

ETHNOSCIENCE IN THE DERO PILGRIMAGE TRADITION: RELATIONSHIPS WITH RELIGIOUS ATTITUDES AND ECOSYSTEM CONCEPT UNDERSTANDING AMONG STUDENTS OF SMA TAKHASSUS AL-QUR'AN KALIBEKBER WONOSOBO

Wulida Maghfiroh¹, Ngarifin Shidiq², Mahfudz Junaedi³

^{1,2,3} Master Program in Education, Universitas Sains Al-Qur'an, Wonosobo, Indonesia

Article Info

Article history:

Received 30/06/2026

Accepted 01/10/2026

Published 07/10/2026

Keywords:

Dero pilgrimage;

Ecosystem concept
understanding;

Ethnoscience;

Pesantren education;

Religious attitudes.

ABSTRACT

The integration of local culture into science education remains a critical yet underexplored strategy, particularly in pesantren-based schools where religious and academic values intersect. The study identified several ethnoscientific values embedded in the Dero pilgrimage route, particularly those related to ecological components, biodiversity, ecological interactions, and environmental stewardship. Employing a quantitative associative approach with an ex post facto design, data were collected from 66 students of SMA Takhassus Al-Qur'an using questionnaires measuring Dero pilgrimage participation and religious attitudes, together with a written test assessing ecosystem concept understanding. Two separate simple linear regression analyses were conducted to examine the relationships between Dero pilgrimage participation and each outcome. The analyses showed significant positive relationships between Dero pilgrimage participation and religious attitudes ($r = 0.858$, $R^2 = 0.737$, $p < 0.001$) and between Dero pilgrimage participation and ecosystem concept understanding ($r = 0.839$, $R^2 = 0.704$, $p < 0.001$). These findings suggest that the Dero pilgrimage may provide a meaningful context for connecting cultural experiences, religious values, and Biology learning in pesantren-based education, while the observed relationships should not be interpreted as causal effects. This is an open-access article under the CC BY-SA license

This is an open-access article under the [CC BY-SA](#) license.



Corresponding Author:

Wulida Maghfiroh

Master Program in Education, Universitas Sains Al-Qur'an, Wonosobo, Indonesia

Email: wulidamaghfiroh9@mhs.unsiq.ac.id

1. INTRODUCTION

Science learning becomes more meaningful when scientific concepts are connected with learners' cultural and environmental contexts. Ethnoscience provides an approach for connecting indigenous and local knowledge, practices, and cultural experiences with formal scientific knowledge. A systematic literature review by Jannah et al. (2022), which analyzed 73 studies on ethnoscience in Indonesian science education, found that ethnoscience has been widely integrated into learning materials and instructional models, with reported outcomes including scientific literacy, critical thinking, creative thinking, and problem-solving. Similarly, Kasi et al. (2021), through a thematic review of 71 ethnoscience studies in Indonesia, reported that research has predominantly examined the integration of ethnoscience into science learning to improve students'

achievement and attitudes toward science. At the international level, Latip et al. (2024) reviewed 52 studies indexed in Scopus and Web of Science and showed that local and indigenous knowledge has become an increasingly recognized component of science education across different cultural contexts.

More recently, Supriatna et al. (2025) found that ethnoscience-integrated science teaching materials can strengthen scientific concepts while simultaneously maintaining and valuing local cultural knowledge. Together, these studies indicate that ethnoscience can function as a bridge between formal scientific knowledge and students' lived cultural and environmental experiences. Fitria et al. (2025) further reported that integrating ethnoscience into science learning can support students' critical thinking, communication, and creativity while enhancing cultural appreciation. Hikmawati et al. (2021) also reported that ethnoscience-based science learning can integrate local cultural knowledge with scientific concepts, providing a contextual approach to science education. Muyassaroh et al. (2025) further highlighted the importance of bridging cultural knowledge and formal education to support meaningful learning in culturally diverse context.

In Indonesia, local traditions provide diverse contexts through which scientific knowledge can be identified, reconstructed, and incorporated into science learning. Amidi et al. (2023), for example, demonstrated that the Nyadran tradition contains ethnoscientific knowledge and environmental ethics that can be utilized in science learning. Maysarah et al. (2025) demonstrated that local cultural practices can be analyzed from ethnoscientific perspective to identify scientific concepts embedded in community tradition. Rizaldi et al. (2021) similarly showed that the Nyirih tradition can be reconstructed through an ethnoscience perspective to connect cultural practices with concepts in biology, physics, and chemistry. At the senior high school level, Ikhwal et al. (2023) developed an ethnoscience-based interactive e-module using the Kenduri Sko traditional ceremony, demonstrating the feasibility of transforming local cultural practices into structured science learning resources. Hikmah & Yohandri (2025) further emphasized the potential of ethnoscience to reveal culturally embedded scientific knowledge that can be utilized in science education.

In the context of Biology education, Husni & Mukra (2025) also emphasized the integration of ethnoscience into high school Biology learning, supporting the relevance of culturally grounded approaches for contextualizing biological concepts. Lestari & Zulirfan (2024) also examined the effectiveness of ethnoscience-based learning resources, indicating the potential of culturally contextualized materials to support science learning. Marlina et al. (2025) further demonstrated the development of Biology learning resources that integrate ecosystem concepts with local wisdom, reinforcing the potential of local contexts for contextual Biology learning. Sudirman et al. (2025) further highlighted the integration of ethnoscience into science learning as a way to connect scientific concepts with local cultural knowledge and contexts. Anwar et al. (2024) reported that ethnoscience can be incorporated into integrated science teaching materials, highlighting the potential of culturally grounded contexts in science education. Similarly, Aprilia et al. (2025) highlighted the relevance of ethnoscience-based contextual teaching in connecting scientific concepts with students' natural and social environments. Taken together, these studies indicate that ethnoscience and local wisdom can serve as meaningful contexts for connecting scientific concepts with students' cultural and environmental experiences. However, much of the existing research has focused on developing learning resources, teaching materials, or instructional

approaches, rather than examining students' participation in a culturally embedded religious tradition and its relationship with both scientific understanding and religious attitudes.

