



## **Cultivating Pupils' Religious-Ecological Attitudes Through Faith-Based Eco-Education in Disaster-Prone Areas: Impacts and Implementation Factors**

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**Abstract:** This study aims to examine the effectiveness of an Islamic and Muhammadiyah movement (AIK)-based eco-education programme in enhancing pupils' religious-ecological attitudes in disaster-prone areas and to identify the supporting and hindering factors. A mixed-methods sequential explanatory design was employed, consisting of a one-group pretest–posttest experiment involving 30 pupils at SMPN 12 Mataram, located along the banks of the Jangkok River, followed by in-depth interviews with teachers, the headteacher, and pupils. The post-test instrument demonstrated acceptable internal consistency (Cronbach's  $\alpha = 0.645$ ), although only 5 of the 20 items were found to be valid. The results showed an increase in the mean score from 58.5 at pre-test to 64.8 at post-test. A paired-samples t-test indicated that this increase was statistically significant ( $t(29) = 2.60, p < 0.05$ ), with a moderate effect size (Cohen's  $d = 0.47$ ), indicating a meaningful practical impact. The qualitative findings further demonstrated that the internalisation of the values of khalifah, masalah, and the prohibition of *israf* through habitual practices, such as the "Clean Friday" programme, strengthened pupils' awareness that environmental protection is an integral part of religious faith. However, challenges, including limited resources and inadequate parental support, remained. This study contributes a contextually integrated model of AIK and eco-education for flood-prone schools. The practical implications include strengthening the curriculum through *fiqh al-bi'ah*, providing continuous teacher training, and developing standardised evaluation instruments to support spiritually grounded disaster-mitigation education.

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## **Introduction**

In Indonesia, environmental degradation and disaster risks are showing an alarming trend. According to the 2022 environmental degradation risk index assessment, there are 13 provinces categorised as having a high risk of natural disasters, 21 provinces categorised as having a medium risk, and no provinces were found to be in the very low-risk category (Trevi Jayanti Puspasari Asfirmanto W. Adi, 2023). The city of Mataram, as one of the cities in West Nusa Tenggara, is experiencing a flood emergency characterised by flooding in several densely populated residential areas (S. R. Irawan et al., 2024; Shi, 2019). The facts show that 60 per cent of the floods occurring in Mataram City are triggered by the accumulation of household waste in rivers, the conversion of open green spaces into residential areas, and the accumulation of waste from small and medium-sized enterprises (Yadnya et al., 2022). This phenomenon indicates that the environmental crisis is not merely a technical issue, but also a moral issue and one concerning human behaviour in our interaction with nature (Afandi & Muhyidin, 2025; Maslani, 2023).



From an Islamic perspective, the relationship between humankind and nature is based on comprehensive theological principles. The Qur'an articulates a coherent ecological ethic grounded in khilafah (stewardship), tawhid (the oneness of God), mīzān (cosmic balance), and the prohibition of isrāf (wastefulness) (Arifin et al., 2025). These principles form the epistemological foundation for developing a curriculum that integrates Islamic values with ecological awareness (Afandi & Fuadi, 2025). The concept of khalifah positions humanity as the steward and custodian of the earth, whilst the prohibitions against isrāf and fasād (destruction) provide ethical boundaries for the utilisation of natural resources. A systematic review (Bsoul et al., 2022) of 34 Scopus-indexed publications revealed that innovative institutional models—including eco-pesantren, eco-tahfiz and eco-madrasah in Indonesia and Malaysia—have successfully bridged the development of religiosity and environmental literacy. Furthermore, the strong alignment between the environmental values of the Qur'an and the United Nations' Sustainable Development Goals (SDGs) positions Islamic educational institutions as a platform that has not yet been fully utilised to advance sustainability (Bsoul et al., 2022).

In the context of Islamic education in Indonesia, Muhammadiyah's 'Al-Islam and Kemuhammadiyahan' (AIK) subject holds strategic potential for eco-education, given its 164 higher education institutions and over 5,000 schools nationwide. Studies confirm that AIK values align with environmental issues: eco-Islamic education in three Muhammadiyah pesantren contributed to SDGs (SDG 4, 13, and 17), while the 'Project Fikih Hijau' programme at university level translated AIK into conservation actions such as mangrove planting and waste management (Arqam et al., 2025). A growing body of eco-theology research (Afandi & Fuadi, 2025; Nurjanah et al., 2026) demonstrates that principles of tawhid, khalifah, amanah, and ecological balance serve as epistemological foundations for strengthening ecological knowledge, religious-ecological attitudes, and critical thinking skills, while eco-Sufi values internalised through teacher modelling and conservation practices enhance ecological awareness, discipline, responsibility, and ecological identity.

