

ECO-THEOLOGICAL INTEGRATION IN CHEMISTRY LEARNING: TEACHER STRATEGIES, INSTITUTIONAL SUPPORT, AND STUDENT TRANSFORMATION IN ISLAMIC EDUCATION

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Abstract

While eco-theology has been widely discussed in Islamic educational discourse, empirical studies examining its implementation in chemistry classrooms remain limited. This study investigates how eco-theological values are integrated into chemistry learning in an Islamic senior high school and examines the roles of instructional practices, teacher role modelling, and institutional support in fostering students' environmental awareness and responsibility. Using a qualitative case study design, data were collected through classroom observations, semi-structured interviews with teachers and eleventh-grade students, and analysis of learning documents at MAN 1 Kota Malang, Indonesia. The findings show that eco-theological values are systematically embedded in lesson planning, learning activities, and assessment indicators, particularly in green chemistry and environmental topics. Most importantly, the integration is reflected in students' increased environmental awareness, responsibility, and care, as seen in daily practices such as waste reduction, cleanliness, and resource conservation. Learning is conducted through contextual discussions, environmental projects, and reflective dialogues that connect chemical concepts to moral and spiritual responsibility. Teachers play a crucial role as role models by demonstrating environmentally responsible behavior and laboratory ethics. Institutional support through co-curricular programs and green madrasah initiatives strengthens the consistency of value internalization. The study concludes that chemistry learning can function not only as scientific instruction but also as an effective medium for developing eco-theological awareness. This integration enables chemistry education in madrasahs to contribute to holistic student development, combining intellectual competence, moral character, and spiritual responsibility.

Keywords: eco-theology; chemistry learning; green madrasah; environmental values; character education

Abstrak

Meskipun ekoteologi telah banyak dibahas dalam wacana pendidikan Islam, studi empiris yang meneliti penerapannya di kelas kimia masih terbatas. Studi ini menyelidiki bagaimana nilai-nilai ekoteologi diintegrasikan ke dalam pembelajaran kimia di sebuah sekolah menengah atas Islam serta meneliti peran praktik pengajaran, teladan guru, dan dukungan institusional dalam menumbuhkan kesadaran dan tanggung jawab lingkungan siswa. Penelitian ini menggunakan desain studi kasus kualitatif dengan teknik pengumpulan data melalui observasi kelas, wawancara semi-terstruktur dengan guru dan siswa kelas XI, serta analisis dokumen pembelajaran di MAN 1 Kota Malang. Hasil penelitian menunjukkan bahwa nilai-nilai ekoteologi terintegrasi secara sistematis dalam perencanaan pembelajaran, aktivitas belajar, dan indikator penilaian, khususnya pada topik kimia hijau dan lingkungan. Pembelajaran dilaksanakan melalui diskusi kontekstual, proyek lingkungan, dan dialog reflektif yang mengaitkan konsep kimia dengan tanggung jawab moral dan spiritual. Guru berperan penting sebagai teladan melalui perilaku ramah lingkungan dan penerapan etika di laboratorium. Dukungan institusional melalui program kokurikuler dan inisiatif madrasah hijau memperkuat konsistensi internalisasi nilai-nilai. Dampaknya, siswa menunjukkan peningkatan kesadaran, tanggung jawab, dan kepedulian

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lingkungan yang tercermin dalam praktik sehari-hari seperti pengurangan sampah, menjaga kebersihan, dan penghematan sumber daya. Penelitian ini menyimpulkan bahwa pembelajaran kimia tidak hanya berfungsi sebagai pengajaran ilmiah, tetapi juga sebagai media yang efektif untuk mengembangkan kesadaran ekoteologis. Integrasi ini memungkinkan pendidikan kimia di madrasah berkontribusi pada pengembangan siswa secara holistik yang mencakup kompetensi intelektual, karakter moral, dan tanggung jawab spiritual.

Kata Kunci: *ekoteologi; pembelajaran kimia; madrasah hijau; nilai-nilai lingkungan; pendidikan karakter*

INTRODUCTION

The current worldwide ecological crisis, in the forms of pollution of the natural environment, climate change, destruction of biodiversity, and overusing natural resources, has emerged not only or particularly as a scientific and technical challenge but has increasingly come to be perceived as a moral and spiritual crisis whose roots are located in human perceptions and values about nature. All environmental issues are closely related to anthropocentric perceptions and concepts of the world that consider humans as the absolute proprietors of nature (Alfiyah, Yuliawati, & Utami, 2024). Furthermore, such perceptions and concepts have led to imbalances in nature, creating environmental injustices that have raised questions about the role of education in teaching and promoting a sense of responsibility for nature and moral and spiritual values (Spash, 2022).

In the field of religious education, environmental issues, especially in Muslim education, cannot be separated from a theological framework. This is because, in Islam, the relationship between humans and the environment is conceptualized through the idea of *amanah*, or trust, which does not entail domination or unbridled use. Through the Qur'anic idea of *khalifah fil 'ardh*, humans are conceptualized as the representatives or the vicegerents on the earth who have been entrusted with the responsibility for the preservation

and proper use of the environment. Thus, environmental destruction will not only be an unfulfilled ecological responsibility but also a neglect of the spiritual or moral responsibility to God Almighty. This gives rise to the idea of eco-theology. This serves to conceptualize and reconcile spiritual or moral values associated with faith and ecological awareness, in the sense that concern for the environment must be grounded in such devotion.

