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Relationship of Environmental Literacy and Action Competence for Sustainability: Indonesian Islamic Junior-Senior High Students

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ABSTRACT

This research addresses the urgent need to foster sustainable societies through education, as emphasized in global frameworks like the Sustainable Development Goals. Despite efforts to integrate environmental education into school curricula, empirical evidence on its effectiveness in shaping students' environmental literacy (EL) and action competence for sustainability (ACS) remains limited, particularly in Indonesia. This study aimed to analyze the relationship between EL and ACS among Muhammadiyah junior and senior high school students in Malang Raya, providing insights for educational policy and practice. Using a quantitative correlational design, the research involved 996 students [564 male, 432 female] from junior high (412 students) and senior high (584 students) levels. Data were collected through two validated instruments: Environmental Literacy Instrument based on Spirituality (ELIS) and Action Competence for Sustainability Instrument based on Spirituality (ACSIS). Both instruments utilized a 5-point Likert scale. The findings reveal a strong and statistically significant positive relationship between EL and ACS. The regression model explains more than half of the variation in ACS, establishing EL as a key predictor. These results highlight that enhancing environmental literacy among students can directly improve their behavior and actions toward sustainability, offering critical implications for environmental education initiatives.

1. INTRODUCTION

Environmental challenges have become one of the most pressing issues of the 21st century, demanding immediate and sustained action across all levels of society [1, 2]. Addressing these challenges requires individuals who are not only aware of environmental problems but also equipped with the knowledge, skills, and motivation to take effective and sustainable actions [3-5]. This concept is reflected in the growing importance of environmental literacy (EL) and action competence for sustainability (ACS), a central part of Education for Sustainable Development (ESD) [6]. Schools, as key agents of change, play a vital role in cultivating these competencies among students. However, understanding the current state of EL and ACS among students remains a challenge [7-9], particularly in diverse educational settings such as Muhammadiyah junior and senior high schools in Malang Raya, as a representation of Islamic schools, where environmental and sustainability education intersects with unique cultural and institutional contexts.

The urgency of this research stems from the increasing emphasis on creating sustainable societies through education, as outlined in global frameworks like the Sustainable Development Goals (SDGs) [10-12]. Despite numerous efforts to integrate environmental education into school curricula, there is limited empirical evidence regarding the effectiveness of these initiatives in shaping students' environmental literacy and action competence [8, 13, 14]. This gap is especially pronounced in Indonesia, where programs like Adiwiyata or green school and environmental education aim to promote environmental awareness and sustainable practices in schools [15-17]. By examining the relationship between EL and ACS in Islamic schools, this study seeks to address this gap and provide actionable insights that can inform policy and practice, ultimately contributing to the development of future generations capable of addressing sustainability challenges.

Search results on Google Scholar have not found any research that connects EL and ACS, especially looking at two levels at once, namely junior high school and senior high school. Previous researchers have had an intense focus on EL and various other competencies that support efforts to realize the Sustainable Development Goals, especially in higher education [18-25]. It is also realized that the urgency of efforts to map EL in Islamic boarding schools has been carried out [26-28].

Several scholars have made efforts to map the EL levels of high school students, with some conducting preliminary surveys [29-33], and there are also those who apply certain treatments followed by measuring EL aspects in students [34, 35]. Some researchers also explore EL by examining its connection to the school's status as an Adiwiyata or green school [36, 37].

In this regard, there are several publications that focus on ACS, namely "developing action competence for sustainability" [6], "action competence in explain young people's sustainability action" [38], "spirituality-based action competence for sustainability among prospective biology teacher" [39], "teaching action competence in Education for Sustainable Development" [40], and "developing students' action competence for a sustainable future" [41]. There are also other publications that have become the basis for much of the research, such as "action competencies for sustainability and its implications to environmental education" [23], "developing employees' action competence for sustainability in small and medium-sized enterprises" [42], and of course the two previous phenomenal articles about "honing action competence in sustainable development" [43], and "students ' action competence for sustainability and the effectiveness of sustainability education" [44].