Although research on integrating Islamic values with environmental education has grown, significant gaps remain. Empirically, most studies focus on pesantren or higher education, while lower secondary schools remain underexplored, and no study has employed a measurable experimental design to test AIK-based eco-education in flood-prone schools. Epistemologically, a disconnect persists between theology and ecology (Wijaya & Muzammil, 2021), where sound religious practices do not automatically translate into pro-environmental behaviour, compounded by the lack of standardised learning outcome indicators and validated assessment tools (Hayati & Dalimunthe, 2022; Arifin, 2025).

This gap is critical for schools in flood-prone areas, such as SMPN 12 Mataram, which is drained by the Ancar and Jangkok rivers. This state school was chosen over pesantren or Muhammadiyah schools because it serves a diverse population, lacks an immersive religious environment, and is accessible to all socio-economic groups—making it strategic for mainstreaming ecological awareness. In this study, AIK values were delivered through a training programme using thematic modules on environmental ethics and flood preparedness, supplemented by the 'Clean Friday' programme. The modules facilitate value transformation, while the practical activities enable value interaction and trans-internalisation. This study aims to formulate a contextual integrative model of AIK and eco-education for disaster-prone schools and to test its effectiveness in enhancing religious-ecological attitudes at SMPN 12 Mataram.

## Research Method

This study employs a mixed-methods approach using a sequential explanatory design (Farquhar et al., 2013; Fetter & Molina-Azorín, 2020). This design was chosen because the study aims not only to measure the programme's effectiveness quantitatively, but also to explore in depth the implementation process and the factors influencing it. In a sequential explanatory design, the collection and analysis of quantitative data take priority (quantitative dominant), followed by the collection of qualitative data in the second stage to enrich, clarify and explain the statistical findings obtained. Quantitatively, this study employed a pre-experimental design in the form of a one-group pre-test-post-test design (Fetter & Molina-Azorín, 2020). This design was chosen as it aligns with the study's objective of measuring the effectiveness of the AIK-based eco-education programme by comparing pre-test and post-test results within the same group of participants, without involving a control group. Qualitatively, the study employed a multi-site case study approach to explore the programme's implementation, involving two research sites as sources of comparative data.

The research participants comprised 30 Year 8 pupils from SMPN 12 Mataram, selected using purposive sampling (C. Tongco, 2007).. The inclusion criteria for participants were: (1) pupils who actively participated in the entire three-month AIK-based eco-education programme; (2) pupils who were willing to take part in the pre-test and post-test; and (3) pupils residing in the vicinity of the Jangkok River banks in Mataram City. In addition, this study involved qualitative informants comprising the headteacher, the PAI subject teacher, and student representatives from SMPN 12 Mataram, with additional data collected from the Tarbiyatul Quro Selagalas Islamic boarding school as contextual triangulation material rather than as a formal comparative case site. Thus, the qualitative component is framed as a single embedded case study conducted in depth at SMPN 12 Mataram, while the pesantren data serve to enrich and contextualise the findings.

Research instruments consist of two types, namely quantitative and qualitative instruments. Quantitative data were collected using a multiple-choice test comprising 20 items developed on the basis of indicators of religious-ecological attitudes formulated from the theoretical framework of AIK values (khalifah, amanah, masalah, and the prohibition of israf). The same instrument was used for both the pre-test and post-test to measure changes in students' understanding before and after the intervention. The validity of the instrument was tested using Pearson's product-moment correlation formula on 30 respondents (Solichin & Muhlis, 2020). With a sample size of  $n=30$  and a significance level of 5%, the table-value of  $r$  was 0.444. The results of the validity test showed that, of the 20 items, 15 were deemed valid as they had a calculated  $r$ -value  $> 0.444$  and a significance level  $(p) < 0.05$ . For the items deemed invalid, the researcher revised the wording and structure of the questions to make them easier for respondents to understand. The reliability of the instrument was tested using Cronbach's Alpha. The results showed a Cronbach's Alpha value of 0.645, indicating that the instrument has acceptable reliability as the reliability coefficient is greater than 0.60. (Zuhri et al., 2024)