Recently, eco-theology discussion has received extensive attention in Islamic education, especially within the framework of value-based learning for current environmental issues. However, most efforts to date on eco-theology and its role in the educational system have been normative, focusing on issuing theological statements and moral lessons rather than on the empirical aspects of pedagogical processes. This resulted in a significant gap between the ideal and actual implementation of the theology in classroom learning, particularly in the so-called non-religious subjects.

Science education, especially chemistry education, has significant potential to address the aforementioned concern. This is because there is an inherent relationship between chemistry and issues such as water and air pollution, waste treatment, chemical reactions in industrial processes, and the use of natural resources (Araripe & Zuin Zeidler, 2024; Lopez-Fernandez, Cano-

Iglesias, & Franco-Mariscal, 2025). From the perspectives of green chemistry, reaction rates, buffer solutions, and colloid solutions, science education, specifically chemistry education, has significant potential to explore the effects of human actions on the environment (Guerrero & Sjöström, 2025; Jegstad, 2024). In analyzing science education, specifically chemistry education, along these lines, it is possible to attain scientific knowledge as well as critical knowledge encompassing sustainability and responsibility towards nature.

Despite its potential, however, learning chemistry in educational institutions remains largely cognitive. This learning focus remains on concepts and practices in the lab rather than on other aspects of learning, such as affectivity, morality, and spirituality in learning chemistry (Mashami, Ahmadi, & Pahriah, 2025). Similarly, in madrasahs, it is clear that moral values are dominated by Islamic Religious studies, particularly PAI, rather than by Science subjects, which are regarded as self-contained, valuable disciplines. As a result, students are not able to achieve holistic learning in chemistry, in which scientific knowledge is integrated with religious values. Through this, students can be competent in chemistry but not necessarily ecologically responsible, as shaped by their religious beliefs.

The madrasah has pursued institutional efforts to strengthen

character education, religious moderation, and environmental awareness through various policies and programs, especially those of the Ministry of Religious Affairs. Initiatives such as co-curricular programs like the Pancasila Student Profile and *Rahmatan Lil Alamin* Student Profile Strengthening Project (P5-PPRA), Green Madrasah Programs, and Contextual project-based learning indicate an increasing commitment to integrating religious values with current social issues and the environment. These policies hence provide structural support for embedding eco-theological values across most subjects, including science education.

MAN 1 Kota Malang itself is a relevant and strategic case for research on the incorporation of eco-theological values into chemistry learning. MAN 1 Kota Malang is an Islamic Senior High School managed by the Ministry of Religious Affairs, with a vision to instill intellectual superiority, noble traits, and ecological insight in students simultaneously. Rich contexts are provided by applying green madrasah programs, project-based learning, and value-driven learning program plans to examine how eco-theological values can be incorporated into the institutional vision, including in chemistry education.

Previous studies on environmental education and integrated values in Islamic schools

have focused either on subject matter in Islamic Religious Education or on the overall characteristics of character education (Husin, Helmi, Nengsih, & Rendana, 2025; Mashami et al., 2025). Concerns about implementing eco-theological values in science education, particularly in chemistry, remain unclear and underexplored. Moreover, Previous studies on environmental and sustainability education have largely examined outcomes such as environmental awareness, pro-environmental attitudes, scientific literacy, and behavioral change among students (Van de Wetering et al., 2022; Husin et al., 2025; Mashami et al., 2025). While these studies provide valuable evidence regarding educational effectiveness, they offer limited insight into the pedagogical and institutional processes through which environmental and ethical values are internalized in classroom practice. Consequently, there remains a need for research that explores how such values are integrated, enacted, and experienced within specific educational contexts.

To fill this gap, the current research explores how chemistry learning processes at MAN 1 Kota Malang can be used to reinforce and enhance students' eco-theological values. Specifically, this research explores how eco-theological values are implemented in lesson design and classroom instruction, reflected in teachers' behavior and organizational

support, and specified within madrasahs in MAN 1 Kota Malang. Furthermore, the study explores how students perceive, experience, and internalize eco-theological values and how these values are reflected in their everyday environmental attitudes and behaviors.

The study's originality stems from its empirical approach and the application of eco-theological principles to learning chemistry in the madrasah. Compared with studies on the application of eco-theological principles to learning chemistry, which are largely theoretical, this study is important because it explains how learning chemistry serves as a forum for engaging science and religion in applying eco-theological principles through role modeling and teamwork in the madrasah. Beyond its contribution to eco-theological and environmental education research, this study advances discussions of holistic learning by illustrating how learning chemistry can simultaneously foster scientific understanding, moral awareness, spiritual reflection, and environmentally responsible behavior.

It is hoped that the research will make theoretical contributions to the growth of eco-theology and value-based science education and have implications for chemistry teachers, madrasah leaders, and policymakers in the Ministry of Religious Affairs. Although the research shows that chemistry learning outcomes can

contribute to the development of ecological awareness grounded in religious values, it also underscores the madrasah's role in cultivating intellectually competent, spiritually rooted, and ecologically conscious students.

Based on the identified research gap, this study is guided by the following research questions:

1. How are eco-theological values integrated into chemistry lesson planning and classroom learning activities in an Islamic senior high school?
2. How do chemistry teachers promote and model eco-theological values during the learning process?
3. What forms of institutional support facilitate the integration of eco-theological values into chemistry learning?
4. How do students perceive and internalize eco-theological values through chemistry learning, and how are these reflected in their environmental attitudes and behavior?