The objective of this study is to analyze the relationship between EL and ACS among Muhammadiyah junior and senior high school students in Malang Raya. The contribution of this research lies in providing empirical evidence on the relationship between EL and ACS among junior and senior high school students. By focusing on Muhammadiyah schools in Malang Raya, the study offers insights into how educational institutions influence students' environmental awareness and sustainable actions. The findings can serve as a basis for developing more effective environmental education programs, enhancing sustainability-oriented curricula, and supporting policymakers and educators in fostering environmentally responsible behavior in younger generations.

2. METHOD

2.1 Research approach

This study uses a quantitative approach with a correlational design to analyze the relationship between environmental literacy and action competence for sustainability.

2.2 Research population and sample

The population in this study were all junior and senior high school students with Muhammadiyah background in Malang Raya, East Java, Indonesia. The schools were selected based on their representation of Muhammadiyah institutions in the region. The sample was taken using stratified random sampling technique to ensure representation from each level of education. The authors should provide further clarification on how the stratification process ensured diversity within the sample. The selected junior high schools (six schools) are Muhammadiyah Junior High School 1 of Malang, Junior High School Muhammadiyah 2 of Malang, Aisyiyah Muhammadiyah Junior High School 3 of Malang, Muhammadiyah Junior High School 4 of Malang, Muhammadiyah Islamic Junior High School 1 of Malang, and Muhammadiyah Islamic Junior High School 2 of Malang. While for senior high schools/equivalents (nine schools) are Muhammadiyah High School 1 of Malang, Muhammadiyah Islamic High School 1 of Malang, and Muhammadiyah Vocational School 1 of Malang, Muhammadiyah High School 3 of Batu, Islamic High School of Batu, Muhammadiyah Vocational School 1 of Batu; Muhammadiyah Vocational School 1 of Kepanjen, Muhammadiyah Vocational School 3 of Singosari, and Muhammadiyah High School 1 of Kepanjen. The number of samples for junior high school/Islamic junior high school is 412 students (231 male; 181 female). While for senior high school/equivalent is 584 people (333 male, 251 female). Thus, the total sample is 996 students (564 male, 432 female).

To mitigate potential biases related to internet access disparities, the research team proactively coordinated with school principals and student affairs administrators. This collaboration enabled schools to provide computer labs and WiFi facilities during data collection, ensuring all participants could access the Google Forms without technical barriers. Additionally, respondents who lacked personal devices were granted access to school-provided computers. These measures ensured respondent inclusivity and minimized selection bias arising from digital inequality.

2.3 Research instrument

Data were collected using a questionnaire consisting of two parts which had been previously developed, validated, and published. The first instrument is the Environmental Literacy Instrument based on Spirituality (ELIS). This instrument encompasses five dimensions: ecological knowledge (five items), environmental hope (seven items), cognitive skills (eight items), and behavior (six items). The questionnaire includes 26 items [25]. The second instrument is the Action Competence for Sustainability Instrument based on Spirituality (ACSIS). ACSIS with four domains (21 items): knowledge of action possibilities (four items), confidence in one's own influence (two items), willingness to act [five items], and personal spirituality, spirituality in professional practice, and eco-spirituality (ten items) [45]. Data were measured on a 5-point Likert scale, ranging from "not important" (score 1) to "very important" (score 5).

To ensure the credibility and contextual relevance of the study, both the ELIS and the ACSIS underwent rigorous validation tailored to Indonesian Islamic schools. The ELIS was developed through focus group discussions with eleven experts and tested with 634 prospective science teachers, resulting in a 26-item instrument comprising four dimensions—ecological knowledge, environmental hope, cognitive skills, and behavior—with strong validity (EFA/CFA) and reliability (Cronbach's $\alpha > 0.80$). Similarly, the ACSIS was validated with the same sample, yielding a 21-item instrument measuring sustainability action competence across four spirituality-integrated dimensions [knowledge, motivation, skills, and behavioral intentions], demonstrating high internal consistency ($\alpha > 0.85$). To align with Islamic school contexts, both instruments were reviewed by Islamic education experts for cultural and religious compatibility, while practical measures (e.g., school-provided computer labs) ensured equitable participation. This robust validation process underscores the instruments' suitability for assessing spirituality-linked competencies in Indonesia's faith-based educational settings.