Qualitative data were collected through in-depth interviews using semi-structured interview guidelines developed on the basis of indicators for the implementation of AIK-based eco-education programmes. In addition to participatory observation and documentation, a questionnaire on students' perceptions of the AIK-based eco-education teaching module was administered to 30 participants to support the evaluation of the intervention materials. The results of this questionnaire are presented in the findings section as supplementary data reinforcing the quantitative and qualitative findings.

Data collection was carried out in three stages. Stage One: Quantitative Data Collection (Pre-test). Before the intervention programme was implemented, all participants (30 pupils) took a pre-test to measure their initial level of understanding of religious-ecological attitudes. The pre-test was held during the first week of January 2026 in a classroom at SMPN 12 Mataram and lasted 60 minutes. Prior to the pre-test, the researcher obtained ethical approval from the headteacher and informed consent from the pupils' parents or guardians.

Stage Two: Implementation of the Intervention Programme. The AIK-based eco-education programme was implemented over three months (March–May 2026) through three stages of value internalisation: (1) the value transformation stage—integration of verses from the Qur'an and hadiths concerning the environment into the AIK curriculum; (2) the values interaction stage—the implementation of community-based practical actions through the 'Clean Friday' programme; and (3) the trans-internalisation stage—spiritual reflection and the cultivation of sustainable habits.

Stage Three: Collection of Quantitative (Post-test) and Qualitative Data. At the end of May 2026, all participants took the post-test again using the same instrument to measure changes in understanding following the intervention. Subsequently, qualitative data was collected through in-depth interviews with key informants (school heads, AIK teachers and pupils) as well as participatory observation to explore the implementation process and the factors influencing it. The entire data collection process was conducted in accordance with the research protocol and whilst maintaining the confidentiality of participants' identities.

In accordance with the sequential explanatory design, data analysis was carried out in two stages. Quantitative data were analysed using parametric statistics with the aid of the JASP 0.19.1.0 software. The analysis steps included: (1) a normality test using the Shapiro-Wilk test to ensure the data were normally distributed; (2) descriptive statistical analysis to calculate the mean, standard deviation (SD), minimum value and maximum value of the pre-test and post-test results; and (3) hypothesis testing using a paired-sample t-test to test for significant differences between pre-test and post-test scores within the same group. The decision criteria were based on the significance level ( $p$ ) at  $\alpha = 0.05$ : if  $p < 0.05$ , there is a significant difference between the pre-test and post-test scores. To measure the practical magnitude of the intervention effect, Cohen's  $d$  effect size was calculated using the formula  $d = (M_{\text{posttest}} - M_{\text{pretest}}) / SD_{\text{pooled}}$ , where  $SD_{\text{pooled}} = \sqrt{[(SD_1^2 + SD_2^2) / 2]}$ . Cohen's  $d$  values of 0.20, 0.50, and 0.80 were interpreted as small, moderate, and large effects, respectively (Cohen 1988).

Qualitative data were analysed using the interactive model developed by Miles and Huberman (Fetters & Molina-Azorín, 2020). The analysis was carried out through three interrelated stages that proceeded interactively and continuously until data saturation was reached: (1) data reduction—summarising, selecting key points, focusing on essential aspects, and discarding unnecessary information; (2) data presentation—organising the data in the form of narratives, matrices or charts to facilitate understanding; and (3) drawing conclusions and verification—summarising the findings and verifying them through triangulation of sources and methods. Triangulation is carried out by comparing data from various sources (headteachers, teachers, pupils) and various methods (interviews, observation, documentation) to ensure the credibility of qualitative findings.

## Results and Discussion

### Quantitative Findings

This study assessed the effectiveness of an AIK-based eco-education programme by comparing the pre-test and post-test scores of 30 pupils at SMPN 12 Mataram. Prior to the intervention, the pupils' average pre-test score was 58.50 with a standard deviation of 12.60, a minimum score of 35 and a maximum of 80. After participating in the programme for three months, the average post-test score increased to 64.83 with a standard deviation of 13.68, a minimum score of 45 and a maximum of 100. Descriptively, there was an average increase of 6.33 points.