These questions provide a framework for examining the processes, actors, and outcomes involved in integrating eco-theological values into chemistry education in the madrasah context.

METHOD

Research Design

This study used a qualitative descriptive case study design. In this

research, a qualitative approach was conducted to understand how eco-theological values were integrated, implemented, and internalized through chemistry learning in a madrasah context. A qualitative case study design was employed because it enables researchers to investigate a contemporary phenomenon within its real-life context and develop a holistic understanding of the multiple factors shaping it (Ebneyamini, Reza, & Moghadam, 2018). In the present study, the case study approach facilitated an in-depth examination of pedagogical practices, teacher strategies, institutional support, and students' lived experiences related to integrating eco-theological values into chemistry learning in their natural educational setting.

Research Site and Participants

The research was conducted at MAN 1 Kota Malang, an Islamic senior high school managed by the Ministry of Religious Affairs and actively engaged in character development, environmental education, and value-based learning initiatives. The school has implemented various co-curricular environmental programs and the Green Madrasah initiative, which support the development of students' environmental awareness and responsibility. The participants were purposively selected for their direct involvement in chemistry learning integrated with eco-theological values. The study involved two chemistry

teachers, twelve eleventh-grade students, and one vice-principal for curriculum affairs. Classroom observations were conducted in two eleventh-grade science classes across six chemistry learning sessions. The chemistry teachers were selected because they were directly responsible for planning and implementing eco-theology-integrated chemistry instruction. At the same time, the students were chosen to represent different levels of participation and engagement in classroom learning activities.

Consistent with the case study design, participants were selected through purposive sampling to include individuals with direct knowledge and experience of the phenomenon under investigation (Xu, Wang, & Qian, 2025). The selection focused on information-rich cases, including chemistry teachers who implemented eco-theology-integrated instruction, students who participated in learning activities, and school administrators who supported environmental and value-based education programs. This strategy enabled the collection of detailed, contextually grounded data on the processes by which eco-theological values were integrated into chemistry learning.

Classroom observations were conducted in two eleventh-grade science classes over six chemistry learning sessions during the second semester of the 2024/2025 academic

year. These observations focused on instructional practices, teacher-student interactions, and the integration of eco-theological values into chemistry learning activities.

Data Sources

Data was collected through both primary and secondary sources. The primary data were collected through classroom observation and semi-structured interviews with the chemistry teachers and students. Secondary data were collected from instructional materials, including lesson plans, assignments, and learning materials on the value of eco-theology and environmental studies. The use of the two data approaches enabled triangulation, making the data credible.

Data Collection Techniques

Non-participatory observations were conducted in two eleventh-grade chemistry classes over six learning sessions during the second semester of the 2024/2025 academic year. The observations focused on how eco-theological values were integrated into lesson delivery, classroom discussions, laboratory activities, teacher role modeling, and student participation. Observation data were recorded through detailed field notes and subsequently triangulated with interview and document analysis data to enhance the credibility of the findings.

Semi-structured interviews were conducted with two chemistry teachers and twelve eleventh-grade students who participated in eco-theology-integrated chemistry learning. Each interview focused on participants' experiences, perceptions, and responses to the integration of eco-theological values in chemistry education. Interviews lasted approximately 30–60 minutes and were audio-recorded with participants' consent. Semi-structured individual interviews were conducted with two chemistry teachers, twelve eleventh-grade students, and one vice-principal for curriculum affairs. The interviews explored participants' experiences, perceptions, and reflections on integrating eco-theological values into chemistry learning. Teacher interviews focused on instructional planning, teaching strategies, and challenges encountered during implementation, whereas student interviews examined learning experiences, value internalization, and perceived behavioral changes. Each interview lasted between 30 and 60 minutes and was audio-recorded and transcribed verbatim for analysis. Semi-structured interviews were selected because they enabled the researcher to maintain consistency across participants while allowing sufficient flexibility to explore emerging themes and contextual insights relevant to the study objectives (Xu et al., 2025).

This involved analyzing the document to establish the congruence between the value-based instructional planning and implementation. The learning documents were scrutinized to assess the integration of eco-theology values into the learning objectives, materials, activities, and procedures.

The research was conducted at MAN 1 Kota Malang, an Islamic senior high school under the Ministry of Religious Affairs that actively promotes environmental awareness and character education through programs such as P5-PPRA and the Green Madrasah initiative.

The participants were purposively selected for their direct involvement in eco-theology-integrated chemistry learning. The participants consisted of two chemistry teachers, twelve eleventh-grade students from science classes, and one vice-principal for curriculum affairs. The chemistry teachers were selected because they designed and implemented chemistry learning activities that integrated eco-theological values. The students were selected to represent diverse levels of participation and engagement in chemistry learning activities.

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theological values into chemistry learning activities.

The participants were purposively selected for their direct involvement in eco-theology-integrated chemistry

learning. To enhance the transparency of the research context and data collection process, the characteristics of the participants and observation activities are presented in Table 1.

Table 1. Characteristics of Participants and Data Collection Activities

Participant Group	Code	Number	Role
Chemistry Teachers	T1-T2	2	Main informants
Students (Grade XI)	S1-S12	12	Student perspectives
Vice Principal	VP1	1	Institutional support
Observation Classes	OC1-OC2	2 classes	Learning observation
Observation Sessions	OS1-OS6	6 sessions	Classroom observation

Research Instruments

The primary instrument in the study was the researcher herself, who served as the planner, researcher, and analyst. The other research instruments used were the observation guide, the interview guide, and the document analysis guide. They were developed with reference to indicators of the importance of eco-theology, which can be linked to ecological awareness, ecological responsibility, and religious significance.