Supporting these findings, Rosyidah et al. (2025), through a systematic review of 155 Scopus-indexed publications, identified local wisdom as an increasingly important context for science education and reported substantial attention to environment, ecology, and biology. However, their review also indicated that research remains concentrated in qualitative-exploratory studies and that the high-school level is comparatively underrepresented. These findings highlight the need for further empirical studies examining how culturally embedded practices can be connected with students' scientific understanding at the senior high school level.

The relevance of local cultural practices becomes particularly important in pesantren-based education, where formal academic learning is integrated with religious routines, social interaction, and cultural habituation. The cultural climate of pesantren can contribute to the formation of students' religious attitudes through repeated practices and the internalization of religious values. Ihsan et al. (2021) found that the culture of Islamic boarding schools plays an important role in shaping students' religious attitudes. Furthermore, Abdullah et al. (2023), in developing and validating a religiosity scale for Indonesian Muslim youth, identified belief, ritual, social, and commitment as meaningful dimensions of Muslim youth religiosity. These findings suggest that students' religious attitudes are shaped not only through formal religious instruction but also through participation in religious and social-cultural practices. Thus, culturally embedded religious traditions in pesantren may provide a context in which spiritual development and academic learning can occur simultaneously.

One such tradition is the *napak tilas Dero* at Pondok Pesantren Al-Asy'ariyyah Kalibeber, Wonosobo, a culturally and religiously embedded pilgrimage tradition. The approximately 8.3-kilometer journey from Kalibeber to Dero Duwur combines communal *dzikir* and prayer with direct encounters with diverse natural environments, including rice fields, rivers, hills, bamboo vegetation, and forest areas. These environment encounters provide opportunities for students to encounter ecological phenomena related to biotic and abiotic components, biodiversity, ecological interactions, and relationships between organisms and their environment. At the same time, communal worship and remembrance of the pesantren's religious heritage provides a cultural and spiritual context in which students engage with religious practices and values. Taken together, these characteristics make the Dero pilgrimage a relevant context for examining how a culturally embedded religious tradition relates to students' experiences of ecological phenomena and religious practice.

Although previous studies have demonstrated the potential of ethnoscience and local wisdom as resources for contextual science learning, much of existing research has focused on identifying local knowledge, developing ethnoscience-based learning resources, or examining learning outcomes (Jannah et al., 2022; Kasi et al., 2021; Latip et al., 2024, Supriatna et al., 2025). Meanwhile, existing reviews indicated that ethnoscience and local wisdom research has remained concentrated in exploratory studies, while research at the senior high school level is comparatively less represented (Rosyidah et al., 2025). This limitation is particularly relevant to culturally embedded religious traditions, which can involve scientific and religious dimensions.

In particular, empirical evidence remains limited regarding the relationship between students' participation in a pesantren-based pilgrimage tradition and their religious attitudes and ecosystem concept understanding. The Dero pilgrimage provides a distinctive context because it

combines communal religious practices with direct encounters with diverse ecological environments along the pilgrimage route. Therefore, this study extends previous ethnoscience research by examining the Dero pilgrimage not only as source of local scientific knowledge but also as an experiential cultural context associated with students' religious attitudes and ecosystem concept understanding. The novelty of this study lies in examining a single pesantren-based tradition as a context where cultural, religious, and ecological dimensions converge, while empirically examining two separate relationships between students' participation in the tradition and their religious attitudes and ecosystem concept understanding.

Accordingly, using a quantitative associative approach with an ex post facto design, this study aims to (1) identify the ethnoscientific values embedded in the napak tilas Dero tradition, particularly those related to ecological and environmental contexts; (2) examine the relationship between students' participation in the Dero pilgrimage and their religious attitudes; and (3) examine the relationship between students' participation in the Dero pilgrimage and their ecosystem concept understanding.

2. METHOD

This study employed a quantitative associative approach with an ex post facto design. The design was selected because the independent variable had occurred naturally before the study and could not be manipulated by the researcher. The study therefore examined statistical relationships between students' participation in the Dero pilgrimage tradition and two outcome variables without experimental intervention (Creswell & Creswell, 2018). The independent variable (X) was students' participation in the Dero pilgrimage tradition, while two dependent variables were examined separately: religious attitudes (Y_1) and ecosystem concept understanding (Y_2).

Accordingly, the study examined two independent relationships: (1) the relationship between Dero pilgrimage participation (X) and religious attitudes (Y_1); and (2) the relationship between Dero pilgrimage participation (X) and ecosystem concept understanding (Y_2). Because each analysis involved one independent variable and one dependent variable, both relationships were tested separately using simple linear regression.