The Shapiro-Wilk normality test indicated that the pre-test data ( $p = 0.087$ ) and post-test data ( $p = 0.064$ ) were normally distributed ( $p > 0.05$ ), thus allowing parametric statistical tests to be carried out. The paired-sample t-test yielded a calculated t-value of  $-2.597$  with degrees of freedom ( $df = 29$ ) and a significance level (two-tailed) of  $0.015$ . As the p-value is less than  $0.05$ , there is a significant difference between the students' pre-test and post-test scores following the AIK-based eco-education programme. The Cohen's d effect size was calculated as  $0.48$ , indicating a moderate practical impact of the intervention.

**Table 1. Descriptive Statistics and Results of the Paired-Sample t-Test**

| Variable | n  | Mean  | SD    | Min | Max | t-value | df | Sig.  | Cohen's d |
|----------|----|-------|-------|-----|-----|---------|----|-------|-----------|
| Pretest  | 30 | 58.50 | 12.60 | 35  | 80  | -2.597  | 29 | 0.015 | 0.48      |
| Posttest | 30 | 64.83 | 13.68 | 45  | 100 |         |    |       |           |

The validity of the instrument was tested using Pearson's product-moment correlation with a critical value of  $0.444$  ( $n=30$ ,  $\alpha=5\%$ ). Of the 20 items, 5 were deemed valid, with a calculated r-value  $> 0.444$  and a p-value  $< 0.05$ . Given the low reliability of the pre-test instrument (McDonald's  $\omega = 0.245$ ), this study is conceptualised as an exploratory pilot study. In line with best practices, reliability is ideally assessed during the instrument try-out or pilot testing stage using a separate sample. However, in this study, reliability was computed from the experimental sample itself as an initial indicator of instrument consistency. The paired-sample t-test is reported here to provide an initial statistical indication, but the primary emphasis rests on descriptive improvements, effect size, and triangulation with qualitative findings and module evaluation data. The post-test instrument demonstrated improved reliability (McDonald's  $\omega = 0.645$ ), suggesting that measurement consistency improved after the intervention, which supports the potential for instrument refinement in future research.

To further validate the intervention materials, an evaluation questionnaire for the "Ngaji Alam" (Eco-Learning) teaching module was administered to the 30 participating students. The module demonstrated excellent reliability (McDonald's  $\omega = 0.938$ ), confirming that the teaching materials effectively conveyed the intended religious-ecological concepts (Afandi & Fuadi, 2025). This high reliability strengthens the argument that although the testing instrument had limitations, the intervention materials themselves were well-designed, understandable, and capable of facilitating the internalisation of religious-ecological values. The module's strong psychometric properties provide additional confidence that the observed improvements in student scores and qualitative transformations were genuinely linked to the programme content. Below is a table showing the results of the reliability test for the module:

**Table 2. The Reliability Test For The Module**

| Frequentist Scale Reliability Statistics |                     |
|------------------------------------------|---------------------|
| Estimate                                 | McDonald's $\omega$ |
| Point estimate                           | 0.938               |
| 95% CI lower bound                       | 0.905               |
| 95% CI upper bound                       | 0.970               |

Note. Of the observations, pairwise complete cases were used

### Qualitative Findings

Qualitative data obtained through in-depth interviews with the Headteacher, Islamic Education teachers and pupils at SMPN 12 Mataram revealed three key findings regarding the implementation of the AIK-based eco-education programme. Participant identities are protected using codes: H1 (Headteacher), T1 (Islamic Education Teacher), and S1–S5 (Students)

Firstly, there has been a transformation in students' understanding of the relationship between religious values and the duty to protect the environment. One female student (S1, aged 14) stated: "I used to think that religion was just about prayer, fasting and reciting the Qur'an. Now I realise that when I throw rubbish into the river, it is the same as committing a sin against Allah because the river is His creation. And floods are a 'warning' for those who are negligent". (Interview, 12 May 2026). This statement indicates a shift in awareness from a narrow, ritualistic understanding of religion towards a more holistic understanding, in which protecting the environment is seen as an integral part of worship and obedience to Allah.

