaining environmental cleanliness and practicing environmental care both at school and in the community.

Science Process Skills

The improvement in students' science process skills was examined across two learning cycles. During the pre-cycle stage, only a limited number of process-skill indicators were evident; these findings were used as material for evaluation and reflection before the next cycle. Table 3 presents the achievement of the science process-skill indicators in Cycles I and II.

Table 3. Improvement of students' process skills through SETS-based science learning

No	Indicator	Cycle I (%)	Cycle II (%)
1	*Observing*	77	90
2	*Classifying*	80	90
3	*Communicating*	77	89
4	*Measuring*	76	94
5	*Predicting*	77	89
6	*Inferring*	79	90

The implementation of SETS-based learning resulted in substantial improvements in students' science process skills. As illustrated in Table 3, all indicators showed an upward trend from Cycle I to Cycle II. Observation skills increased from 77% to 90%, classification from 80% to 90%, communication from 77% to 89%, measurement from 76% to 94%, prediction from 77% to 89%, and inference from 79% to 90%. These results indicate that students became more actively engaged in inquiry-based learning through experimentation and problem-solving activities.

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Conceptual Understanding

Table 4 presents the percentage of students demonstrating conceptual understanding across the pre-cycle stage, Cycle I, and Cycle II. The data indicate a gradual increase in students' conceptual understanding following the implementation of instructional interventions, as reflected by the rising percentages in each cycle. These results demonstrate the contribution of the learning process to enhancing students' conceptual understanding.

Table 4. Students' conceptual understanding across the learning stages

No	Stage	Percentage (%)
1	*Pre-Cycle*	25
2	*Cycle I*	50
3	*Cycle II*	86

Students' conceptual understanding improved substantially throughout the learning cycles. Table 4 shows an overall increase from 25% at pre-cycle to 50% in Cycle I and 86% in Cycle II. Further analysis of conceptual indicators (Table 5) revealed improvements in providing examples, developing concepts, restating concepts, and problem-solving. These findings indicate that the SETS approach effectively supports students in constructing and applying scientific concepts. Improvements in environmental management behavior align with the environmental strand of SETS, which encourages learners to understand human–environment interactions and apply environmentally responsible practices. Finally, conceptual understanding strengthened as students reaffirmed, exemplified, extended, and applied scientific concepts, consistent with Sumarmo's indicators of conceptual understanding as cited in Rahayu and Pujiastuti (2018).

Table 5. Indicators of student conceptual understanding

No	Indicator	Cycle I (%)	Cycle II (%)
1	*Restating concepts*	45	75
2	*Providing examples*	55	80
3	*Elaborating concepts*	52	75
4	*Applying concepts to problem solving*	65	100

Table 5 illustrates an improvement in students' conceptual understanding across all indicators from Cycle I to Cycle II. In the restating concepts indicator, the percentage increased from 45% to 75%, indicating a considerable improvement in students' ability to restate concepts. The providing examples indicator also showed an increase from 55% to 80%, suggesting that students became more capable of giving relevant examples related to the concepts.

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Furthermore, the elaborating concepts indicator improved from 52% to 75%, reflecting students' enhanced ability to develop and connect concepts more deeply. The most substantial improvement occurred in the applying concepts to problem solving indicator, which rose from 65% in Cycle I to 100% in Cycle II. This result indicates that all students were able to apply their conceptual understanding to solve problems. Overall, the data demonstrate that the implemented learning process was effective in gradually and comprehensively improving students' conceptual understanding.

Overall, these findings show that the four learning outcomes reinforce each other within the SETS model. Contextual learning enhances scientific literacy, inquiry supports conceptual understanding, and environmental engagement develops responsible behavior—all of which position SETS as an effective framework for strengthening 21st-century science learning in elementary schools.

DISCUSSION

The findings show that applying the SETS model integrated with Islamic values improved students' scientific literacy, science process skills, conceptual understanding, and environmental care attitudes. The scientific literacy N-Gain score of 0.638, classified in the moderate category, reinforces the findings reported by Çepni and Lee as cited in Ulfah et al. (2020), indicating that SETS can stimulate scientific capability through social and technological contexts. The integration of QR-code-based digital e-modules facilitates access and reflects an inclusive adaptation of science learning to the digital age.