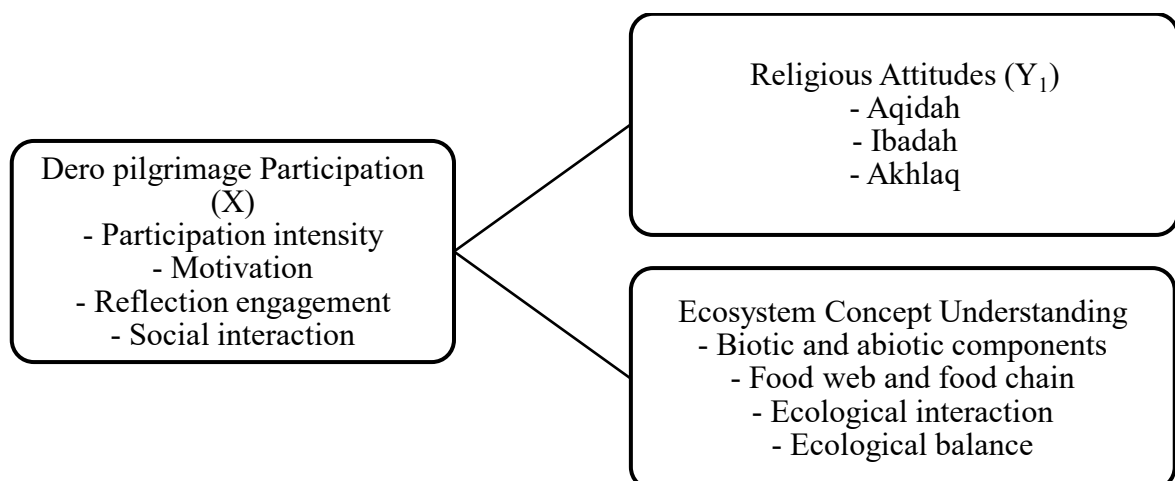


Figure 1. Conceptual framework illustrating the hypothesized relationship between Dero pilgrimage participation, religious attitudes, and ecosystem concept understanding

Based on Figure 1, the conceptual framework of the study is illustrating two separate relationships between students' participation in the Dero pilgrimage tradition (X) and the two outcome variables.

The first relationship concerns the association between Dero pilgrimage participation (X) and religious attitudes (Y_1). Religious attitudes were operationalized through three dimensions: *aqidah* (theological belief), *ibadah* (religious practice), and *akhlaq* (moral character). These dimensions reflect the religious and behavioral aspects examined in the pesantren context. The broader conceptualization of Muslim youth religiosity proposed by Abdullah et al. (2023), which includes belief, ritual, social, and commitment dimensions, provides supporting evidence for examining religiosity through multidimensional indicators. This multidimensional understanding is also relevant to studies of Muslim adolescent's religiosity (Warsiyah, 2018). In addition, the role of pesantren culture in shaping students' religious attitudes has been documented by Ihsan et al. (2021).

The second relationship concerns the association between Dero pilgrimage participation (X) and ecosystem concept understanding (Y_2). Ecosystem concept understanding was assessed through Biology content concerning biotic and abiotic components, food webs, ecological interactions, and ecological balance. These concepts correspond to ecological phenomena that students may encounter directly during the Dero pilgrimage, including agricultural, aquatic, and terrestrial environments.

Based on the conceptual framework and previous empirical evidence, two hypotheses were formulated and tested independently using simple linear regression. The first hypothesis (H_1) states that there is a significant positive relationship between students' participation in the Dero pilgrimage tradition and their religious attitudes. The second hypothesis (H_2) states that there is a significant positive relationship between students' participation in the Dero pilgrimage tradition and their ecosystem concept understanding.

Before data collection, the research instruments were reviewed to ensure their relevance, clarity, and alignment with the predetermined research indicators. The instruments were reviewed by the school principal, vice principal for curriculum, and senior subject teachers, who provided feedback and suggestions for improvement. The review focused on the suitability of the items with the intended constructs, content, and student characteristics. The Dero pilgrimage participation questionnaire (X), consisting of 30 items covering students' participation from the preparation stage through reflection, was also subjected to empirical item analysis using the Pearson product-moment correlation at α 5% significance level. The item analysis was conducted using responses from 32 students in class XI-B. Items were evaluated by comparing the obtained correlation coefficients with the critical value of 0.349. Reliability was subsequently assessed to determine the internal consistency of the instruments. The results of the instrument characteristics, item analysis, and reliability are presented in Table 1.

Based on Table 1, the characteristics and reliability of the three research instruments. The Dero pilgrimage participation questionnaire (X) consisted of 30 items, the religious attitudes scale (Y_1) consisted of 25 items, and the ecosystem concept understanding test (Y_2) consisted of 20 multiple-choice items. The reliability of Y_1 and Y_2 was assessed using Cronbach's α (Cronbach, 1951). The Cronbach's α coefficients were 0.812, 0.847, and 0.763 for X, Y_1 , and Y_2 , respectively. As all coefficients exceeded the minimum acceptable value of 0.70, the three instruments were considered to have acceptable internal consistency. The ecosystem concept understanding test also

showed a mean item difficulty index of 0.56 and a mean item discrimination index of 0.40, indicating moderate item difficulty and good discriminatory capacity.

Table 1. Summary of Research Instrument Characteristics and Reliability

No.	Indicator	Dero Pilgrimage Participation (X)	Religious Attitudes (Y ₁)	Ecosystem Concept Understanding (Y ₂)
1	Number of items	30	25	20
2	Instrument type	Questionnaire	Questionnaire	Achievement test
3	Initial empirical item analysis	19/30 met criterion	-	-
4	Validity evidence	Expert review and empirical item analysis	Expert review	Expert review and item analysis
5	Cronbach's α	0.812	0.847	0.763
6	Reliability status	Reliable	Reliable	Reliable
7	Mean Item Difficulty	-	-	0.56
8	Mean Item Discrimination	-	-	0.40

2.1. Research Setting and Participants

The study was carried out at SMA Takhasus Al-Qur'an Kalibebber in Wonosobo, Central Java, Indonesia. The school is managed by Pondok Pesantren Al-Asy'ariyyah and integrates Islamic educational practices with the national curriculum. The school had approximately 1,233 students across grades 10–12, comprising 389 students in grade 10, 412 students in grade 11, and 432 students in grade 12. Purposive sampling was used to select students in grades 11 and 12 who were full-time santri at the pesantren and had participated in the Dero pilgrimage at least once. The final sample consisted of 66 students, comprising 32 students from class XI-B and 34 students from class XII-A. This sampling criterion was used to ensure that all respondents had relevant prior experience with the Dero pilgrimage tradition and to provide a relatively homogeneous experiential context.

