



Enacting Islamic Ecological Values across Science Curriculum, Pedagogy, and School Culture in an Integrated Islamic Elementary School

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Abstract

Environmental education in elementary schools requires approaches that connect scientific understanding with ethical responsibility. Yet how Islamic ecological values are enacted across science learning and school culture remains insufficiently documented. This study aims to examine how these values are articulated through the curriculum, enacted through pedagogy, and reinforced by school culture at SDIT at Taqwa, an integrated Islamic elementary school in Bekasi, Indonesia. The study employed a qualitative case study design involving observations of three Grade V science lessons, interviews with school staff, questionnaires completed by 60 pupils in Grades IV and V, and school documents. Data were analyzed using the Miles and Huberman interactive model. The findings revealed three interconnected dimensions: ecological values embedded in science objectives and Qur'anic references, experiential and project-oriented environmental activities, and school routines reinforced through teacher modeling. Four student-practice indicators received observation ratings of 3.3–3.6 on a four-point scale. Approximately 85% of pupils perceived that science lessons supported their environmental awareness, while 82% reported participating in environmental activities. These results reflect observed practices and reported perceptions rather than causal effects or sustained character development. The study contributes a case-grounded interpretive framework connecting curriculum articulation, learning experiences, and institutional reinforcement in integrated elementary science education.

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1. Introduction

Science education at the elementary level plays a central role in developing scientific literacy and helping children understand their relationships with the natural environment. Beyond acquiring scientific concepts, environmental literacy involves connecting knowledge with attitudes and everyday decisions about resources, waste, and ecological well-being (Wilujeng et al., 2019; Gunamantha & Dantes, 2025; Vesterinen & Ratinen, 2024). In Indonesia, the Merdeka



Curriculum and the Pancasila Student Profile place character development alongside disciplinary learning (Nisa et al., 2024). A meta-analysis of environmental education for children and adolescents found gains in knowledge and attitudes but emphasized substantial heterogeneity and measurement limitations (van de Wetering et al., 2022). This orientation raises a practical and scholarly question: how can elementary science instruction connect explanations of natural phenomena with values that guide environmentally responsible conduct? The question is particularly relevant to integrated elementary education, in which learning activities, moral development, and school routines form interconnected educational experiences.

Research on environmental education provides an important starting point. Studies of elementary environmental literacy have examined how young learners understand ecological issues and relate knowledge to attitudes and behavior (Nugraha et al., 2022; Gunamantha & Dantes, 2025; Vesterinen & Ratinen, 2024). A review of Indonesian ecopedagogy research likewise identifies growing attention to environmentally oriented learning (Amaliati et al., 2024), while project-based learning offers opportunities to investigate real-world problems through active participation (Bell, 2010). Taken together, these perspectives support contextual and participatory science learning. Research on the environmental value–action gap underscores the role of curricular and institutional conditions in translating values into practice (Portus et al., 2024). Studies of outdoor education with children also distinguish contextual learning opportunities from the longer-term outcomes such activities may or may not produce (Collins et al., 2025; Whitburn et al., 2023). However, developing ecological knowledge or participating in an environmental activity does not necessarily explain how learners interpret the ethical meaning of their actions or how those actions become part of everyday school practices. Understanding these connections requires examining how classroom instruction, ethical interpretation, and recurring school practices relate to one another, rather than treating environmental awareness as a self-explanatory outcome.

In Integrated Islamic Elementary Schools (SDIT), Islamic ecological values provide a relevant ethical perspective for addressing this challenge. The concepts of *khalifah fil ardh* (human stewardship of the earth), *israf* (wastefulness), and *mīzān* (balance) can connect environmental responsibilities with religious understandings of human conduct. For science learning, these principles are educationally meaningful when they are related to observable situations such as water conservation, waste management, and care for living things, rather than presented only as scriptural quotations. Research on Islamic eco-theology has explored how ecological principles may be incorporated into religious and character education curricula (Rohman et al., 2024; Nur et al., 2025), while studies of Islamic green-school practices have highlighted institutional approaches to environmental responsibility (Muin et al., 2025). Comparative

evidence on character education in an Islamic elementary school likewise illustrates how culturally grounded school routines can support values education. However, it did not specifically investigate science-based ecological teaching (Mansur & Sholeh, 2024). These studies establish the relevance of religious values to ecological education, but their emphases do not fully explain the integration process within elementary science lessons.

Research has also examined the relationship between Islamic values and science instruction in Islamic primary schools. Sutiana and Nugraha (2025), for example, identified approaches to integrating scientific learning with Islamic values, highlighting the pedagogical possibilities and challenges of this integration. Kusufa et al. (2026) investigated problem-based learning and ecological awareness in coastal primary-school social studies. Their study provides a useful point of comparison, but concerns problem-based learning, not the project-based activities reported here, and does not investigate religious value integration. The studies illuminate related dimensions of ecological or values-based education, yet a process-oriented question remains: how do teachers connect those values to science lesson planning and classroom activities, and how are the experiences reinforced through school culture and reflected in students' environmental practices? Much of the relevant scholarship addresses environmental literacy, Islamic religious education, or science–religion integration from different analytical starting points (Amaliati et al., 2024; Rohman et al., 2024; Sutiana & Nugraha, 2025; Kusufa et al., 2026). Consequently, the relationship among curriculum articulation, enacted learning experiences, and everyday ecological practices in SDIT warrants closer empirical examination. This is a gap concerning the educational process and its interconnected dimensions, rather than simply the absence of studies conducted in a particular school.

