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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 (*Salin-PP-Nomor-4-Tahun-2022.pdf*, n.d.).

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 (D. A. 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 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 *Capaian Pembelajaran* (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. There are several indicators of concept understanding according to Sumarmo (Rahayu & Pujiastuti, 2018), namely, (1) Reaffirming a concept; (2) Providing examples; (3) Developing the conditions of a concept; and (4) Applying the concept of problem solving.

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.

In addition, science-based learning, *Science, Environment, Technology, and Society* (SETS), also provides opportunities for students to develop science-based solutions. They can design environmental projects, propose sustainable policies, and seek technological innovations to address these issues. It is not just about instilling knowledge, but also critical thinking, problem-solving, and creativity skills that can be used to answer the questions and problems of the larger society. According to NC State University (*Science, Technology and Society (STS)*, n.d.) states that the importance of science-based learning *Science, Environment, Technology, and Society* (SETS) is not only in helping students understand today's environmental and social challenges, but also in equipping them with the tools to become future leaders who can find sustainable solutions and play an active role in protecting the earth and our society. Thus, science learning is one of the main pillars to overcome the complexity of environmental and social problems that are increasingly urgent (D. Uswatun & Rohaeti, 2015) The advantage of the SETS learning approach is that it can motivate students in the learning process because students are guided to analyze problems through the four components of SETS (Fuller, 2019). In addition, this model can also improve students' creative and inquiry skills by emphasizing the learning process based on cognitive, affective, and psychomotor aspect(Suci & Taufina, 2020). Making learning more meaningful and easy for students to understand can foster students' sense of concern for problems in their environment(Fuller, 2019). Meanwhile, the disadvantage of the SETS learning model is that it takes a long time (Amin S. Pd. & Sumendap, 2022), not all subjects can use the SETS model, teachers must have broad readiness and insight in applying the SETS learning model because to be able to raise issues at the invitation stage, teachers must be able to respond to problems in the environment (Fuller, 2019).

The SETS approach is an approach that connects the four elements in SETS, namely: Science, Environment, Technology, and Society, in a learning meter, accompanied by experiments and examples in daily life (Amanda et al., 2018). The term SETS in Indonesian is known as "Salingtemas", which this approach stands for science, environment, technology, and society, which aims to make students not only focus on the study material, but also pay attention to the natural life around them(Suherman et al., 2019). The SETS approach is also one of the approaches in the learning process, which is student-centered, so that students can have global thinking skills and can solve problems using concepts from various related sciences (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 process and science 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.

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 analysis was performed using content analysis techniques. The analysis process included data reduction, data classification, and interpretation of findings. The collected data were coded and organized into thematic categories related to science concepts, environmental awareness, technological application, social relevance, and Islamic values. Data analysis was carried out continuously during the data collection process to ensure consistency between empirical data and research findings (Scott, 2013).

To ensure the validity of the data, this study applied triangulation of sources and techniques by comparing data obtained from documents, interviews, and observations. This approach was used to enhance the credibility of the research results and to provide a

comprehensive understanding of SETS-based science learning integrated with Islamic values at the elementary school level (Scott, 2013).

RESULTS AND DISCUSSION

The results of applying the SETS model to science learning in this study were measured on concept understanding, science process skills, science literacy, and environmental care attitudes. The study results for each variable are presented on the following graph.

Science Literacy Aspects

Science literacy is developed through e-teaching modules with the SETS approach. Cepni and Lee (Ulfah et al., 2020) state that SETS can improve students' scientific knowledge (*Scientific Literacy*). This shows that it is important to have scientific knowledge to respond to the various problems that develop in society. The development of digital teaching modules supports expertise and technology, as these teaching e-modules can be accessed using QR codes that make it easy for educators and students to obtain lesson plans and student worksheets. It aligns with the world (Feriyanti et al., 2019).

Table 1. Results of pretest and posttest of science literacy in SETS-based science learning

No	Variable	Skor
1	*Skor N-Gain*	0,638
2	*Presentation N-Gain*	63,8%
3	*Category*	currently
4	*Mean Pretest*	58
5	*Mean Posttest*	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 reached 0.638 or 63%, which falls within 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.