2.2. Instruments

Three instruments were used for data collection: a questionnaire measuring Dero pilgrimage participation (X), a questionnaire measuring religious attitudes (Y₁), and a multiple-choice test measuring ecosystem concept understanding (Y₂). The Dero pilgrimage participation questionnaire initially consisted of 30 items covering students' participation from the preparation stage through participation and reflection after the activity. The items were developed according to predetermined indicators of participation, including students' involvement in the activity, motivation, social interaction, and reflective engagement.

The religious attitudes questionnaire consisted of 25 items measuring the predetermined dimensions of *aqidah*, *ibadah*, and *akhlak*. The construction of the instrument was informed by

the multidimensional nature of Muslim youth religiosity described by Abdullah et al. (2023) and by previous research demonstrating the role of pesantren culture in the development of students' religious attitudes (Ihsan et al., 2021). The ecosystem concept understanding instrument consisted of 20 multiple-choice items covering ecosystem components, food webs, ecological interactions, and ecological balance. The items were aligned with the Biology curriculum and the ecological phenomena relevant to the Dero pilgrimage environment.

Before the main data collection, the 30 initial items were reviewed and empirically analyzed using responses from 32 students in class XI-B. Item validity was examined using the Pearson product-moment correlation at a 5% significance level, with a critical correlation value of 0.349. The analysis showed that 19 of the 30 initial items met the validity criterion. The remaining 11 items were revised based on the item analysis and feedback obtained during the instrument review process. The revised 30-item questionnaire was retained for the main study. Its internal consistency was subsequently assessed using Cronbach's alpha based on responses from the 66 participants, yielding a coefficient of 0.812.

The religious attitude scale (Y_1) consisted of 25 items with five response categories. It was operationalized through three dimensions of Islamic religious attitudes: *aqidah* (belief), *ibadah* (worship), and *akhlak* (moral character). The construction of the instrument was informed by the multidimensional nature of Muslim youth religiosity and previous research on religious attitudes in Islamic educational contexts (Abdullah et al. 2023; Ihsan et al. 2021). The ecosystem concept understanding test (Y_2) consisted of 20 multiple-choice items aligned with the senior high school Biology curriculum. The test covered biotic and abiotic components, food chains and food webs, ecological interactions, and ecological balance.

Before data collection, the instruments were reviewed by the school principal, vice principal for curriculum, and senior subject teachers to assess the relevance, clarity, and alignment of the items with the intended indicators, content, and student characteristics. Feedback and suggestions from the review were considered in refining the instruments. The reliability of Y_1 and Y_2 was assessed using Cronbach's alpha, with a coefficient of 0.70 used as the minimum criterion for acceptable internal consistency. For Y_2 , item difficulty and item discrimination were also examined. The characteristics and reliability results of the three instruments are presented in Table 1. Instrument quality was also considered in terms of validity and reliability to ensure that the measurement instruments were appropriate for the study (Retnawati, 2016).

2.3. Data Analysis

Data were analyzed using descriptive and inferential statistics. Data were analyzed using descriptive and inferential statistics following standard procedures for statistical analysis (Field, 2018). Descriptive statistics included the mean, standard deviation, minimum, and maximum scores. Prior to inferential analysis, normality and linearity assumptions were assessed using the Kolmogorov–Smirnov test and the ANOVA test for linearity, respectively. Because the study involved one independent variable and two dependent variables, two simple linear regression models were conducted separately. The first model examined the relationship between students' participation in the Dero pilgrimage (X) and religious attitudes (Y_1), while the second examined the relationship between participation in the Dero pilgrimage (X) and ecosystem concept understanding (Y_2). For each model, Pearson's correlation coefficient (r), coefficient of

determination (R^2), regression coefficient, t-test, and ANOVA F-test were examined. In simple linear regression, the F-test for the regression model and the two-tailed t-test for the slope provide equivalent significance tests (University, 2026). All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 26.0 (Corp., 2019). The significance level was set at $\alpha = 0.05$.

3. RESULTS AND DISCUSSION

3.1. Ethnoscience Values in the Dero Pilgrimage Tradition

The Dero pilgrimage tradition at Pondok Pesantren Al-Asy'ariyyah, Kalibeper, Wonosobo, is an annual cultural and religious activity involving an approximately 8.3-km journey from Kalibeper to Dero Duwur. The route passes through diverse environmental settings, including rice fields, streams, bamboo vegetation, hills, and mixed terrestrial vegetation. These settings provide contextual encounters with ecological phenomena that are relevant to senior high school Biology learning.

The ethnoscience analysis identified several ecological aspects that can be related to ecosystem concepts. In agricultural areas, students may encounter interactions among plants, animals, and other organisms within rice-field ecosystems. Along stream and river sections, flowing water and surrounding vegetation provide contextual examples of aquatic and riparian environments. Areas dominated by bamboo and other terrestrial vegetation provide opportunities to observe biodiversity, vegetation distribution, and interactions between organisms and their physical environment. Such connections are consistent with the broader ethnoscience literature, which emphasizes the reconstruction of local and indigenous knowledge into scientific concepts and learning contexts (Jannah et al., 2022; Latip et al., 2024; Supriatna et al., 2025).

The agricultural environment along the route can also be interpreted through concepts of producers, consumers, decomposers, trophic relationships, and ecological interactions. Previous research has demonstrated that local agricultural environments can provide meaningful contexts for connecting students' everyday experiences with scientific concepts. Ethnoscience-based learning has also been shown to support the contextualization of science concepts through local cultural and environmental knowledge (Hikmawati et al., 2021; Herlinawati & Suhartini, 2025). Thus, the rice-field environment encountered during the Dero pilgrimage provides a potential contextual setting for interpreting ecosystem concepts rather than merely serving as scenery along the pilgrimage route.

The aquatic sections of the route provide another relevant ecological context. Students encounter streams and flowing-water environments in which interactions between water, vegetation, soil, and aquatic organisms can be observed. Such environmental encounters are consistent with the principles of contextual science learning, in which local environments can serve as meaningful resources for connecting abstract scientific concepts with observable phenomena. Research on local wisdom and ecosystem-based learning has similarly shown that environmental contexts can strengthen students' understanding of ecological concepts and environmental awareness (Al Ayyubi et al., 2025).