To examine this relationship, the present study adopts a practice-oriented conceptual perspective that links three dimensions of integrated education: the articulation of Islamic ecological principles in science content and learning objectives, their enactment through contextual and experiential activities, and their reinforcement through teacher practices and school culture. Islamic ecological principles provide an ethical orientation; science learning and environmental projects create occasions to connect explanations with action; and recurring school activities may support the continuity of those practices (Bell, 2010; Rohman et al., 2024; Rahmania, 2024). A broader sustainability-education model also treats knowledge, attitudes, and action as related but analytically distinct dimensions (Baierl et al., 2025). These connections provide sensitizing concepts for interpreting the case rather than predetermined causal pathways. The analysis distinguishes intended curriculum integration, learning activities actually described or observed, and schoolwide routines; students' reported

awareness and observed practices are treated as contextual evidence, not as proof of sustained character change.

Against this background, this qualitative case study investigates the integration of Islamic ecological values into science learning at SDIT At Taqwa, Bekasi. It addresses four interrelated questions: (1) how are Islamic ecological principles represented in science content and learning plans; (2) what instructional strategies do teachers use to connect these principles with pupils' learning experiences; (3) what patterns of environmental awareness and behavior are evident in students' responses and observed school activities; and (4) how does school culture support the enactment of ecological values beyond individual lessons? The study considers classroom observations, interviews, student questionnaires, and school documentation to examine these questions from complementary perspectives. Its qualitative design is intended to illuminate contextual practices and relationships, not to establish causal effects or statistical generalizations across schools.

The study aims to provide an empirically grounded and context-sensitive account of how scientific learning, Islamic ethical values, and environmental character education can be integrated in an elementary school setting. By examining the relationships among curriculum integration, experiential learning strategies, and school culture, this study seeks to clarify the pedagogical processes by which Islamic ecological principles are translated into school practices. The proposed contribution is a case-grounded account of the alignment—and potential discontinuities—between intended values, instructional enactment, and institutional routines. It also offers considerations for teachers seeking to connect scientific explanations with ethical reflection without conflating students' participation with proven changes in character.

2. Methods

This study employed a qualitative case study design to examine how Islamic ecological values were incorporated into science learning and school environmental practices at Integrated Islamic Elementary Schools (SDIT) at Taqwa, Bekasi. The design was appropriate because the research questions concern instructional processes, participants' perspectives, and school culture within a specific educational setting, rather than measuring causal effects (Creswell, 2003). The school constituted the bounded case, with classroom practices, participant accounts, and institutional documents examined as complementary forms of evidence.

Participants included a science teacher, an Islamic Education (PAI) teacher, the school principal, and 60 students from Grades IV and V of SDIT At Taqwa, Bekasi, Indonesia. Participants were selected purposively because of their direct

involvement in science instruction or school environmental programs. The science teacher provided accounts of lesson planning and classroom practice; the PAI teacher described collaboration to connect Qur'anic references with scientific topics; the principal explained school policies and environmental activities; and students contributed evidence of their learning experiences and environmental practices. This single-school sample was intended to support contextual understanding rather than statistical generalization.

Four complementary data collection techniques were used: observation, semi-structured interviews, student questionnaires, and document analysis. Classroom observations encompassed three Grade V science lessons. They examined how teachers connected Islamic ecological values to scientific topics, including the water cycle and plant processes, as well as to practical learning activities. Observations of school-based behavior addressed waste disposal, water conservation, classroom cleanliness, participation in environmental activities, and teacher role modeling. Interviews with the science teacher, PAI teacher, and principal explored curriculum planning, instructional strategies, interdisciplinary collaboration, and environmental programs. All 60 participating Grade IV and V students completed a questionnaire containing Likert-scale items about environmental awareness, Qur'anic references in science lessons, spiritual perceptions, and participation in environmental activities. Documents included lesson plans (RPP), curriculum materials, photographs of activities, and school reports. These sources permitted comparisons among staff accounts, directly observed practices, students' self-reports, and institutional records. They did not constitute an experimental intervention or repeated-measures assessment.

Data analysis followed the interactive model of Miles and Huberman, comprising data reduction, data display, and conclusion drawing or verification (Miles et al., 2014). Observation, interview, and documentary materials were selected, organized, and coded to identify recurring patterns concerning the inclusion of Islamic ecological principles in science content, experiential and project-based learning, environmental practices, teacher role modeling, and school culture. The materials were compared across sources, displayed through thematic narratives and tables, and synthesized into the three connected dimensions described in the Results: curriculum integration, experiential learning, and school culture. The categories function as an interpretive synthesis of the reported materials, not as independently validated constructs. Questionnaire percentages and four-point observation ratings were summarized descriptively to complement the qualitative findings; they were not treated as evidence of causal effects or measured changes over time.

The credibility of the interpretations was addressed through source and method triangulation, peer debriefing, and member checking. Interview accounts were considered alongside classroom observations, questionnaire responses,

and school documents to examine consistency across perspectives and methods. Preliminary interpretations were shared with participants to confirm their accuracy, while peer debriefing provided an additional opportunity to question the emerging findings. The study was conducted with permission from the school, and participant identities were kept confidential. Given the single-school design and descriptive measures, the findings characterize practices and perceived environmental responsibility within this case rather than establishing an intervention effect.

3. Results

3.1 Islamic Ecological References and Environmental Practices in Science Lessons

Across three Grade V science lessons, the teacher linked environmental science content with Qur'anic references. During instruction on the water cycle, QS. Al-Anbiya:30 was cited in explaining water as the basis of life. During lessons on plants and photosynthesis, QS. An-Nahl:10–11 was used when discussing natural processes. These observations documented connections between scientific topics and Islamic teachings during instruction; they did not measure changes in students' scientific understanding or spiritual awareness.