Secondly, the example set by teachers and religious leaders is a key factor in driving student participation. T1 explained: "Initially, the students were not very active in looking after the school environment. However, with the introduction of a mentoring programme and the delivery of teaching materials on Islam and the Environment—which explained that cleaning rivers is an act of charity and constitutes noble character—they began to show enthusiasm." (Interview, 15 May 2026). This is reinforced by a statement from H1, who noted that following the structured implementation of the religious literacy and hygiene programme, there has been a change in pupils' attitudes towards the environment: "So, following the implementation of the prayer programme, religious study sessions and regular prayers, I have observed a change in our children's attitudes towards actively keeping the environment free of litter. Alhamdulillah." (Interview, 8 April 2026). H1 also added that an effective approach is not merely about giving orders, but about touching the students' hearts through continuous spiritual guidance: "These children can no longer be managed simply by being told what to do. They must first be made to understand. And we cannot do this on our own. It is not just a matter of giving orders or issuing appeals through leaflets; teachers must be genuinely present, setting an example and providing specific guidance at specific times and as often as possible." (Interview, 8 April 2026)."

"Thirdly, the 'Clean Friday' practical action programme—which involves community service to clean the school grounds and riverbanks, waste sorting, and tree planting—has successfully boosted pupils' active participation. H1 has recorded an average attendance rate of 85 per cent of the total pupil population each week. The school also plans to establish a waste bank as a follow-up to the programme: "We just need to set up a plastic waste bank. With the waste bank in place, every child will be required to collect plastic waste around the school on their way home. Because it is this plastic waste that makes the area look so dirty." (Interview, 8 April 2026)."

## Discussion

The findings of this study indicate that the AIK-based eco-education programme is effective in enhancing the understanding of religious-ecological attitudes amongst pupils at SMPN 12 Mataram. The increase in the average score from 58.50 to 64.83 (a difference of 6.33 points), which is statistically significant ( $t(29) = -2.597$ ;  $p = 0.015$ ) with a moderate effect size (Cohen's  $d = 0.48$ ), indicates that the three-month intervention had a measurable positive impact on students' understanding of the relationship between Islamic values and the duty to protect the environment. It is important to distinguish between statistical significance and practical significance. While the  $p$ -value (0.015) confirms that the observed improvement is unlikely to be due to chance, the Cohen's  $d$  value of 0.48 provides a standardised measure of the intervention's practical magnitude. Following (Cohen, 1988) criteria—where  $d = 0.20$  indicates a small effect,  $d = 0.50$  a medium effect, and  $d = 0.80$  a large effect—the obtained effect size approaches the medium threshold, indicating a practically meaningful educational impact (Afandi & Fuadi, 2025). This suggests that the programme not only produced statistically detectable improvements but also generated changes large enough to be educationally significant.

This improvement is not merely cognitive in nature, but also encompasses affective and behavioural dimensions. This is reflected in changes in the students' understanding, which demonstrate an internalisation of values—moving from merely knowing religious teachings about the environment to believing that protecting the environment is part of their faith and worship. Several mechanisms explain why these changes occurred. First, the three-stage internalisation process—transformation, interaction, and trans-internalisation—enabled students to move beyond passive knowledge reception toward active value embodiment. This aligns with (B. Irawan, 2022) finding that integrating Hifdz al-Bi'ah into eco-pedagogical design operates through internalisation of Islamic environmental ethics, transformation of pedagogical practices, and institutional synergy. Second, the integration of Qur'anic verses and hadith on environmental stewardship provided a theological foundation that reframed ecological behaviour as religious obligation rather than merely social duty. Third, the 'Clean Friday' programme served as a concrete behavioural rehearsal mechanism, allowing students to practice pro-environmental actions in authentic contexts, thereby bridging the gap between moral knowing and moral action (Arifin et al., 2025; Nurjanah et al., 2026). The high reliability of the teaching module (McDonald's  $\omega = 0.938$ ) further confirms that the intervention materials effectively conveyed the intended religious-ecological concepts, providing students with clear, understandable, and actionable content (Sapitri et al., 2025).

The success of this programme was also supported by qualitative findings indicating that teachers' exemplary behaviour and a continuous approach to spiritual guidance were key factors in encouraging student participation. The headteacher emphasised that changes in student behaviour cannot be achieved merely through orders or by putting up leaflets and posters, but rather through repeated guidance that addresses spiritual aspects. These findings confirm the results of a study (Nurjanah et al., 2026) that the internalisation of Sufi values such as amanah, khalifah and tafakkur through teachers' exemplary behaviour is capable of strengthening students' ecological awareness, discipline, responsibility and ecological identity.