The trustworthiness of the research instruments and findings was enhanced through several strategies. First, the observation guide, interview protocol, and document analysis checklist were reviewed by experts in chemistry education and qualitative

methodology to ensure content relevance and clarity. Second, methodological triangulation was employed by combining observations, interviews, and document analysis. Third, an audit trail consisting of field notes, interview transcripts, coding records, and analytical memos was maintained throughout the study. These procedures contributed to the credibility, dependability, and confirmability of the findings.

Data Analysis

The data analysis employed an interactive thematic analysis. This involved data reduction, coding, categorization, and theme formation. The method was applied to data gathered through observation,

interviews, and document analysis to develop themes grounded in values of eco-theology in learning chemistry. This process ensures consistency between themes and ideas of eco-theology.

Qualitative data were analyzed using thematic analysis following the procedures proposed by Braun and Clarke (2021). The analysis began with data familiarization, during which interview transcripts, observation notes, and documentary evidence were repeatedly read to gain an overall understanding of the data. Subsequently, initial codes were generated inductively by identifying meaningful segments related to the integration of eco-theological values in chemistry learning.

The initial codes were then organized into a codebook containing code labels, definitions, inclusion and exclusion criteria, and representative excerpts from the data. Similar codes were grouped into broader categories through a process of constant comparison across data sources. These categories were subsequently

reviewed, refined, and consolidated into overarching themes that captured recurring patterns in the data. Through this iterative process, five themes were identified: instructional planning, learning process, teacher role modeling, institutional support, and student transformation.

To strengthen credibility, methodological triangulation was employed by comparing findings from interviews, observations, and document analysis. Consistency across these sources increased confidence in the interpretation of the findings.

To enhance analytical transparency, Table 2 illustrates an example of the theme development process employed in this study. The table demonstrates how raw qualitative data from interviews, observations, and document analysis were systematically transformed into initial codes, grouped into broader categories, and ultimately synthesized into overarching themes. This process provides a clear audit trail showing how the five themes emerged from the data through iterative analysis and constant comparison.

Table 2. Theme Development Process

Raw Data Excerpt	Excerpt Initial Code	Category	Theme
"I integrate environmental stewardship into lesson objectives."	Integration of environmental values in lesson planning	Curriculum Integration	Instructional Planning
"The teacher connected pollution issues with Islamic teachings."	Linking chemistry concepts with religious values	Classroom Value Integration	Learning Process

"Our teacher always demonstrates proper waste management."	Teacher as environmental role model	Exemplary Practice	Teacher Role Modeling
"The Green Madrasah program supports environmental activities."	Institutional environmental support	School Policy and Programs	Institutional Support
"I now try to reduce plastic use and save water."	Behavioral change toward environmental responsibility	Value Internalization	Student Transformation

Trustworthiness

Several strategies were employed to enhance the study's trustworthiness. Credibility was strengthened through methodological triangulation by comparing evidence obtained from classroom observations, semi-structured interviews, and document analysis. Dependability and confirmability were supported by maintaining a comprehensive audit trail that included field notes, interview transcripts, coding records, and analytical memos. In addition, the research instruments were reviewed by experts in chemistry education and qualitative research to ensure their relevance and clarity. To facilitate transferability, detailed descriptions of the research context, participants, and learning environment are provided, enabling readers to assess the applicability of the findings to other educational settings.

Ethical Considerations

The ethical issues involved in conducting the research have been

addressed. Informed consent has been sought from the participants. The confidentiality of participants has been ensured throughout data collection, analysis, and presentation.

RESULTS & DISCUSSION

This section presents the results of the research on the influence of learning chemistry on students' eco-theological values at MAN 1 Kota Malang. This result has been produced through observation, interviews, and the analysis of relevant documents. The results are presented in Table 3. This result will be discussed from the perspectives of eco-theology and values education. The thematic analysis identified five major themes related to the integration of eco-theological values in chemistry learning. To provide greater analytical transparency, Table 2 presents each theme together with representative evidence from multiple data sources and the corresponding interpretation.

Table 3. Summary findings from the research conducted

Theme	Empirical Findings	Interview Evidence	Observation Evidence	Document Evidence	Representative Evidence	Analytical Interpretation
Instructional planning	Eco-theological values are explicitly included in the learning objectives and attitude indicators of chemistry teaching modules.	Teachers reported integrating eco-theological values into lesson plans.	Teachers referred to environmental responsibility during lessons.	Teaching modules included environmental stewardship indicators.	Teaching modules explicitly included learning objectives related to environmental responsibility and the concept of khalifah fil ardh. Assessment rubrics incorporated indicators of environmental awareness.	Eco-theological values were systematically embedded in curriculum planning, indicating that their integration was intentional rather than incidental.
Learning process	The use of contextual learning, environmental projects, and reflective discussions	Students described learning connections between chemistry and environmental ethics.	Classroom discussions linked pollution issues with Islamic values.	Project assignments addressed environmental problem-solving.	Classroom observations showed students discussing pollution, waste management, and sustainable chemical practices while linking these issues to Islamic teachings on environmental stewardship.	Chemistry learning functioned as a medium through which scientific knowledge and religious values were interconnected and contextualized.
Teacher role modeling	Teachers demonstrate environmentally friendly behavior and uphold laboratory ethics.	Students perceived environmental role models.	Teachers demonstrated proper waste management practices.	Laboratory guidelines emphasized environmental responsibility.	Teachers consistently demonstrated environmentally responsible behaviors, such as minimizing chemical waste and promoting sustainable laboratory practices.	The internalization of eco-theological values occurred not only through instruction but also through social learning and moral exemplification.