Observed practical activities included examining plants in the school garden, conducting simple water-filtration activities, and planting hydroponic vegetables. Students took part in these tasks, which connected the science topics being taught with environmental activities within the school setting.

As shown in Table 1, the four-point observation ratings were 3.6 for proper waste disposal, 3.4 for water conservation, 3.5 for classroom cleanliness, and 3.3 for participation in green activities. Teacher role modeling received the highest rating (3.7). The unweighted mean across all five indicators was 3.5 out of 4; because one indicator concerns teacher behavior, this value should not be interpreted as a student-only character score.

The scores are descriptive ratings of selected practices in the reported observation period, not pre–post comparisons or independently validated measures of environmental character. Participation in green activities had the lowest rating (3.3), indicating that the recorded frequency varied across the observed indicators.

Table 1.

Observed Environmental Practices and Teacher Role Modeling

No.	Behavior Indicator	Average Score (1–4)	Category
1	Proper waste disposal	3.6	Frequent – Very Frequent
2	Water conservation	3.4	Frequent
3	Classroom cleanliness	3.5	Frequent
4	Participation in green activities	3.3	Frequent
5	Teacher role modeling	3.7	Very Frequent

Source: Classroom observation records from the study.

3.2 Curriculum Planning, Teacher Collaboration, and Role Modeling

Interviews provided complementary accounts of the integration of ecological values into science learning. The science teacher described the inclusion of environmental-care indicators in lesson plans, project-based activities, and teachers' everyday examples:

"We integrate Islamic-based environmental values through several approaches. First, we include learning indicators related to environmental care and Islamic values in the lesson plans. Second, we implement project-based learning so that students can directly participate in environmental activities. For example, they create posters themed 'Islam and Nature' and carry out classroom greening projects. Third, we model environmentally responsible behavior, such as bringing reusable water bottles to reduce plastic waste."

The Islamic Education (PAI) teacher described collaboration in selecting Qur'anic references for science topics:

"Collaboration between the PAI and science teachers is essential for effective integration. When the topic is about the earth or the universe, I prepare relevant Qur'anic verses. The science teacher then connects these verses with scientific explanations so that students understand that science and religion complement each other."

The principal described schoolwide environmental routines associated with the Green Islamic School program:

"Our Green Islamic School program aims to build an environmentally friendly school culture grounded in Islamic principles. Routine activities such as Friday Clean-Up, classroom cleanliness competitions, and monthly tree planting help students practice environmental values in real-life situations. This program strengthens the integration of Islamic ecological values into science learning."

Across the three interviews, participants described lesson-planning links between science and Islamic values, cooperation between science and PAI teachers, practical environmental projects, and teacher role modeling. These are participants' accounts of implementation; classroom observations and school

documents provide additional evidence concerning enacted practices and organized activities.

3.3 Students' Self-Reported Environmental Awareness and Participation

All 60 participating students from Grades IV and V completed the questionnaire. Approximately 85% agreed or strongly agreed that their science lessons had made them more environmentally aware. This finding reflects students' reported perceptions of their learning experience rather than an independently measured change in environmental awareness.

Approximately 78% of students reported that teachers frequently connected science lessons with Qur'anic verses or Hadith, while 75% reported feeling spiritually closer to Allah when learning about the natural world. These responses indicate students' perceptions and do not constitute a before-and-after measure of spiritual development.

About 82% of respondents reported participating in activities such as tree planting, waste sorting, and school clean-up programs. Figure 1 displays the four questionnaire percentages as reported in the research summary; individual item counts and missing-response checks should be confirmed against the original forms before submission. These self-reports are presented separately from the direct observation ratings in Table 1.

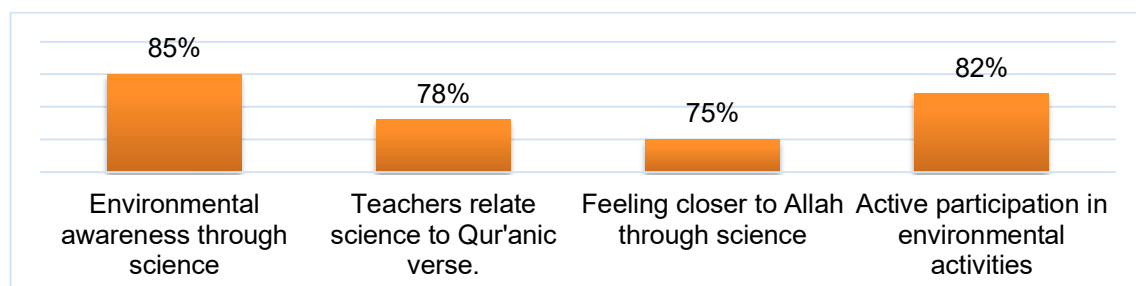


Fig. 1. Student Perceptions and Participation in Islamic Ecological Science Learning

Source: Student questionnaire (n = 60); percentages reported as approximate whole numbers.

3.4 Documented Curriculum Links and School Environmental Programs

Curriculum materials, lesson plans (RPP), school activity reports, and photographs provided evidence of planned instruction and school environmental initiatives. For the topic "Water as a Source of Life," a lesson-plan indicator asked students to explain the water cycle while recognizing water as a divine blessing to be conserved. This documented objective corresponds to the water-cycle topic identified in classroom observations.