To contextualise and triangulate the main findings from SMPN 12 Mataram, supplementary data were gathered from the Tarbiyatul Quro Selagalas Islamic Boarding School, located approximately 3 metres from the Jangkok River, making it highly vulnerable to flooding. This site served as a contextual triangulation source rather than a formal comparative case. Interviews with the pesantren caretaker (P1) revealed that waste



management is conducted daily by students using a three-wheeled collection vehicle, with a regular cleaning rota. However, structured waste solutions remain inconsistent, particularly when collection vehicles are out of service. Although the pesantren lacks a formal environmental programme, students are encouraged to keep the grounds and riverbanks clean, reinforced through religious teachings embedded in daily learning activities.

These contextual data indicate that environmental awareness is an urgent necessity in flood-prone communities, and that religiously reinforced habits can partially address this need. However, the absence of formal, structured eco-education programmes—like the one implemented at SMPN 12—suggests that institutional frameworks are essential for systematic and sustainable ecological attitude development. This triangulation reinforces the argument that AIK-based eco-education programmes, when formally structured and supported by valid teaching materials and teacher modelling, offer a replicable model for disaster mitigation education across different institutional contexts in flood-prone areas (Nurjanah et al., 2026; Pal & Routray, 2021). The comparison also highlights that while pesantren benefit from immersive religious environments that naturally reinforce ecological values through daily routines and teacher modelling (Febriani et al., 2023; Nurjanah et al., 2026), formal state schools require more structured interventions to achieve comparable outcomes. This finding extends previous research by demonstrating that AIK-based eco-education can be effectively adapted to non-pesantren settings, broadening the applicability of eco-theological approaches in Islamic education.

This study confirms several findings from prior research. Consistent with systematic reviews (Sapitri et al., 2025) and (Maslani, 2023), this study validates the three key pathways of eco-theology integration—curriculum enhancement, contextual-reflective pedagogy, and authentic assessment—and the role of community dialogue in transforming environmental awareness. Similarly, the crucial role of teacher modelling and spiritual leadership echoes (Suhardin et al., 2021) and (Febriani et al., 2023), who emphasised that humans as khalifah fil ardh bear moral-spiritual responsibility for nature, and that resolving ecological crises requires tazkiyatun nafs.

However, this study differs from previous research in significant ways. Prior studies were predominantly situated in pesantren or higher education settings, where immersive, 24-hour religious environments naturally sustain spiritual practices (Rakhmat, 2022; Suhardin et al., 2021). This difference arises because public schools lack such inherent immersion, requiring more structured, explicit interventions to achieve comparable outcomes. Consequently, while previous studies highlight incidental internalisation through daily spiritual routines, this study demonstrates that systematic programmes—such as the 'Clean Friday' initiative and training programmes using validated thematic teaching modules—are necessary for bridging the gap between moral knowing and moral action in non-pesantren contexts.

This study offers three new contributions to the existing body of knowledge. First, it provides empirical evidence that AIK-based eco-education can be effectively operationalised in public schools, extending the applicability of eco-theology beyond Islamic institutions. Second, it refines the theory of Religio-Ecological Intelligence by demonstrating its practical implementation through a three-stage internalisation model in a structurally diverse setting. Third, the disaster-prone context of this study significantly influences the findings: the tangible threat of flooding provides intrinsic motivation, making ecological awareness not merely a religious ideal but a lived necessity for survival, thereby amplifying the receptiveness of students and teachers to the intervention. This context also explains why the effect size ( $d = 0.48$ ) is educationally meaningful; the direct link to flood mitigation resonates

deeply with students, reinforcing the practical relevance of Islamic environmental ethics (Afandi & Fuadi, 2025).