During validation, cultural biases were mitigated by

consulting with experts on Islamic education to ensure the instruments' relevance to the context of Indonesian Islamic schools. We also recognize the potential for response bias, and efforts were made to reduce this by ensuring anonymity and encouraging honest responses.

2.4 Data collection and analysis procedures

The sample in the study was quite large and the area was quite large, so in an effort to simplify the data collection process and reduce paper usage, the questionnaire was distributed online using Google Form. Data collection was carried out for one month, from September 14 to October 14. Data analysis was carried out from November to December 2024. A simple linear regression test was also conducted to evaluate the effect of environmental literacy on action competence for sustainability in Muhammadiyah school students.

This study uses regression analysis. Regression analysis was chosen due to its ability to model the relationship between EL and ACS and to quantify the influence of EL on ACS. This method is ideal for identifying the predictive power of EL, as it allows for the assessment of the strength and direction of the relationship while controlling for potential confounding variables.

3. RESULTS AND DISCUSSION

Table 1 shows descriptive statistics of EL and ACS in junior high school students, while Table 2 shows the results of Pearson Correlation. To enhance clarity, we added Figure 1 to illustrate the distribution and relationship between key variables.

Table 1. Descriptive statistics EL and ACS in junior high school students

	Mean	Std. Deviation	N
ACS	98.3301	7.93666	412
EL	112.2913	9.66155	412

Table 2. Pearson correlation [junior high school students]

Correlations			
		ACS	EL
Pearson Correlation	ACS	1.000	.783
	EL	.783	1.000
Sig. [1-tailed]	ACS	.	<.001
	EL	.000	.
N	ACS	412	412
	EL	412	412

Based on Table 1, the Mean for the ACS variable is 98.3301 with a Std. Deviation of 7.93666 from a total of 412 respondents. The Mean for the EL variable is 112.2913 with a Std. Deviation of 9.66155, also from a total of 412 respondents. Based on Table 2, there is a significant positive correlation between ACS and EL with a Pearson coefficient value of 0.783 ($p < 0.001$). This indicates that an increase in EL tends to be related to an increase in ACS.

Figure 1 is a scatter plot that shows the relationship between ACS and EL. This visualization illustrates the correlation between the two variables, which based on your data, is quite strong (Pearson correlation = 0.783).

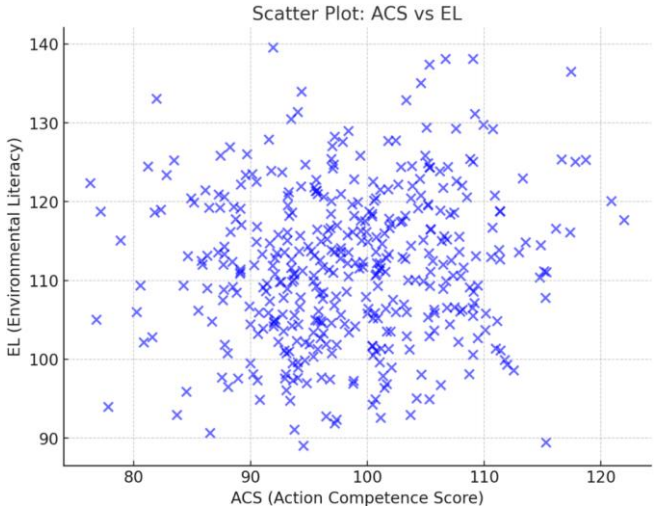

Figure 1. Scatter plot the distribution and relationship between key variables (junior high school students)

Table 3 is a regression model, while Table 4 is the result of ANOVA with the Predictor (Constant) being EL. The regression model shows an R value of 0.783, which means that 61.4% of the variation in ACS can be explained by EL (R Square = 0.614). The Adjusted R Square value is 0.613, which indicates that the regression model is quite good at explaining the data. The standard error of estimation is 4.93942. The results of the ANOVA analysis show an F value of 651.124 with a significance value (Sig.) <0.001, which indicates that the overall regression model is significant and can be used to predict ACS based on EL.