The terrestrial and sloping sections of the route provide additional examples of biodiversity, vegetation structure, and relationships between biotic and abiotic factors. These

characteristics are consistent with the use of local ecological environments as sources of ethnoscience learning. Studies of ethnoscience-based science learning have demonstrated that local environments and cultural practices can be reconstructed into learning resources that connect scientific concepts with students' cultural experiences (Rizaldi et al., 2021; Supriatna et al., 2025). The Dero pilgrimage also contains religious and cultural values. Collective dzikir, prayer, remembrance of the pesantren founder, and transmission of religious teachings provide opportunities for students to engage with values related to aqidah, ibadah, and akhlaq. The communal nature of the activity also creates opportunities for social interaction, collective responsibility, and reflection. This combination of cultural, ecological, and religious dimensions distinguishes the Dero pilgrimage from a conventional field observation because the environmental experience occurs within an established cultural and religious practice.

From an ethnoscience perspective, these characteristics indicate that the Dero pilgrimage can function as a contextual setting for connecting students' cultural experiences with formal scientific concepts and religious values. Previous studies have shown that local traditions can contain ethnoscience knowledge and environmental value (Amidi et al., 2023), while ethnoscience-based learning can transform cultural practices into meaningful science-learning resources (Rizaldi et al., 2021; Ikhwal et al., 2023). The Dero tradition therefore provides a potentially rich context for integrating ecological learning with students' cultural and religious experiences.

3.2. Students' Religious Attitudes

Descriptive analysis showed that students' religious attitude scores were generally high. The 66 students obtained a mean score of 89.45 (SD = 4.41), with scores ranging from 78 to 98. The religious attitude instrument assessed three dimensions: aqidah, ibadah, and akhlaq. The relatively high scores should be interpreted in relation to the characteristics of the participants, most of whom were full-time santri living in a pesantren environment. Religious practices and social interactions are integrated into students' daily experiences in such settings. Previous research has demonstrated that the cultural climate of Islamic boarding schools contributes to the formation of students' religious attitudes through habituation, social interaction, and internalization of religious values (Ihsan et al., 2021).

The multidimensional nature of religious development is also consistent with Abdullah et al. (2023), who developed and validated a religiosity scale for Indonesian Muslim youth and identified belief, ritual, social, and commitment as important dimensions of religiosity. Although the dimensions used in the present study are operationalized as aqidah, ibadah, and akhlaq, both frameworks recognize that religious development encompasses cognitive, behavioral, and social-moral dimensions.

The Dero pilgrimage provides a context in which these dimensions may be encountered through collective dzikir, prayer, remembrance of the pesantren founder, interaction with peers and teachers, and reflection on religious teachings. Nevertheless, the descriptive findings alone cannot establish that participation in the Dero pilgrimage caused students to become more religious. The high scores may also reflect students' broader experiences within the pesantren environment. Therefore, the relationship between Dero pilgrimage participation and religious attitudes was examined further through simple linear regression.

3.3. Students' Ecosystem Concept Understanding

The ecosystem concept understanding test showed a generally high level of achievement among the participants. The mean score was 89.88 (SD = 4.15), with scores ranging from 82 to 100. The test assessed students' understanding of ecosystem components, food chains and food webs, ecological interactions, and ecological balance. These concepts are contextually related to environmental settings encountered along the Dero pilgrimage route. Rice-field environments can provide examples of producer-consumer relationships and food webs, while streams and surrounding vegetation provide opportunities to observe interactions between organisms and abiotic environmental factors. The use of local environmental contexts in science learning is supported by research showing that local wisdom and environmental settings can make scientific concepts more contextual and meaningful (Rosyidah et al., 2025; Latip et al., 2024).

The findings are also consistent with studies demonstrating the potential of ethnoscience-integrated Biology learning to strengthen students' conceptual understanding. Herlinawati & Suhartini (2025) through a systematic literature review, found that ethnoscience-based electronic modules in high school Biology learning were associated with improvements in learning outcomes, scientific literacy, critical thinking, and other twenty-first-century skills. Similarly, Al Ayyubi et al. (2025) demonstrated the effectiveness of an ecosystem learning resource incorporating local wisdom in improving students' understanding of environmental concepts and environmental-care character. Similarly, Sultan et al. (2021) developed RULIBA learning media based on local wisdom for teaching ecosystem balance, illustrating how cultural context can support the learning of ecological concepts.

Nevertheless, the descriptive results alone cannot establish that participation in the Dero pilgrimage produced higher ecosystem understanding. Students' achievement may also be associated with classroom instruction, prior knowledge, academic experiences, and other factors. Therefore, the statistical relationship between Dero pilgrimage participation and ecosystem concept understanding was examined separately using simple linear regression.

3.4. Relationship Between Dero Pilgrimage Participation and Religious Attitudes

The first simple linear regression analysis showed a strong positive relationship between students' participation in the Dero pilgrimage and their religious attitude scores. The Pearson correlation coefficient was $r = 0.858$ ($p < 0.001$), indicating a strong positive linear relationship. The coefficient of determination was $R^2 = 0.737$, indicating that approximately 73.7% of the variance in religious attitude scores was statistically accounted for by variation in Dero pilgrimage participation scores within the present sample.

Table 2. Simple Linear Regression Results for Dero Pilgrimage Participation and Religious Attitudes

Relationship	r	R ²	B	SE	t	F	p
X → Y ₁	0.858	0.737	0.892	0.067	13.385	179.145	<0.001

The estimated regression equation was $Y_1 = 14.291 + 0.892X$. The regression coefficient was statistically significant ($B = 0.892$, $SE = 0.067$, $t = 13.385$, $p < 0.001$), and the regression

model was significant, $F(1, 64) = 179.145$, $p < 0.001$. These results support H_1 , which proposed a significant positive relationship between Dero pilgrimage participation and students' religious attitudes.