Photographs and school reports documented recycling competitions, tree planting, compost-making activities, and other environmental programs. The annual school report recorded participation in environmental activities at 65% in the preceding year and 85% during the study period. These school-reported

proportions describe the documented figures but do not establish why they differed. Therefore, the documents showed ecological values appearing in both planned science instruction and schoolwide environmental routines. This evidence complemented the teachers' and principal's accounts, while observation and questionnaire data described enacted activities and students' reported experiences.

3.5 Three Dimensions of Ecological Integration

Comparison of classroom observations, interviews, questionnaire responses, and school documents identified three recurring dimensions of integration within the case: curriculum connections between science and Islamic ecological values, experiential instructional activities, and reinforcement through school culture. These dimensions describe patterns across sources rather than separately tested causal effects.

Curriculum integration was evident in lesson-plan objectives and teachers' accounts of using Qur'anic references. Experiential learning appeared in garden activities, water filtration, and hydroponic planting, and was also described by the science teacher through project assignments. School-culture reinforcement was represented by the principal's account of Friday Clean-Up, tree planting, and cleanliness competitions alongside school activity records. Students' environmental self-reports and observed practices were documented within this combined setting, but their specific causes cannot be isolated from the available data. Figure 2 presents a case-based synthesis of the links among Islamic ecological values, curriculum integration, instructional activities, school culture, and observed or reported environmental practices. Its arrows represent hypothesized conceptual connections among the documented practices, not experimentally established pathways or estimated effects.

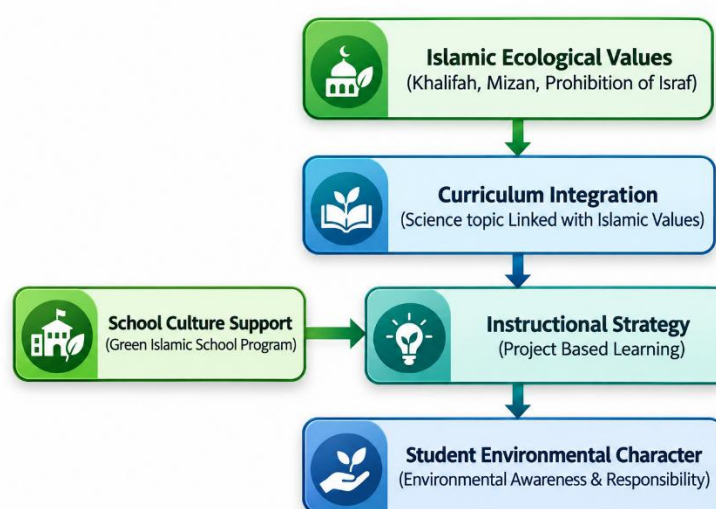


Fig. 2. Case-Based Framework of Islamic Ecological Integration

Source: Authors' synthesis of observations, interviews, questionnaires, and school documents.

4. Discussion

4.1 Integration of Islamic Ecological Values in Science Learning

The classroom evidence suggests that Islamic ecological values can be connected to elementary science without replacing scientific explanations with religious instruction. During lessons on the water cycle and plant processes, the science teacher related scientific topics to QS. Al-Anbiya:30 and QS. An-Nahl:10–11. The lesson-plan indicator on water conservation and the account of collaboration between science and Islamic Education (PAI) teachers further indicate that these connections were planned rather than confined to incidental quotations. This finding extends discussions of science–religion integration in Islamic primary education (Sutiana & Nugraha, 2025) by showing how the connection was enacted in a specific ecological learning context.

Islamic ecological principles provide an ethical lens for interpreting these practices. *Khalifah fil ardh* highlights human stewardship, *israf* concerns wastefulness, and *mīzān* refers to balance. Eco-theological scholarship positions such concepts within environmental responsibility and religious education (Nur et al., 2025; Rohman et al., 2024; Lutfauziah et al., 2023). In the observed lessons, however, the direct evidence concerns the use of particular Qur'anic references, an environmental-care learning indicator, and associated classroom activities. Therefore, the study illustrates a pedagogical connection between science content and Islamic ethics; it does not establish that students comprehensively understood or internalized each of these theological concepts.

The principal interpretive issue is how value integration moves from curriculum intentions into learning experiences. Research on Islamic boarding-school environmental curricula demonstrates how Islamic values can be operationalized through curriculum design, while remaining institutionally distinct from elementary science lessons (Lutfauziah et al., 2023). In this case, lesson plans connected scientific content with environmental responsibility, the science and PAI teachers described cooperation in selecting relevant references, and pupils encountered environmental topics through practical activities. Whereas Rohman et al. (2024) examine eco-theology within religious and character education curricula, Sutiana and Nugraha (2025) consider the integration of Islamic values and science in Islamic primary education. The present case connects these perspectives through documented lesson-planning, teacher collaboration, and school environmental activities; it does not establish the comparative effectiveness of these approaches.

The value–action literature emphasizes the importance of learning settings and whole-school processes rather than assuming that values translate automatically into action (Portus et al., 2024). Across interviews, observations, and documents, three linked dimensions explain the organization of the practices reported here: curriculum integration, experiential learning, and school-culture

reinforcement. Curriculum integration gave ecological responsibility a place in lesson objectives; experiential activities made care for natural resources visible in school tasks; and recurring school programs provided occasions for similar practices beyond individual science lessons. Figure 2 represents this relationship as a case-based interpretive framework. Its contribution is to specify how the dimensions coexist and connect within a single integrated school environment, not to claim that the arrows identify independently tested causes of students' environmental character.