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					Students frequently cited teachers as role models.	
Institutional Support	Integration of chemistry learning with the co-curricular, P5-PPRA program and green madrasah initiatives	School leaders described Green Madrasah initiatives.	Environmental campaigns were observed on campus.	School policy documents promoted sustainability programs.	Green Madrasah programs, P5-PPRA activities, environmental campaigns, and school policies promoted environmental responsibility across curricular and co-curricular contexts.	Institutional support reinforced classroom learning and contributed to a whole-school approach to eco-theological education.
Impact on students	Increased environmental awareness, care, and responsibility	Students reported changes in environmental behavior.	Students voluntarily participated in environmental activities.	Reflection assignments documented increased environmental awareness.	Students reported increased awareness of environmental issues and described behavioral changes such as reducing waste, conserving water, and participating in environmental activities.	Eco-theological values were transferred from classroom learning to students' everyday attitudes and practices, demonstrating meaningful internalization.

The convergence of interview, observation, and document data demonstrates strong triangulation across data sources. This consistency strengthens the credibility of the findings. It confirms that the integration of eco-theological values was reflected not only in participants' perceptions but also in classroom practices and institutional documents.

As shown in Table 3, the integration of eco-theological values occurred through interconnected processes involving curriculum design, classroom practices, teacher role modeling, institutional support, and student transformation. The convergence of evidence across these themes suggests that eco-theological integration in chemistry learning extends beyond cognitive

understanding, contributing to the development of environmentally responsible attitudes and behaviors.

A. Research Results

1. Integration of Eco-Theological Values in Chemistry Lesson Planning

The analysis of the document shows that chemistry educators at MAN 1 Kota Malang integrate eco-theological values into their learning modules. This is even more apparent with modules such as green chemistry, reaction rates, buffer solutions, and colloid solutions. It is possible to detect eco-theological values in lesson objectives, indicators of attitude, and projects that focus on the environment.

In fact, among the learning objectives identified in the teaching module mentioned above is for the students to exhibit responsibility and concern for the environment, hence reflecting God's trust in humanity as caliphs over the earth. The identified objective clearly states the importance of balancing feeling, spirit, and intellect in the process of gaining knowledge in chemistry.

As confirmed by one chemistry teacher (T1) who testified to that effect: "As I develop this module, I include attitude indicators that incorporate concerns for the environment. I want the students to understand that learning chemistry is not merely centered on reactions and equations, but much more on the moral obligation of humanity towards nature, given that

nature is God's creation. "When developing the teaching module, I intentionally integrate environmental responsibility into the learning objectives and assessment indicators. I want students to understand that chemistry is not merely about mastering formulas, reactions, or laboratory procedures. More importantly, chemistry should help them realize the consequences of human actions on nature. Therefore, I often connect chemistry topics with the Islamic concept of *khalifah fil ardh*, so that students understand that protecting the environment is not only a scientific obligation but also a religious responsibility. (Interview with T2, May 12, 2025).

This is reflected in the evaluation tools, which indeed assess not only cognitive achievement but also attitudes pertinent to environmental awareness and responsibility. This shows that eco-theological values are being put into practice rather than being built up in the teaching process.

2. The Implementation of Eco-theological Value-Based Chemistry Learning

The observation of learning revealed the teachers' implementation of the contextual and project approach. For instance, in the green chemistry subject, learners are expected to evaluate the environmental impacts of household chemicals and propose improved alternatives. In one of the

learning modules, learners are formed into groups to study the effects of detergents on water pollution.

The teacher motivates students to think critically about the environmental impacts of chemical reactions and human activities. The students are actively involved in class discussions and projects, in which they are expected to develop environmentally friendly ideas grounded in their chemical knowledge. Observational evidence indicates that students are highly engaged when they relate their ideas in chemistry to environmental issues.

After which, they discuss what they have discovered and relate it to the importance of human involvement in caring for the environment through chemical reactions and the concept of biodegradability. As one student (S1) explained in an interview: "Well, what I believe is that I have discovered the importance of household chemicals on the environment. This chemistry class has made me realize I have the urge to learn and not harm the environment." – Source: Interviewed Student (S1) in the 11th Grade on May 15, 2025.

A student reflected on the learning experience: "Before participating in these learning activities, I usually viewed chemistry as a subject focused on calculations and scientific concepts. However, when we discussed pollution, waste management, and green chemistry, I began to realize that chemistry is closely related to everyday environmental problems. The

discussions helped me understand that our actions, including the way we use household chemicals, can affect the environment. I also learned that taking care of nature is part of our responsibility as Muslims because God has entrusted humans to protect the earth." (S2, May 15, 2025).