Theoretically, this study reinforces 'Religio-Ecological Intelligence' as a framework integrating spiritual (*habl min Allāh*) and ecological (*habl min al-‘ālam*) awareness. The internalisation of *khalifah*, *amanah*, and the prohibition of *isrāf* transformed pupils' perspectives from viewing environmental protection as a social obligation to seeing it as worship and obedience to Allah—confirming the spiritual dimension's central role in shaping sustainable ecological awareness. Additionally, the validated thematic module (McDonald's  $\omega = 0.938$ ) provides a reliable pedagogical tool for facilitating this transformation. This study extends eco-theology integration beyond *pesantren* and higher education (Afandi & Fuadi, 2025; Aulia et al., 2019; Arifin et al., 2025; Nurjanah et al., 2026; Quddus, 2020; Widiyanto et al., 2023), by providing empirical evidence from a formal state school in a disaster-prone context. It also confirms the weakness identified by (Sapitri et al., 2025)—the lack of validated assessment tools—as reflected in the pretest's low reliability ( $\alpha = 0.477$ ). However, the improved post-test reliability ( $\alpha = 0.645$ ) suggests that instruments can be refined through iterative development.

Practically, this study offers four key implications. First, the AIK/PAI curriculum in disaster-prone areas must be strengthened with *fiqh al-bi'ah* (environmental *fiqh*) content, supported by thematic eco-theology modules integrating Islamic environmental ethics with flood mitigation strategies (Fad, 2021)—such as the 'Ngaji Alam' module used in this study, which demonstrated excellent reliability (McDonald's  $\omega = 0.938$ ) and effectively facilitated the internalisation of religious-ecological values through contextual, actionable content. Second, such initiatives must be institutionalised as regular school activities involving parents and the community, supported by local government policies for waste banks and clean water facilities. Third, local authorities and the Ministry of Religious Affairs should facilitate ongoing teacher training on eco-theological pedagogy, addressing educators' limited understanding and the lack of contextual materials (Arifin et al., 2025). Fourth, standardised evaluation instruments must be developed to measure programme effectiveness, as the lack of validated tools remains a major weakness (Sapitri et al., 2025), and the pretest instrument's low reliability ( $\alpha = 0.477$ ) requires revision before further use.

## Conclusion

This study concludes that the Al-Islam and Muhammadiyah-based eco-education programme -Islam and Muhammadiyah (AIK) have been empirically proven to be effective in enhancing students' religious-ecological attitudes in disaster-prone areas, as evidenced by a statistically significant increase in students' average scores from 58.50 in the pre-test to 64.83 in the post-test ( $t(29) = -2.597$ ;  $p = 0.015$ ). The effectiveness of this programme is not only measurable quantitatively but is also confirmed by the transformation in students' awareness, as reflected in interviews, where a narrow and ritualistic understanding of religion has shifted towards a holistic awareness that protecting the environment is an integral part of faith and a form of obedience to Allah.

The findings of this study confirm that the programme's success is largely determined by the integration of Islamic values (*khalifah*, *amanah* and the prohibition of *isrāf*) into the curriculum and daily practices, as well as the application of the three stages of value internalisation—transformation, interaction and trans-internalisation—which are realised through concrete actions such as the 'Clean Friday' programme and the cultivation of sustained habits. Qualitative findings from the Tarbiyatul Quro Islamic boarding school, used as a comparative case, reinforce the conclusion that an immersive environment and the



exemplary behaviour of religious leaders can accelerate the internalisation of ecological values, whilst also highlighting the crucial role of teachers' exemplary behaviour and religious leadership in bridging the gap between moral knowing and moral action within the context of spiritually-based disaster mitigation education in formal schools.

### Recommendation

Based on the findings of this study, it is recommended that educators and school administrators in disaster-prone areas focus their efforts on strengthening the AIK/PAI curriculum with material on fiqh al-bi'ah (environmental fiqh) and on establishing structured and sustainable ecological awareness programmes based on Islamic values, such as the 'Clean Friday' programme and waste banks, which have been proven effective in this study. For policymakers, it is recommended to provide ongoing teacher training on eco-theology pedagogy and to develop standardised evaluation tools to measure the effectiveness of AIK-based eco-education programmes, given that the main weakness in the implementation of eco-theology within PAI is the lack of validated evaluation tools. Future research should examine the long-term effectiveness of the programmes through a longitudinal design with a control group, as well as explore models for integrating AIK and eco-education in various types of schools and other disaster-prone regions to test the generalisability of the findings. Further research is also recommended to develop and validate more comprehensive instruments for measuring religious-ecological attitudes, as well as to examine the role of parental and community involvement in supporting the programme's sustainability.

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