The relatively high R^2 value (0.737) should nevertheless be interpreted with caution. This value indicates that 73.7% of the variance in students' religious attitude scores was statistically accounted for by variation in Dero pilgrimage participation within the present sample; it does not indicate that participation in the Dero pilgrimage causally explains 73.7% of students' religious attitudes. The relatively high value may be related to the specific characteristics of the participants, who were students in a pesantren-based educational environment and had experience with the Dero tradition. Religious attitudes may also be shaped by other factors, including religious habituation, daily pesantren activities, family background, peer interaction, and students' prior religious experiences. Therefore, the observed relationship should be understood within the specific context of the study and not generalized as a causal effect beyond the sample.

From a theoretical perspective, the observed relationship can be understood through the experiential and habituation processes embedded in the Dero pilgrimage. Participation in communal dzikir, prayer, and remembrance of the pesantren's religious heritage may provide students with repeated opportunities to engage in religious practices within a shared social context. Such experiences may provide a context for connecting religious knowledge with concrete practices and social interactions. In this sense, participation in the Dero tradition can be viewed as an experiential context in which dimensions of religious attitudes, including aqidah, ibadah, and akhlaq, are encountered through practice, reflection, and interaction. This mechanism provides a possible explanation for the statistical relationship observed in the present study, while the *ex post facto* design does not permit the relationship to be interpreted as a direct causal effect. This interpretation is also consistent with previous research emphasizing the role of cultural and religious contexts in students' religious experiences. Rather than treating the Dero tradition only as a cultural practice, the present findings highlight its experiential and communal characteristics as a relevant context for students' religious experiences.

3.5. Relationship Between Dero Pilgrimage Participation and Ecosystem Concept Understanding

The second simple linear regression analysis also indicated a strong positive relationship between Dero pilgrimage participation and ecosystem concept understanding. The Pearson correlation coefficient was $r = 0.839$ ($p < 0.001$), indicating a strong positive linear relationship. The coefficient of determination was $R^2 = 0.704$, meaning that approximately 70.4% of the variance in ecosystem concept understanding scores was statistically accounted for by variation in Dero pilgrimage participation scores within the present sample.

Table 3. Simple Linear Regression Results for Dero Pilgrimage Participation and Ecosystem Concept Understanding

Relationship	r	R²	B	SE	t	F	p
X→ Y ₂	0.839	0.704	0.820	0.067	12.326	151.940	<0.001

Based on Table 3, the regression coefficient was statistically significant ($B = 0.820$, $SE = 0.067$, $t = 12.326$, $p < 0.001$), and the regression model was significant, $F(1,64) = 151.940$, $p < 0.001$. These findings support H_2 , which proposed a significant positive relationship between Dero pilgrimage participation and ecosystem concept understanding.

The relatively high R^2 value (0.704) should also be interpreted cautiously. This value indicates that 70.4% of the variance in students' ecosystem concept understanding was statistically accounted for by variation in Dero pilgrimage participation within the present sample. It should not, however, be interpreted as evidence of a causal effect of Dero pilgrimage participation on 70.4% of students' ecosystem concept understanding. Students' understanding of ecosystem concepts may also be influenced by other factors, such as prior Biology learning, classroom instruction, prior knowledge, learning resources, environmental familiarity, and individual learning experiences. The high R^2 value may therefore reflect the specific characteristics and educational context of the participants, and the finding should not be generalized as a causal effect beyond the study context.

The relationship can also be interpreted through the experiential nature of the Dero pilgrimage. Along the pilgrimage route, students encounter rice fields, rivers, hills, bamboo vegetation, and forest areas, providing opportunities to observe organisms and environmental conditions in their natural settings. Such direct encounters may provide contextual experiences through which students can connect observable ecological phenomena with formal Biology concepts, including biotic and abiotic components, biodiversity, ecological interactions, and relationships between organisms and their environment. From this perspective, the Dero pilgrimage functions as an experiential context that may help students relate concrete environmental observations to abstract ecosystem concepts. This mechanism offers a theoretical explanation for the observed statistical relationship, while the *ex post facto* design does not establish a direct causal effect.

This interpretation is supported by previous research demonstrating the potential of local wisdom-based resources for ecosystem and environmental learning. Al Ayyubi et al. (2025) reported that ecosystem learning resources incorporating local wisdom could support students' understanding of environmental concepts, while Herlinawati & Suhartini (2025) found that ethnoscience-based Biology learning resources can support students' learning outcomes and scientific literacy. These studies provide supporting evidence for the contextual value of local environments in science learning, while the present study examines the Dero pilgrimage as a culturally embedded context associated with students' ecosystem concept understanding.

3.6. Integrated Discussion of the Two Relationships

The two regression analyses reveal a consistent pattern: Dero pilgrimage participation was positively associated with both religious attitudes (Y_1) and ecosystem concept understanding (Y_2). The statistical association was slightly stronger for religious attitudes ($r = 0.858$; $R^2 = 0.737$) than for ecosystem concept understanding ($r = 0.839$; $R^2 = 0.704$). This difference is understandable in relation to the characteristics of the tradition. Religious practice is an explicit component of the Dero pilgrimage, whereas the relationship with ecosystem understanding is more contextual and depends on students' encounters with natural environments along the route.

The findings provide an integrated perspective on the potential educational significance of culturally embedded activities in pesantren-based education. The Dero pilgrimage combines religious-cultural practices with direct encounters with diverse environmental settings. Such integration is consistent with the broader literature showing that local wisdom and ethnoscience can connect formal science learning with students' cultural experiences (Amidi et al., 2023; Rosyidah et al., 2025). It is also consistent with research suggesting that the integration of Islamic values and local wisdom can support the development of students' character alongside academic learning (Arizona et al., 2025).