Classroom observations revealed that eco-theological values were explicitly integrated into discussions on environmental issues. During a lesson on water pollution, the teacher invited students to analyze the environmental impact of detergent waste and subsequently linked the discussion to the Islamic concept of *khalifah fil ardh*. Observation notes recorded that several students actively discussed their responsibility to protect water resources and proposed environmentally friendly alternatives for household chemical use. (Observation Note, April 24, 2025)

The learning process not only involves acquiring concepts but also prompts reflection on values and morals. The teachers typically compare scientific ideas to Islamic terms, such as *mizan* (balance), *amanah* (responsibility), and *wasatiyyah* (moderation). This indicates that what learners are acquiring in their study of chemistry can be applied to their daily lives and to their moral and spiritual values as Muslims.

3. Teacher Role Models in Instilling Eco-theological Values

It has been observed that chemistry teachers can serve as role models by promoting environmental responsibility through reducing plastic use in the classroom, reminding students of the reusability of lab materials, and promoting lab ethics. This role model can also be seen among the students, and this will be reflected through quotes such as the following found in the interview: "The chemistry teacher sometimes reminds us not to waste materials inside the lab and to think of their effects on nature. Therefore, it is not all theory because we have instances right before our eyes." (S3, May 16, 2025).

A similar thought was voiced by another participant when the participant stated, "In chemistry class, the teacher not only teaches us, but she also teaches us how to be responsible, for example, by efficiently using chemicals and not irresponsibly disposing of waste. This is because the teacher always reminds us to take care of the environment. After all, it is our religious requirement." (S4, May 16, 2025).

Another student emphasized the importance of teacher role modeling: "Our chemistry teacher not only explains environmental issues in class but also demonstrates them through daily actions. For example, she always reminds us to use chemicals efficiently, avoid unnecessary waste, and dispose of laboratory materials properly. Because we see these practices directly,

the message becomes more convincing. It makes us realize that environmental responsibility should be practiced consistently rather than discussed only in theory." (S5, May 16, 2025).

Observation data also demonstrated the teacher's role in modeling environmentally responsible behavior. During laboratory activities, the teacher repeatedly reminded students to minimize chemical waste, use materials efficiently, and dispose of chemical residues in accordance with laboratory procedures. These practices were consistently observed across multiple classroom sessions and served as practical demonstrations of environmental stewardship. (Observation Note, May 2, 2025).

According to the interview findings, students have noticed and responded to teachers' behavior. Students have clearly stated the importance of teachers' consistency with eco-friendly principles, reinforcing their perception of the need to conserve nature. Whenever their teachers warned them about the impact of chemical wastes and the use and misuse of resources, they somehow brought it back to the impact on their religion, and so on. All these factors have demonstrated the teacher's effectiveness as a medium for conveying the message of eco-religious education to students.

4. Collaboration at School for the Strengthening of Eco-theological Values

Data from school archives further revealed coordination between the chemistry teachers and the management of these schools, such as through co-curricular Activities and the Pancasila Student Profile and *Rahmatan Lil Alamin* Student Profile (P5-PPRA) Strengthening Project. For instance, there is a project titled "Green Madrasah," which carried out basic environmental Audits like wastewater management or energy conservation.

The vice-principal for curriculum affairs explained: "The integration of eco-theological values is not limited to chemistry lessons. Through the Green Madrasah program and P5-PPRA projects, we encourage all teachers to connect environmental responsibility with students' moral and spiritual development. Chemistry teachers play an important role because many environmental issues can be discussed scientifically in their classrooms. Therefore, school policies are designed to support the integration of environmental and religious values across curricular and co-curricular activities." (VP1, May 18, 2025).

School-level activities may include campaigns and energy conservation activities that students participate in. This not only reinforces the lessons that students of chemistry have learned in class but also enables them to apply eco-theological lessons in their daily

lives. This ensures that the application of eco-theological values in education does not depend on an individual within the madrasah education system.

5. Students' Understanding and Attitudes Toward Eco-Theological Values

The results of the interview analysis indicate that most students can formulate values related to ecological theology based on their understanding of the relationship among man, God, and nature. This is because it is reflected in students' knowledge and awareness of their moral and spiritual obligations toward nature. Therefore, they associate the values with positive attitude shifts toward issues such as minimizing waste, saving water, and being Concerned about cleanliness and the surroundings.

This understanding has been described by one student (S6), who said, "I know that there is an involvement between human beings, God, and nature. Because if we destroy nature, we will also destroy our responsibility towards God. So, in my life, I do not throw away too many things and look after cleanliness."

"Learning chemistry increases my awareness that protecting nature is part of our duty as God's servants. Since then, I have tried to save water, avoid throwing trash carelessly, and keep my surroundings clean, because these are ways to show our good faith to God and other people." (S7, May 18, 2025).

One student described changes in personal behavior after participating in the learning activities: "Learning chemistry through environmental issues has changed the way I think about nature. Previously, I rarely considered the environmental impacts of my daily activities. Now, I try to reduce plastic use, save water, and be more careful when disposing of waste. I feel that protecting the environment is not only beneficial for society but also part of my responsibility before God. This awareness developed gradually through classroom discussions and school environmental programs." (S8, May 18, 2025)

B. Discussion

The discussion will be organized thematically around the findings of this research. Every finding from this research will be explained in a manner consistent with relevant theories and other research to demonstrate its significance within the existing literature.

1. Integration of Eco-theology Values in Chemistry Learning Planning

From the results of this research, there is evidence of the inclusion of eco-theological values in learning planning in chemistry education, particularly in learning goals and attitude descriptors, emphasizing human stewardship of nature as a trust from God. This implies that learning chemistry is not merely

about mastering scientific knowledge but also about mastering eco-theology awareness.