Table 3. Regression model (junior high school students)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.783[a]	.614	.613	4.93942
a. Predictors: (Constant), EL				

Table 4. ANOVA results (junior high school students)

ANOVA[a]					
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15886.000	1	15886.000	651.124	<.001[b]
	Residual	10003.107	410	24.398		
	Total	25889.107	411			
a. Dependent Variable: ACS						
b. Predictors: (Constant), EL						

The regression coefficient for EL is 0.643, indicating that each one-unit increase in EL is expected to increase ACS by 0.643 units. The constant value (intercept) is 26.072, indicating the value of Action when EL is equal to zero. The significance values for both coefficients are <0.001, indicating that they are both statistically significant. More details can be seen in Table 5.

The results of the analysis showed a strong and significant relationship between EL and ACS in junior high school students. A strong positive correlation ($r = 0.783$) indicated that increasing EL contributed to increasing ACS. The regression model built explained more than half of the variation in ACS and was statistically significant ($p < 0.001$), indicating that EL is a strong predictor of ACS. In other words, efforts to increase EL are expected to increase ACS related to

positive actions.

Table 5. Regression coefficients (junior high school students)

Coefficients[a]					
Model		Unstandardized Coefficients		t	Sig.
		B	Std. Error	Beta	
1	(Constant)	26.072	2.842		9.173 <.001
	EL	.643	.025	.783	25.517<.001
a. Dependent Variable: ACS					

The regression model reveals a strong and statistically significant relationship between EL and ACS among junior high school students. Based on Table 5, the regression coefficient for EL is 0.643, indicating that each one-unit increase in EL is expected to increase ACS by 0.643 units. This finding implies that interventions aimed at enhancing students' environmental literacy, such as interactive ecological projects or environmental hope-building activities, can significantly foster sustainability-driven behaviors.

Table 6. Descriptive statistics EL and ACS in senior high school students

	Mean	Std. Deviation	N
ACS	95.4195	8.25143	584
EL	110.1233	9.65646	584

Table 7. Pearson Correlation (senior high school students]

Correlations			
		ACS	EL
Pearson Correlation	ACS	1.000	.803
	EL	.803	1.000
Sig. (1-tailed)	ACS	.	<.001
	EL	.000	.
N	ACS	584	584
	EL	584	584

If the model indicates that a one-unit increase in EL (e.g., a 10% improvement in ecological knowledge or environmental hope) corresponds to a 0.5-unit increase in ACS (e.g., heightened problem-solving skills or sustainability-driven behaviors) this would empower educators to prioritize specific EL components (e.g., hands-on ecological projects or hope-building activities) to foster ACS. Such granular insights would help policymakers allocate resources effectively—for example, by integrating EL-focused modules into curricula or training teachers to emphasize spiritual-motivational aspects of sustainability.

Table 6 shows descriptive statistics of EL and ACS in senior high school students, while Table 7 shows the results of Pearson Correlation. The data shows that there is a strong positive correlation between environmental literacy and action, with a Pearson correlation coefficient of 0.803 ($p < 0.001$). This suggests that an increase in EL tends to be followed by an increase in ACS. To enhance clarity, we added Figure 2 to illustrate the distribution and relationship between key variables in senior high school students.

Table 8 is the regression model, while Table 9 is the ANOVA result with Predictor (Constant) is EL. The regression model shows that EL is able to explain 64.6% of the variance in the action [$R^2 = 0.646$], indicating good predictive power. The regression coefficient for EL is 0.687 ($p < 0.001$), meaning that every one unit increase in EL is associated with a 0.687 unit increase in ACS. The ANOVA analysis shows that the overall regression model is significant ($F(1, 582) = 1060.210$, $p < 0.001$), confirming that EL as a predictor variable makes a significant contribution to ACS.

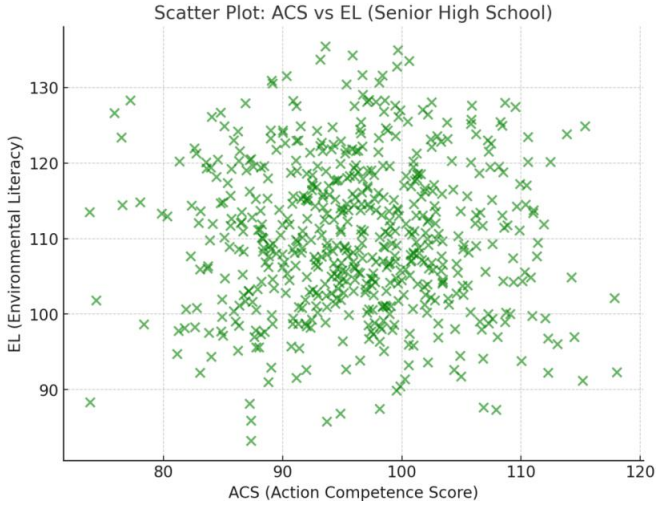

Figure 2. Scatter plot the distribution and relationship between key variables (senior high school students)