Importantly, the present study does not establish a causal effect of the Dero pilgrimage on either outcome. Rather, the results demonstrate two statistically significant positive relationships involving the same predictor, examined through two separate simple linear regression models. This distinction is important because the *ex post facto* design does not involve manipulation of the independent variable and therefore does not permit causal conclusions.

The findings therefore suggest that the Dero pilgrimage may provide a meaningful contextual setting for connecting values and Biology learning in pesantren-based schools, particularly when its ecological and cultural dimensions are explicitly connected to curricular objectives. This interpretation is consistent with recent research showing the potential of ethnoscience to connect scientific learning with local culture, strengthen scientific literacy and conceptual understanding, and preserve cultural knowledge (Atmojo et al., 2025; Fitria et al., 2025; Herlinawati & Suhartini, 2025). Further experimental or quasi-experimental studies are needed to determine whether deliberate integration of the Dero tradition into instructional activities produces measurable changes in students' religious attitudes or ecosystem concept understanding.

4. CONCLUSION

The *napak tilas Dero* (Dero pilgrimage) tradition at Pondok Pesantren Al-Asy'ariyyah Kalibeber, Wonosobo, contains ethnoscientific values that are relevant to Biology learning, particularly in relation to ecosystem components, biodiversity, ecological interactions, and environmental stewardship. The tradition also incorporates religious practices and reflective activities that are relevant to the development of *aqidah*, *ibadah*, and *akhlaq*. These characteristics indicate that the Dero pilgrimage provides a culturally meaningful context for connecting local cultural experiences, religious values, and scientific concepts in pesantren-based education. Based on data from 66 students, students' participation in the Dero pilgrimage was significantly and positively associated with religious attitudes and ecosystem concept understanding. The first simple linear regression showed a significant positive relationship between Dero pilgrimage participation and religious attitudes ($r = 0.858$, $R^2 = 0.737$, $p < 0.001$), while the second showed a significant positive relationship between Dero pilgrimage participation and ecosystem concept understanding ($r = 0.839$, $R^2 = 0.704$, $p < 0.001$). These findings support the two proposed hypotheses and indicate that variation in students' participation scores was statistically associated with variation in both outcome measures. The findings suggest that the Dero pilgrimage may provide a meaningful contextual setting for connecting religious values, cultural experiences, and Biology learning in pesantren-based schools. Its combination of religious practices, social interaction, reflection, and direct encounters with diverse natural environments provides opportunities to connect students' cultural experiences with formal Biology concepts and religious

values. However, because this study employed an ex post facto design, the observed relationships should not be interpreted as causal effects. Other factors, such as prior learning experiences, classroom instruction, and students' religious environment, may also be related to the observed outcomes. Future studies may examine the integration of the Dero pilgrimage into Biology instruction using experimental or quasi-experimental designs to provide stronger evidence regarding its educational outcomes. Comparative and longitudinal studies involving other local traditions and pesantren contexts may also help examine the transferability of the findings.

REFERENCES

- Abdullah, S., Warsiyah, W., & Ju'subaidi, J. (2023). Developing a religiosity scale for Indonesian Muslim youth. *REID (Research and Evaluation in Education)*, 9(1), 73–85. <https://doi.org/10.21831/reid.v9i1.61201>
- Al Ayyubi, S. H. Y., Rusilowati, A., & Saptono, S. (2025). Effectiveness of an ecosystem e-booklet containing local wisdom of Lake Rawa Pening to improve students' understanding of environmental care concepts and character. *Unnes Science Education Journal*, 14(1), 183–189. <https://doi.org/10.15294/usej.v14i1.19761>
- Amidi, A., Amalia, A. V., & Prasetyo, B. (2023). Study of local wisdom Nyadran Sruwen Hamlet as ethnoscience and environmental ethics. *Unnes Science Education Journal*, 12(1), 32–38. <https://doi.org/10.15294/usej.v12i1.58226>
- Anwar, S., Sumarna, O., & Kusrijadi, A. (2024). Permasalahan guru IPA SMP mengajarkan IPA terpadu berbasis ethnoscience. *Jurnal Abmas*, 24(1), 67–74. <https://doi.org/10.17509/abmas.v24i1.64208>
- Aprilia, V., Sartika, S. B., & Salim, A. (2025). Contextual teaching and learning based on ethnoscience in natural and social sciences. *Indonesian Journal of Education Methods Development*, 20(4). <https://doi.org/10.21070/ijemd.v20i4.901>
- Arizona, K., Rokhmat, J., & Ramdani, A. (2025). Integrating Islamic values and local wisdom into science education: Enhancing character development in higher education. *Ulumuna*, 29(1), 398–428. <https://doi.org/10.20414/ujis.v29i1.1308>
- Atmojo, S. E., Anggriani, M. D., & Rahmawati, R. D. (2025). Bridging STEM and culture: The role of ethnoscience in developing critical thinking and cultural literacy. *Jurnal Pendidikan IPA Indonesia*, 14(2), 251–266. <https://doi.org/10.15294/jpii.v14i2.23505>
- Corp., I. B. M. (2019). IBM SPSS Statistics for Windows, Version 26.0. *IBM Corp.*
- Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches. In *SAGE Publications* (5th ed., Vol. 5).
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3), 297–334. <https://doi.org/10.1007/BF02310555>
- Field, A. (2018). Discovering statistics using IBM SPSS statistics. In *SAGE Publications* (5th ed., Vol. 5).
- Fitria, D., Asrizal, A., & Lufri, L. (2025). Enhancing 21st-century skills through blended problem-based learning with ethnoscience integration: A mixed-methods study in Indonesian junior high schools. *International Journal of Learning, Teaching and Educational Research*, 24(1), 464–480.