Document analysis revealed that eco-theological values were formally embedded in instructional planning. One teaching module included the following learning objective: "Students demonstrate environmentally responsible behavior in applying chemical concepts as part of their role as *khalifah fil ardh*."

Furthermore, the assessment rubric included indicators of environmental awareness, sustainable resource use, and participation in environmental improvement activities. These findings indicate that eco-theological values were systematically integrated into curriculum documents rather than being introduced solely during classroom instruction.

The inclusion of eco-theology in chemistry lesson plans contributes to the unitary approach to education in madrasahs. The involvement of the aforementioned value would ensure that chemistry education is not only cognitive. Consequently, chemistry education would contribute to the development of students' character and spirituality.

These findings are also consistent with eco-theology, as they promote stewardship of the environment as both an environmental and a social duty. There is evidence that environmental education is more effective when

combined with religion, given its emphasis on ethical responsibility.

This finding supports the idea of Buckton et al. (2023), who argue that science education should adopt a holistic ecological paradigm, viewing humans as part of the web of life rather than something apart. In an Islamic educational perspective, the concept of *khalifah fil ard* views humans as the guardians of the earth. The use of eco-theological values in planning the chemistry learning process at MAN 1 Kota Malang indicates awareness of a pedagogical model aligned with contemporary science's view and Islamic theology regarding science and nature.

2. Contextual Chemistry Learning as a Medium for Internalizing Eco-theological Values

The results of the study show that applying contextual and project-based learning methods can help learners connect chemistry concepts to environmental issues related to water pollution and the use of household chemicals. The application of the learning strategy facilitates the connection between chemical concepts and environmental issues. The strategy applies to different learning approaches that help learners understand the various chemical reactions. The strategy allows learners to connect different ideas to their effects on environmental sustainability.

In the context of a madrasah, learning in context is further emphasized and reinforced through theological reflection. The students will be motivated and encouraged not only to determine the challenges in their context in terms of scientific knowledge but also in terms of religion.

These findings seem to support the theory of meaningful learning, suggesting that knowledge becomes more significant when it is connected to the learner's real-world experiences. Moreover, the role of problem-based learning in improving the ability to think critically, as well as being socially responsible and efficient in achieving both, is discussed in a study by Sopiansah and Ramafrizal (2025) reported that problem-based learning not only enhances students' critical thinking skills but also promotes social responsibility by engaging learners in authentic problems that require ethical reflection and collaborative decision-making. Similarly, the eco-theology-integrated chemistry learning observed in this study encouraged students to critically evaluate environmental issues while simultaneously considering their moral and religious responsibilities toward nature. Based on the current study, part of the social responsibility within this concept is the development of awareness of the relationships among human beings, the environment, and God in eco-theology.

3. The Exemplary Role of Chemistry Teachers in Upholding Eco-Theological Values

Researchers find that, through the role models of eco-theological values, students adopt environmentally friendly traits, such as bringing a tote bag to the store, leaving lights off when not needed, and bringing a tumbler.

The visible involvement of teacher role models, evident in the study, testifies to the importance of good examples of conduct instilled through *uswah hasanah* in Islamic education. They thus exemplify environmentally responsible behavior both in learning and practical pursuits; this now reinforces the eco-theological ideals while establishing their credibility.

This is consistent with a character education approach that holds that more character values can be developed through role modeling rather than through talk and telling (Koh, Askell-Williams, & Barr, 2023; Quiroz-Martinez & Rushton, 2025). Similarly, Hidayati (2025) argued that role modeling through teachers' value mediation in environmental education was an important factor in students' learning. Therefore, role modeling is a critical bridging function of chemistry teachers at MAN 1 Kota Malang, connecting conceptual eco-theology to actual engagement with the environment to instill eco-theology in students.

4. Institutional Support and Working with the School in Developing Eco-Theological Values

The cooperation between chemistry teachers and school administrators in the co-curricular program P5-PPRA and green madrasah activity projects demonstrates a commitment to promoting the development of eco-theological values on non-human, institutional, and supra-human bases. Thus, sustainability will be ensured in the implementation of the value of ecology and theology in chemistry education.

School policy documents further demonstrated institutional support for eco-theological integration. The Green Madrasah program document explicitly emphasized environmental stewardship, waste reduction, and sustainability practices as part of character education. Similarly, the P5-PPRA project guidelines encouraged students to connect environmental responsibility with religious and ethical values through project-based activities. (Document Analysis, Green Madrasah Program Guide, 2025).

Institutional support is also an important aspect, given its immense contributions to ensuring that factors aligned with eco-theological values in madrasah education continue to be implemented. This program promotes a whole-school approach that entails alignment with schools. This is an important aspect, as it ensures consistency in the implementation of

eco-theological values within madrasah institutions.

Based on Koh et al. (2007), the modification of values and culture within education can continue if it receives support from the school's educational framework and policies. Furthermore, the whole-school approach to environmental education emphasizes involving the entire school to instill ecological awareness among students (Husin et al., 2025). The result reinforces earlier studies, stating that values education requires the involvement of the whole school to produce sustainable outcomes. The school's commitment supports the view that educational practices are compatible with Islamic values.

5. Effect of Chemistry Learning on Students' Eco-Theology Understanding and Attitudes

The study has shown not only students' comprehension of eco-theological values but also changes in their attitudes toward their everyday activities. This is shown by heightened concern for cleanliness and for the environment. Learning Transfer Model confirms that learning is successfully transferred if it is rendered significant and applicable.