The consistent increase in environmental awareness from pre-action to Cycle II, based on both observations and questionnaires, demonstrates the contribution of the SETS model to ecopedagogical values aligned with Islamic teachings. Rudianto (2017) found that the SETS approach encourages learners' active participation in ecological reflection based on real problems. Students not only understand natural phenomena but also analyze their moral responsibility to safeguard God's creation, reflecting an integration of science and faith.

Science process skills improved across all indicators, from observing to inferring, suggesting that the SETS approach simultaneously stimulates cognitive and psychomotor abilities. This finding strengthens the position of science as a means of developing direct, experience-based scientific thinking (Ismunayah et al., 2025; Widiyanto et al., 2025). In addition, students' conceptual understanding increased substantially from the pre-cycle stage to Cycle II, especially in developing concepts and problem-solving. These findings show that SETS can transform abstract scientific concepts into concrete meanings through everyday-life contexts connected to Islamic values.

This study has limitations related to the scope of the sample and the evaluation instruments, which relied substantially on teachers' observations. Future studies should use broader experimental or quasi-experimental designs to strengthen the validity of the evidence. Cross-regional studies are also recommended to examine the consistency of this

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learning model across diverse cultural contexts.

From a social and ethical perspective, the use of digital technology in SETS-based learning should be designed to avoid widening disparities in access to information, especially in the elementary school environment. On the other hand, these findings suggest that integrating Islamic values in science enriches the spiritual aspects of students and provides an ethical foundation for scientific learning and for students' engagement with contextual social issues. Thus, this approach can be a model of future science education that harmonizes science, values, and technology sustainably.

The findings of this study confirm that SETS-based science learning integrated with Islamic values is effective in improving multiple dimensions of elementary science learning. The moderate improvement in scientific literacy supports previous research indicating that the SETS approach enhances students' scientific understanding by linking science concepts to environmental, technological, and social realities. The use of digital e-modules further strengthens learning accessibility and aligns science instruction with contemporary educational practices.

The substantial improvement in students' environmental care attitudes reflects the strength of the environmental component within the SETS framework. By engaging students with real environmental issues from their immediate surroundings, learning becomes meaningful and value-oriented. When integrated with Islamic values, environmental awareness is reinforced as a moral responsibility to preserve nature as part of religious and ethical obligations.

The increase in science process skills demonstrates that SETS-based learning promotes inquiry-oriented and student-centered instruction. Through observation, experimentation, measurement, and inference, students develop essential scientific skills that support higher-order thinking. This finding reinforces the view that science learning should emphasize direct experience and active investigation rather than passive knowledge acquisition.

Improvements in conceptual understanding further indicate that contextual and value-based learning helps students transform abstract scientific concepts into concrete understanding. The integration of science content with daily life experiences and Islamic values enables students to internalize concepts more deeply and apply them in problem-solving situations.

Overall, these findings suggest that the SETS approach provides a holistic learning framework in which scientific literacy, process skills, conceptual understanding, and environmental attitudes mutually reinforce one another. Therefore, SETS-based science learning integrated with Islamic values can be considered an effective pedagogical model for strengthening elementary science education in both cognitive and character dimensions.

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CONCLUSION

This study concludes that the implementation of the Science, Environment, Technology, and Society (SETS**)** approach integrated with Islamic values contributes positively to elementary science learning. The findings indicate improvements in students' scientific literacy, science process skills, conceptual understanding, and environmental care attitudes, confirming that contextual and value-based science learning effectively supports cognitive development and character formation.

The integration of Islamic values strengthens the moral and spiritual dimensions of science learning by encouraging students to understand scientific phenomena as part of God's creation and to develop responsible attitudes toward the environment. At the practical level, SETS-based learning promotes active student engagement through inquiry and contextual learning activities, enabling students to apply scientific concepts in real-life situations. Therefore, this approach can be adopted by elementary school teachers as an alternative instructional model to support holistic, value-based, and contextual science education.

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