- Herlinawati, N., & Suhartini, S. (2025). Implementation of ethnoscience-based electronic modules in high school Biology learning: A systematic literature review. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 11(1), 304–314. <https://doi.org/10.22219/jpbi.v11i1.38147>
- Hikmah, N., & Yohandri. (2025). Uncovering the potential of ethnoscience in science learning to improve students' literacy: A systematic-literature review (2014–2024). *Jurnal Pendidikan IPA Indonesia*, 14(3). <https://doi.org/10.15294/jpii.v14i3.19591>
- Hikmawati, H., Suastra, I. W., & Pujani, N. M. (2021). Ethnoscience-based science learning model to develop critical thinking ability and local cultural concern for junior high school students in Lombok. *Jurnal Penelitian Pendidikan IPA*, 7(1), 60–66. <https://doi.org/10.29303/jppipa.v7i1.530>
- Husni, R., & Mukra, R. (2025). Integration of ethnoscience in high school Biology learning: A systematic literature review from 2021–2025. *Bioedunis Journal*, 4(2). <https://doi.org/10.24952/bioedunis.v4i2.18839>
- Ihsan, M. N., Ahmad, N., & Hasanah, A. (2021). Islamic boarding school culture climate in forming the religious attitude of Islamic students in modern and agrobusiness Islamic boarding schools. *Nazhruna: Jurnal Pendidikan Islam*, 4(2), 362–382. <https://doi.org/10.31538/nzh.v4i2.1492>
- Ikhwal, M., Minarsih, M., & Puspita, S. D. (2023). Pengembangan e-modul interaktif berbasis Android dengan pendekatan etnosains pada upacara adat Kenduri Sko di SMA. *Media Penelitian Pendidikan*, 17(1), 115–123. <https://doi.org/10.26877/mpp.v17i1.13334>
- Jannah, R., Festiyed, F., & Yerimadesi, Y. (2022). Ethnoscience in learning science: A systematic literature review. *Scientiae Educatia: Jurnal Pendidikan Sains*, 11(2), 175–184. <https://doi.org/10.24235/sc.educatia.v11i2.11488>
- Kasi, Y. F., Samsudin, A., & Widodo, A. (2021). A thematic review on exploring ethnoscience in science education: A case in Indonesia. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, 6(2), 229–241. <https://doi.org/10.24042/tadris.v6i2.9509>
- Latip, A., Hernani, H., & Kadarohman, A. (2024). Local and indigenous knowledge (LIK) in science learning: A systematic literature review. *Journal of Turkish Science Education*, 21(4), 651–667. <https://doi.org/10.36681/tused.2024.035>
- Lestari, I., & Zulirfan, Z. (2024). How is the effectiveness of ethnoscience-based modules in science learning in Indonesia?: A systematic literature review. *Scientiae Educatia: Jurnal Pendidikan Sains*, 13(2), 159–171. <https://doi.org/10.24235/sc.educatia.v13i2.18540>
- Marlina, M., Syafi'i, W., & Suwondo, S. (2025). Validity and practicality of ecosystem e-modules integrated with local wisdom to improve students' SCA and critical thinking skills. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 11(2), 728–741. <https://doi.org/10.22219/jpbi.v11i2.40353>
- Maysarah, M., Nazurty, N., & Haryanto, E. (2025). Analisis etnosains dalam pembelajaran IPA di Madrasah Ibtidaiyah Kecamatan Pal Merah, Kecamatan Kota Baru, dan Kecamatan Telanai Pura Kota Jambi. *Jurnal Penelitian Pendidikan IPA*, 11(3), 1014–1021. <https://doi.org/10.29303/jppipa.v11i3.10136>
- Muyassaroh, I., Saputri, A. E., & Saefudin, A. (2025). Bridging cultures in the classroom: A systematic literature review of ethnoscience research in Indonesian elementary science education. *Data and Metadata*, 4, 434. <https://doi.org/10.56294/dm2025434>

- Retnawati, H. (2016). Validitas, reliabilitas, dan karakteristik butir: Panduan untuk penelitian, mahasiswa, dan psikometri. In *Parama Publishing*.
- Rizaldi, D. R., Andayani, Y., Doyan, A., Makhrus, Muh., Fatimah, Z., & Nurhayati, E. (2021). The use of Betel leaf in Nyirih tradition: Analyzing an ethnosience-based learning material. *International Journal on Education Insight*, 2(1), 29. <https://doi.org/10.12928/ijeiv2i1.3579>
- Rosyidah, F., Susantini, E., & Yuliani, Y. (2025). Local wisdom and STEM in science education to support SDG-4: A systematic review. *Jurnal Pendidikan IPA Indonesia*, 14(4), 654–666. <https://doi.org/10.15294/jpii.v14i4.34450>
- Sudirman, S., Sutikno, S., & Indriyanti, D. R. (2025). Integration of ethnosience in natural science learning: Literacy study. *Jurnal Penelitian Pendidikan IPA*, 11(6), 68–77. <https://doi.org/10.29303/jppipa.v11i6.9980>
- Sultan, R. S. A., Hendracipta, N., & Andriana, E. (2021). Developing RULIBA media based on local wisdom for learning the balance of ecosystem in the natural science subject. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 10(3). <https://doi.org/10.33578/10.33578/jpfkip.v10i3.8087>
- Supriatna, A. Y., Hernawati, D., & Badriah, L. (2025). Profil pengembangan modul ajar IPA terintegrasi etnosains sebagai upaya penguatan konsep ilmiah: Systematic literature review. *Jurnal Pendidikan Matematika Dan Sains*, 13(1), 157–171. <https://doi.org/10.21831/jpms.v13i1.84652>
- University, P. S. (2026). STAT 501: Regression methods. *Department of Statistics*. <https://online.stat.psu.edu/stat501/>
- Warsiyah, W. (2018). Pembentuk religiusitas remaja Muslim: Tinjauan deskriptif analitis. *Cendekia: Jurnal Kependidikan Dan Kemasyarakatan*, 16(1), 19–40. <https://doi.org/10.21154/cendekia.v16i1.1262>