The observed behaviors and students' responses are compatible with this interpretation, but they require careful reading. Observation ratings were generally in the frequent range, and 85% of questionnaire respondents agreed or strongly agreed that science lessons had made them more environmentally aware. These indicators describe reported awareness and practices during the study rather than objectively measured improvement. Research on environmental literacy has likewise considered knowledge, attitudes, and behavior as related dimensions (Gunamantha & Dantes, 2025; Baierl et al., 2025); the present study adds a context-sensitive account of the religious and instructional meanings attached to these dimensions without demonstrating their causal relationship.

Consistent with Vesterinen and Ratinen (2024), who synthesize evidence on primary-school sustainability competences, this interpretation gives particular attention to values, collaboration, and action-oriented learning without treating them as interchangeable constructs. Accordingly, the distinctive contribution is not a general claim that Islamic teaching improves environmental outcomes. Rather, it differentiates normative framing in curriculum plans, enactment in experiential tasks, and reinforcement through institutional routines, showing how these educational levels were related within the case. This process-level contribution responds to the gap identified in the Introduction and provides a basis for examining which arrangements may be transferable to other integrated elementary schools. Claims about long-term character formation or the comparative superiority of religiously integrated science instruction would require additional evidence.

4.2 Experiential and Project-Oriented Activities as Pedagogical Strategies

Experiential and project-oriented activities constituted the second dimension of integration. Recent international scholarship highlights the potential of inquiry- and project-oriented learning to connect science concepts with sustainability problems, while noting the importance of implementation quality and assessment alignment (Kopbossyn et al., 2025; Kosherbayeva et al., 2026). Observations documented school-garden exploration, simple water filtration, and hydroponic vegetable planting, while the science teacher described environmental posters and classroom greening projects. These activities created

concrete situations in which children could discuss water, plants, and resource use while participating in environmental tasks. Their pedagogical value in this case lies in connecting a scientific topic with a visible practice; the observations alone do not show whether pupils acquired greater conceptual understanding or environmental commitment than they would have through another approach.

This pattern can be interpreted through participatory and constructivist accounts of project-based learning, in which learners investigate meaningful questions and engage with authentic tasks (Bell, 2010; Kopbossyn et al., 2025). Qualitative research with sixth-grade pupils also illustrates how engagement with environmental challenges can incorporate cognitive, affective, and action-oriented experiences (Gal, 2024). In an integrated Islamic school, the added educational possibility is to connect those tasks with ethical reflection: conserving water can be discussed both as responsible resource use and as a religiously meaningful duty. The case illustrates this alignment in learning activities and teacher accounts. It does not, however, directly document students' reflective reasoning in sufficient detail to establish how each learner related the religious principle to the scientific explanation.

The label "project-based learning" requires particular caution when interpreting this evidence. The teacher reported using PBL, and environmental projects were described. However, the data presented do not specify a full project cycle, the duration of each project, assessment rubrics, or evidence of students' independent inquiry. Consequently, the findings most securely support the presence of experiential and project-oriented strategies, rather than a determination that a particular PBL model was fully implemented or effective. This distinction matters because the quality of a pedagogical strategy cannot be inferred from the presence of hands-on activities alone (Bell, 2010).

Comparisons with the literature further clarify the contribution. Kusufa et al. (2026) analyzed problem-based learning and ecological awareness in social studies, whereas this study examines value integration in elementary science as a situated process; the instructional approaches and research designs must not be conflated. Bell (2010) describes the educational rationale for project-based learning, whereas Noor and Anwar (2025) focus on connecting Qur'anic and Hadith-based environmental education with primary-school learning. The activities at SDIT at Taqwa bring these two concerns into the same instructional setting. The case thus provides an example of how opportunities for scientific inquiry and religiously framed environmental responsibilities can be organized together, without assuming that either body of literature independently establishes the outcomes observed at this school.

A plausible pedagogical mechanism is the repeated movement between explanation, action, and reflection: pupils encounter a science concept, carry out a related environmental task, and are invited to consider its ethical significance.

The current data document the first two elements more directly than the third. Therefore, this interpretation remains a proposition based on observed teaching practices, not a verified sequence of student learning. Future lesson-level studies could examine pupils' explanations, work products, and reflective conversations to determine how scientific knowledge and ecological values become connected in their thinking.

For practice, these findings suggest that science and PAI teachers may benefit from jointly identifying scientific learning goals, selecting relevant ethical references, and designing tasks in which pupils explain both the natural process and their environmental decisions. Schools could also assess students' scientific reasoning separately from participation or compliance with environmental routines. Evidence that outdoor experiences can shape pupils' dispositions toward science and nature (Collins et al., 2025) strengthens the rationale for investigating such experiences. However, it does not establish the same outcomes in this case. These recommendations follow from the observed coordination and activity patterns; the study did not systematically examine time constraints, instructional resources, or teacher competence, so those factors should not be presented as empirically demonstrated obstacles in this case.

4.3 Behavioral and Character Development in Students

Students' environmental character was examined through observable school practices and self-reported perceptions rather than through a longitudinal measure of change. The observation indicators recorded proper waste disposal (3.6), water conservation (3.4), classroom cleanliness (3.5), and participation in green activities (3.3) on a four-point scale. Teacher role modeling was rated 3.7 and should be interpreted as an aspect of the learning environment rather than a student behavior outcome. The ratings describe a set of observations and cannot distinguish the effects of science teaching from wider school routines, prior student dispositions, or observer-related responses.

Questionnaire responses offered a complementary but distinct perspective. Approximately 85% of 60 pupils reported greater environmental awareness through science lessons; 78% reported frequent connections to Qur'anic verses or Hadith; 75% described feeling spiritually closer to Allah when studying nature; and 82% reported participating in environmental activities. These responses suggest that many pupils perceived connections among science learning, religion, and environmental action. Because the items captured perceptions at one point in time, they cannot demonstrate increases in spiritual awareness, stable character traits, or the independent contribution of religious references to behavior.