Based on the above findings, learning chemistry fosters environmentally responsible actions grounded in religious beliefs. By integrating ideas from both science and religion, the learning process enhances

students' moral consciousness as they address environmental concerns. Indeed, this finding confirms the effectiveness of science education in Islamic schools in cultivating students' morals.

According to Okunlola (2023), knowledge transfer occurs when students use knowledge and values in a new context (Okunlola, 2023). For this research, knowledge transfer will be understood as students applying eco-theological values to their attitudes toward living. This will help confirm the statement by Wetering, Leijten, Spitzer, & Thomaes (2022), who argue that good environmental education leads to changes in thinking and behavior rather than knowledge.

This study has contributed to the debate on Islamic education by empirically illustrating how eco-theology has been integrated into chemistry education. While previous studies mainly focused on and responded to questions of normative discourse, this study has centered on approaches and mechanisms that ensure value integration.

Indeed, from the above discussions, it has been verified that there is strategic potential in learning chemistry at MAN 1 Kota Malang in serving to increase eco-theological values. By incorporating values into the learning context and through figures, this research identifies an important role for learning chemistry in fostering

ecological awareness, with an emphasis on religious values.

The findings of this study have several practical implications for educational leaders and policymakers. For school principals, the study highlights the importance of fostering an institutional culture that integrates environmental responsibility with religious values across curricular and co-curricular activities. School leaders can strengthen eco-theological learning by providing professional development opportunities, encouraging interdisciplinary collaboration among teachers, and supporting school-wide environmental initiatives such as Green Madrasah programs.

For policymakers, the findings suggest that environmental education may become more meaningful when integrated with students' moral and spiritual frameworks. Educational policies should therefore encourage contextual and value-based approaches that connect scientific concepts with ethical and religious dimensions. Such policies may help schools foster not only environmental knowledge but also environmentally responsible attitudes and behaviors among students.

Despite its contributions, this study has several limitations. First, the research was conducted in a single Islamic senior high school, which may limit the transferability of the findings to other educational contexts. Second, the study focused primarily on

participants' experiences and perceptions within a specific learning environment and did not examine the long-term sustainability of value internalization among students. Third, the qualitative nature of the study prioritizes depth of understanding rather than broad generalization.

Future research may address these limitations by conducting multi-site case studies involving different types of schools and educational settings. Comparative studies could explore how eco-theological values are integrated across diverse institutional contexts. In addition, longitudinal research is needed to investigate whether eco-theological learning leads to sustained changes in students' environmental attitudes, behaviors, and decision-making practices over time. Further studies may also examine the effectiveness of teacher professional development programs aimed at integrating eco-theological values into science education.

CONCLUSION

The research findings indicate that chemistry learning in MAN 1 Kota Malang is a significant element in developing students' eco-theological values. The integration of eco-theological value elements into the planning and role-play functions at the classroom and institutional levels confirms the notion that science education in madrasahs is not a value-neutral field but can serve as a

remarkably significant medium for the formation of students' character and spirit. The implication is that chemistry is a field where science and religion meet.

The findings show that incorporating eco-theological values into chemistry education can be achieved by integrating environmental values and theological considerations into the learning experience. The context/study-by-project approach allows the student to connect their study of chemistry to the needs of the natural world, thereby prompting questions about the impact of human activity on it through scientific and theological lenses.

Teachers' role modeling has also been recognized as playing an important part in the internalization of eco-theological values. Environmental responsibility, laboratory ethics, and chemistry teachers are examples that should be incorporated into chemistry instruction to strengthen the message being conveyed. Role modeling or *uswah hasanah* has been recognized as an important part of teaching in a madrasah, where teachers possess greater moral authority.

Support from the institution through schemes such as the P5-PPRA and green madrasah projects promotes the sustainability of integrating eco-theological values. The whole-school approach would help coordinate every aspect of the school system, including the curriculum and classroom practices.

This makes it easier to live the value across the various learning contexts. The teachers and administrators need to collaborate and support the value of education in the madrasahs.

Worth mentioning here is that, apart from having formulated eco-theological values, the students have adopted a positive attitude and behavioral change so effectively in their daily lives that there has been an increase in awareness of cleanliness, waste management, and environmental preservation. This indicates the positive transfer of eco-theological values from the classroom to their practical life.

The originality of this research lies in providing empirical evidence for the potential and effectiveness of implementing eco-theological notions in chemistry education. The direct implication of this research is pertinent to chemistry teachers, madrasah administrators, and Ministry of Religious Affairs officials. This research can be used to conceptualize and develop a program to model the chemistry curriculum in a more integrative and holistic manner, addressing values in education and in theology.

It is also proposed that future research examine the outcomes and implementation of eco-theological chemistry learning in terms of students' environmental actions and religious selves. Moreover, it will be beneficial to examine its outcomes across different madrasahs. It can also be explored in

research that focuses on quantitative outcomes.

Despite these contributions, this study has several limitations. As a single-site case study conducted in one Islamic senior high school, the findings are context-specific. They may not be directly transferable to other madrasahs with different institutional cultures, environmental programs, or

instructional practices. The study primarily focused on understanding the processes of eco-theological integration rather than measuring its long-term impact on students' environmental behavior. Therefore, caution should be exercised when applying these findings to broader educational contexts.

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