Aspects of 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. Improving students' environmental awareness attitudes in SETS- based science learning

No	Aspeck Stages	Observations (%)	Questionnaires (%)
1	*Pre-actions*	0	20
2	*Cycle I*	44	56
3	*Cylcle II*	80	84

Students' attitudes toward environmental care showed a consistent increase from the pre-action stage to Cycle II. Observation data revealed an increase from 0% (pre-action) to 44% (Cycle I) and 80% (Cycle II), while questionnaire results increased from 20% to 56% and 84%, respectively (Figure 1.2). 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 effectively fosters environmentally responsible behavior among students (Rudianto, 2017) that learning using the SETS learning model is better in developing an attitude of caring for the environment because the learning atmosphere can be more active through the SETS learning model. Students are also able to identify problems related to maintaining the cleanliness of the school environment and bring it into the classroom as learning objects, invite discussions, and encourage students to connect science, environment, technology, and society so that students can understand the importance of maintaining environmental cleanliness and practicing environmental care both at school and in the community.

Process Skills Aspect

The implementation of process skill improvement is carried out in 2 cycles. In the pre-cycle of process skills indicators, only a few indicators appear to the students, so they become material for evaluation and reflection for the next cycle. The following is the data on the achievement of the results of improving process skills indicators in cycle I and cycle II, as follows;

Table 3. Improvement of students' process skills in SESET-based science learning

No	Indicator	Cycle I (%)	Cycle I (%)
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 also resulted in significant improvements in students' science process skills. As illustrated in Figure 1.3, 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. (*Science, Technology and Society (STS)*, n.d.).

Concept Understanding Aspects

Table 4 presents the percentage of students' improvement in conceptual understanding of process skills measured across three stages: pre-cycle, 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 effectiveness of the learning process in enhancing students' ability to understand concepts more optimally.

Table 4. Understanding Student Concepts Process Skills: Each Indicator

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

Students' conceptual understanding improved substantially throughout the learning cycles. Figure 1.4 shows an overall increase from 25% (pre-cycle) to 50% (Cycle I) and 86% (Cycle II). Further analysis of conceptual indicators (Figure 1.5) 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. (Schreier, 2012). 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 comprehension (Rahayu & Pujiastuti, 2018).

Table 5. Indicators of Student Concept Comprehension

No	Indicator	Cycle I (%)	Cycle I (%)
1	*Restating (Redeclare)*	45	75
2	*Providing Examples*	55	80
3	*Developing Concepts*	52	75
4	*Problem Solving (Troubleshooting)*	65	100

Table 5 illustrates an improvement in students' conceptual understanding across all indicators from Cycle I to Cycle II. In the restating (redeclare) indicator, the percentage increased from 45% to 75%, indicating a significant improvement in students' ability to restate

the concepts they had learned. 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.

Furthermore, the developing 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 problem solving (troubleshooting) 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

Research shows that applying the SETS model based on Islamic values significantly improves students' science literacy, process skills, concept understanding, and attitudes toward environmental care. The increase in science literacy, as indicated by an N-Gain score of 0.638 (medium category), reinforces Cepni and Lee's findings (Ulfah et al., 2020) that the SETS approach can stimulate scientific capabilities through social and technological contexts. The integration of QR code-based digital e-modules makes access easier and reflects the adaptation of science learning to the digital age inclusively and effectively.

Increased consistent environmental awareness from pre-action to cycle II, both through observation and questionnaires, shows the success of the SETS model in instilling ecopedagogical values that align with Islamic teachings. This is supported by the findings (Rudianto, 2017) that the SETS approach encourages the active participation of learners in ecological reflection based on real problems. Students understand natural phenomena and analyze the moral responsibility to safeguard God's creation, a form of integrative approach between science and faith.

Skills: The scientific process improved significantly on all indicators, from observing to inferring, suggesting that the SETS approach simultaneously stimulates cognitive and psychomotor abilities. This strengthens the position of science as a vehicle for the development of direct and experience-based scientific thinking (Ismunayah et al., 2025) (Widiyanto et al., 2025). In addition, students' concept understanding experienced a significant jump from pre-cycle to cycle II, especially in "developing concepts" and "problem solving". These findings show that the SETS approach can transform abstract scientific concepts into concrete meanings

through everyday life scenarios connected to Islamic values.

However, this study has limitations regarding the scope of the sample and evaluation instruments that rely heavily on the subjective observation of teachers. Further research needs to be conducted with a broader experimental design and quasi-quantitative approaches to strengthen the validity of the data. It is also recommended to conduct cross-regional studies to test the consistency of these learning models in diverse cultural contexts.

From a social and ethical perspective, the use of digital technology in SESET-based learning needs to be designed to not cause gaps 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 forms the basis of scientific ethics and 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 significant 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.

CONCLUSION

This study concludes that the implementation of the Science, Environment, Technology, and Society (SETS) approach integrated with Islamic values has a positive contribution 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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