This differentiation between awareness, participation, and durable conduct is consistent with environmental education scholarship that treats knowledge and action as related but nonidentical concerns (Tilbury, 1995; Gunamantha &

Dantes, 2025; Portus et al., 2024; van de Wetering et al., 2022). Noor and Anwar (2025) place Qur'anic and Hadith perspectives within primary-school environmental education, offering a relevant ethical counterpart. The present findings indicate that pupils encountered both forms of learning within the same setting. They do not show that the religious dimension was the determining factor in the frequency of observed practices, nor that students' scientific understanding was directly assessed.

Research evaluating environmental education field trips underscores the importance of distinguishing between a learning experience and evidence of lasting behavioral outcomes (Whitburn et al., 2023). The annual school report provides a longer-term institutional view, recording participation in environmental activities at 65% in the preceding year and 85% during the study period. These figures suggest that participation was documented at different levels across the two reporting periods. However, the manuscript does not establish equivalent denominators, measurement procedures, or the influence of other school activities. The reported difference should therefore not be treated as a measured effect of the science lessons or the ecological integration framework.

An important interpretive insight is that, in this case, ecological conduct was situated within overlapping learning settings. Students encountered environmental responsibility in lessons, hands-on activities, and recurring school routines, while teachers described explicit role modeling. Therefore, the three-dimensional framework locates reported awareness and observed practices within a broader educational ecology rather than attributing them to a single lesson or method. Its explanatory value is conceptual: it makes the relevant classroom and institutional relationships visible for future investigation.

The evidence also sets boundaries for claims about character development. Three observed Grade V science lessons, questionnaires from 60 Grade IV and V pupils, staff interviews, and institutional documents provide useful triangulation but not baseline measures, follow-up observations, or independent information about home practices. Variation in family support, persistence of behaviors outside school, and individual developmental trajectories cannot be established from the reported data. Self-reporting may also be sensitive to social desirability, particularly where environmental care is an explicit school norm; this is a methodological possibility, not a bias directly measured here. A longer-term study combining repeated observations, student work, and pupil or family perspectives would be needed to assess whether reported practices persist and why.

4.4 The Role of School Culture in Strengthening Integration

School culture constituted the third dimension linking classroom instruction with everyday environmental routines. An Indonesian school-environment study similarly identifies institutional and psychosocial contexts as relevant to sustainable practices. However, its mixed-methods evidence does not establish

the effects of specific routines in this case (Rahmania, 2024). The principal described the Green Islamic School program, including Friday Clean-Up, classroom cleanliness competitions, and monthly tree planting; school records also documented environmental activities. These programs gave environmental care an institutional presence beyond a single science topic. Their significance to the case is that students could encounter similar expectations in different school settings, although the available evidence does not isolate the contribution of any individual program.

The role of institutional practice is particularly relevant to integrated elementary education, where classroom learning and character formation are expected to connect. Juliani et al. (2024) discuss environmental education within a Green Islamic School curriculum, while Lutfauziah et al. (2023) examine the development of environmental curricula in Islamic boarding schools. Research in JIEEd also describes how character education at an Islamic elementary school was supported by culture, routines, and teacher practices (Mansur & Sholeh, 2024). Compared with these different educational contexts, the present case demonstrates how ecological themes appeared across elementary science plans, environmental activities, and school routines. Those comparisons support conceptual relevance, not the transfer of effectiveness findings from secondary or residential Islamic settings to this primary school.

Teacher role modeling offers another plausible link between stated values and pupils' everyday experiences. It had the highest observation rating (3.7), and the science teacher described bringing reusable water bottles as a practical way to reduce plastic waste. These data suggest that teachers made environmental expectations visible through their own conduct. Nevertheless, neither the rating nor the interview establishes that pupils copied specific behaviors due to this modeling. The distinction between documented adult practice and inferred student influence should remain explicit.

The findings also help refine the relationship between environmental education and Islamic character education. Studies of the Pancasila Student Profile in Islamic elementary contexts discuss religious character formation (Puspitasari et al., 2025; Mansur & Sholeh, 2024), while eco-theological curriculum research addresses environmental ethics (Rohman et al., 2024). At SDIT at Taqwa, these concerns are addressed through a shared organizational setting: a science lesson could introduce a natural process, Islamic references could frame responsibilities related to it, and school routines could provide opportunities for related actions. This is the conceptual relationship illustrated in Figure 2.

A practical implication is to treat school culture as a context for learning rather than merely a list of environmental campaigns. A qualitative study in a Spanish primary school likewise emphasizes the role of adult mediation and

integrated learning experiences in cultivating sustainability-oriented understanding, while using a different curricular medium (Muela-Bermejo & Pérez-Martínez, 2025). Teachers and school leaders could align learning objectives, environmental activities, teacher examples, and age-appropriate reflection so that pupils have opportunities to explain why a practice matters. Evidence about the quality of these connections would be stronger if future studies included pupils' work, observations across more grade levels, and explicit criteria for evaluating both scientific understanding and environmental responsibility. The present case supports this direction as an informed implication, not as a tested implementation guideline.

Overall, this single-school study offers an empirically grounded, case-based framework that connects Islamic ecological values, the science curriculum, experiential activities, and school culture. Transferability depends on how other schools organize their curricula, collaborate with teachers, and manage institutional routines. The descriptive evidence does not establish causal effects or long-term character development. The principal scholarly contribution is the articulation of interrelated educational processes; the practical contribution is a set of considerations for coordinated teaching and school routines. Future multi-site and longitudinal research should test and refine these connections, including how pupils interpret ecological ethics and whether their practices extend beyond school.

5. Conclusion

This qualitative case study found that Islamic ecological values were incorporated into science learning at SDIT At Taqwa, Bekasi, through lesson objectives and Qur'anic references, experiential and project-oriented activities, and schoolwide environmental routines. The science and Islamic Education (PAI) teachers described coordinating religious references with scientific topics; classroom observations documented these connections in water-cycle and plant lessons, as well as in school-garden activities, water filtration, and hydroponic planting. School documents and the principal's account showed that organized environmental programs were integrated into classroom practices.

Students' questionnaire responses and school observations indicated that environmental awareness and participation were visible within this integrated setting. Approximately 85% of surveyed pupils reported that science lessons had made them more environmentally aware, and 82% reported participating in environmental activities. Observation ratings also documented recurring practices such as proper waste disposal and water conservation. These descriptive indicators, however, do not establish that the integration caused improvements in environmental character, scientific achievement, or sustained behavioral change.

The study's principal scholarly contribution is a case-based interpretive framework connecting three dimensions of integrated elementary education: curriculum integration, experiential learning, and school culture. Rather than establishing a universally effective model, this framework specifies how Islamic ecological ethics, scientific content, instructional experiences, and institutional routines were connected in one school. For practice, the findings suggest coordinated planning between science and PAI teachers, linking environmental tasks to scientific explanations, and maintaining consistent school routines, while assessing scientific understanding and environmental practices as distinct outcomes. The approach may inform sustainability-oriented education and the Pancasila Student Profile, but progress toward those broader goals was not measured.

The findings are limited to one school, three observed Grade V science lessons, and descriptive questionnaire responses from 60 pupils in Grades IV and V, with no reported baseline assessment or longitudinal follow-up. Details of the questionnaire development, observation-rating rubric, and school-report denominators also require verification against the primary research records. Accordingly, the framework's transferability and any effects on lasting character development remain untested. Future multi-school and longitudinal studies should examine pupils' reasoning about scientific and ethical connections, document complete project-based learning cycles, validate behavioral instruments, and assess environmental practices in school and home contexts over time.

Declarations

All authors approved the final manuscript and declared no competing interests. The study complied with ethical standards, obtained necessary consent, and ensured confidentiality. Grammarly assisted with academic language editing and citation consistency. No research data were AI-generated. The authors verified the manuscript and retain full responsibility for its content.

References

- Amaliati, S., Rusydiyah, E. F., & Bakar, M. Y. A. (2024). Ecopedagogy and environmental literacy in research trends in Indonesia. *QALAMUNA: Jurnal Pendidikan, Sosial, dan Agama*, 16(2), 1083–1100. <https://doi.org/10.37680/qalamuna.v16i2.5359>
- Baierl, T.-M., Paul, J., & Bogner, F. X. (2025). From attitudes to action: A multidimensional model for sustainability education. *Frontiers in Education*, 10, Article 1654082. <https://doi.org/10.3389/educ.2025.1654082>

- Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 83(2), 39–43. <https://doi.org/10.1080/00098650903505415>
- Collins, M. A., Romero, V. F., Young, A., Dorph, R., Foreman, J., Strang, C., Pande, A., & Laina, V. (2025). The value of outdoor environmental education programs for girls and youth of color: Cultivating positive dispositions toward science and the environment. *Environmental Education Research*, 31(1), 108–133. <https://doi.org/10.1080/13504622.2024.2340502>
- Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publications.
- Gal, A. (2024). Fostering positive engagement: Climate change and environmental activism in the sixth-grade classroom. *Environmental Education Research*, 30(12), 2272–2290. <https://doi.org/10.1080/13504622.2024.2369804>
- Gunamantha, I. M., & Dantes, I. N. (2025). Cultivating environmental literacy in the classroom: A study of knowledge, attitudes, and behavior toward 3R in Indonesian elementary education in support of SDG 4.7. *Journal of Lifestyle and SDGs Review*, 5(6), Article e06779. <https://doi.org/10.47172/2965-730X.SDGsReview.v5.n06.pe06779>
- Juliani, Mahdi, H., Sari, S. W., Sari, S. I., & Nazwa, N. R. (2024). Green Islamic school: Integrating environmental education in the Islamic education curriculum. *Cendekiawan: Jurnal Pendidikan dan Studi Keislaman*, 3(3), 565–574. <https://doi.org/10.61253/cendekiawan.v3i3.270>
- Kopbossyn, A., Laiskhanov, S., Aksoy, B., Tokbergenova, A., Nametkulov, M., & Kozybakova, A. (2025). Integrated STEM for sustainability in school and early teacher education: A systematic review (2019–2025). *Frontiers in Education*, 10, Article 1697058. <https://doi.org/10.3389/feduc.2025.1697058>
- Kosherbayeva, S., Karbaeva, S., Umirzakova, N., Amirasheva, B., Tulenova, U., & Amantayeva, A. (2026). Project-based environmental education for developing socio-ecological values and sustainable behaviour among Kazakhstani school students. *Frontiers in Education*, 11, Article 1794619. <https://doi.org/10.3389/feduc.2026.1794619>
- Kusufa, R. A. B., Linjon, L., & Sari, Y. I. (2026). Building ecological awareness in coastal elementary schools: The impact of problem-based learning and learning motivation. *Journal of Integrated Elementary Education*, 6(1), 65–81. <https://doi.org/10.21580/jieed.v6i1.29439>
- Lutfauziah, A., Al-Muhdhar, M. H. I., Suhadi, & Rohman, F. (2023). Curriculum development for environmental education at an Islamic boarding school. *Journal of Turkish Science Education*, 20(3), 490–503. <https://doi.org/10.36681/tused.2023.028>

- Mansur, M., & Sholeh, M. (2024). Implementing character education based on local wisdom in a public Islamic elementary school. *Journal of Integrated Elementary Education*, 4(1), 54–70. <https://doi.org/10.21580/jieed.v4i1.20238>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). SAGE Publications.
- Muela-Bermejo, D., & Pérez-Martínez, L. (2025). Enhancing sustainability education through critical reading: A qualitative study in a Spanish primary school. *Environmental Education Research*, 31(5), 1033–1047. <https://doi.org/10.1080/13504622.2024.2408428>
- Muin, A., Rosyid, M. Z., Rahman, H., & Rofiqi. (2025). Ecological tauhid-based green school management: A case study of the implementation of eco-pesantren at Mambaul Ulum Islamic Junior High School, Pamekasan. *EDUKASIA: Jurnal Pendidikan dan Pembelajaran*, 6(1), 551–562. <https://doi.org/10.62775/edukasia.v6i1.1457>
- Nisa, R., Wijaya, H., Asrin, Istiningsih, S., Sumardi, L., & Fahrudin. (2024). Implementation of Pancasila student profile character education in the independent curriculum. *International Journal of Multicultural and Multireligious Understanding*, 11(9). <https://doi.org/10.18415/ijmmu.v11i9.6045>
- Noor, M., & Anwar, K. (2025). Fostering ecological awareness from an early age: Integrating environmental education based on the Qur'an and Hadith into primary school learning. *Tunas: Jurnal Pendidikan Guru Sekolah Dasar*, 10(2), 191–197. <https://doi.org/10.33084/tunas.v10i2.10117>
- Nugraha, L., Saud, U. S., Hartati, T., & Damaianti, V. S. (2022). Profile of learning environmental literacy in elementary school. *PrimaryEdu: Journal of Primary Education*, 6(2), 211–222. <https://doi.org/10.22460/pej.v6i2.3139>
- Nur, A., Husin, H. B., Alwizar, & Yasir, M. (2025). Qur'anic ecotheology and the ethics of forest protection in Indonesia. *Jurnal Studi Ilmu-ilmu Al-Qur'an dan Hadis*, 26(2), 351–382. <https://doi.org/10.14421/qh.v26i2.6312>
- Portus, R., Aarnio-Linnanvuori, E., Dillon, B., Fahy, F., Gopinath, D., Mansikka-Aho, A., Williams, S.-J., Reilly, K., & McEwen, L. (2024). Exploring the environmental value action gap in education research: A semi-systematic literature review. *Environmental Education Research*, 30(6), 833–863. <https://doi.org/10.1080/13504622.2024.2314060>
- Puspitasari, D., Amrullah, M., & Rezania, V. (2025). The implementation of the Pancasila student profile Rahmatan Lil' Alamin approach on the religious character of elementary school. *Metodik Didaktik*, 21(1), 78–89. <https://ejournal.upi.edu/index.php/MetodikDidaktik/article/view/88362>
- Rahmania, T. (2024). Exploring school environmental psychology in children and adolescents: The influence of environmental and psychosocial factors on

- sustainable behavior in Indonesia. *Heliyon*, 10(18), Article e37881. <https://doi.org/10.1016/j.heliyon.2024.e37881>
- Rohman, A., Kurniawan, E., Syifauddin, M., Muhtamiroh, S., & Muthohar, A. (2024). Religious education for the environment: Integrating eco-theology in the curriculum of Islamic religious and character education to enhance environmental education in Indonesia. *Nadwa: Jurnal Pendidikan Islam*, 18(2), 201–226. <https://doi.org/10.21580/nw.2024.18.2.21094>
- Sutiana, D., & Nugraha, M. S. (2025). Integration of Islamic values and science in Islamic primary schools: A philosophy of science approach. *Journal of Elementary Education Research and Practice*, 1(1), 21–34. <https://doi.org/10.70376/bv7bqx53>
- Tilbury, D. (1995). Environmental education for sustainability: Defining the new focus of environmental education in the 1990s. *Environmental Education Research*, 1(2), 195–212. <https://doi.org/10.1080/1350462950010206>
- van de Wetering, J., Leijten, P., Spitzer, J., & Thomaes, S. (2022). Does environmental education benefit environmental outcomes in children and adolescents? A meta-analysis. *Journal of Environmental Psychology*, 81, Article 101782. <https://doi.org/10.1016/j.jenvp.2022.101782>
- Vesterinen, M., & Ratinen, I. (2024). Sustainability competences in primary school education—A systematic literature review. *Environmental Education Research*, 30(1), 56–67. <https://doi.org/10.1080/13504622.2023.2170984>
- Whitburn, J., Abrahamse, W., & Linklater, W. L. (2023). Do environmental education fieldtrips strengthen children’s connection to nature and promote environmental behaviour or wellbeing? *Current Research in Ecological and Social Psychology*, 5, Article 100163. <https://doi.org/10.1016/j.cresp.2023.100163>
- Wilujeng, I., Dwandaru, W. S. B., & Rauf, R. A. B. A. (2019). The effectiveness of education for environmental sustainable development to enhance environmental literacy in science education: A case study of hydropower. *Jurnal Pendidikan IPA Indonesia*, 8(4), 521–528. <https://doi.org/10.15294/jpii.v8i4.19948>