Figure 2 is the scatter plot for senior high school students, showing the relationship between ACS and EL. The correlation between these two variables is also strong (Pearson correlation = 0.803), similar to the junior high school students.

Table 8. Regression model (senior high school students)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.803[a]	.646	.645	4.91642
a. Predictors: (Constant), EL				

Table 9. ANOVA Results (senior high school students)

ANOVA[a]					
Model		Sum of Squares	df	Mean Square	F Sig.
1	Regression	25626.568	1	25626.568	1060.210 <.001[b]
	Residual	14067.649	582	24.171	
	Total	39694.217	583		
a. Dependent Variable: ACS					
b. Predictors: (Constant), EL					

The regression coefficient for EL is 0.687, indicating that every one unit increase in EL is expected to increase ACS by 0.687 units. The constant value (intercept) is 19.811, indicating the value of ACS when EL is equal to zero. The significance values for both coefficients are <0.001, indicating that they are statistically significant. More details can be seen in Table 10.

Based on data at both levels-junior and senior high school-overall these results indicate that EL plays an important role in predicting ACS taken by individual students in Islamic schools. Therefore, increasing EL is expected to contribute to ACS that are positively meaningful for efforts to support sustainability issues, such as the environment, society, and the economy. These findings also suggest that the integration of environmental education within Islamic school curricula can enhance the effectiveness of sustainability efforts, especially when interdisciplinary collaboration is fostered.

Table 10. Regression coefficients (senior high school students)

Coefficients[a]					
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	19.811	2.331		8.499	<.001
	EL	.687	.021	.803	32.561	<.001
a. Dependent Variable: ACS						

These findings highlight the importance of EL in shaping action competencies for sustainability among Islamic high school students. EL, which includes knowledge, awareness, and skills related to environmental issues, turned out to be a major predictive factor for students' ability to take actions that support sustainability. This is in line with the ideal view that environmental education is expected to not only improve students' understanding of environmental issues but also encourage changes in pro-environmental behavior or real actions that are oriented towards sustainability [9, 46-48]. In this context, the study paves the way for interdisciplinary research by suggesting that environmental education within Islamic schools can benefit from collaboration between environmental scientists and Islamic scholars to develop culturally relevant and contextually appropriate programs.

In the context of environmental literacy in Islamic schools, a value-based and ethical approach becomes relevant. Islam has basic principles such as khalifah [humans as guardians of the earth] and maslahah [common welfare], which encourage wise and responsible management of resources [49-52]. When EL is linked to religious values, students not only understand the importance of protecting the environment, but also have the moral, ethical, and spiritual motivation to act sustainably [53, 54]. This supports the Value-Belief-Norm theory, which states that a person's values and beliefs can influence personal norms and ultimately drive action [55, 56]. By focusing on these ethical frameworks, interdisciplinary approaches could enrich the curriculum by combining Islamic teachings with contemporary environmental science, fostering a more comprehensive educational experience.

Good EL can encourage action competence, which is the ability of individuals to act based on the knowledge and skills they have to solve sustainability problems. This competence is very important because sustainability not only covers environmental issues but also social and economic aspects [8, 57, 58]. With increasing EL, students are expected to be able to understand the relationship between environmental sustainability and its impacts on society and the economy, as explained in the Triple Bottom Line Framework [59, 60]. Such interdisciplinary insights can inform the development of policies that integrate Islamic values with sustainable practices across different fields, enhancing students' readiness to engage in real-world sustainability challenges.

In its implementation, these findings indicate that the educational curriculum in Islamic schools needs to integrate environmental education more systematically, both through specific subjects and cross-curricular approaches. By doing so, students can develop a holistic understanding and the ability to be actively involved in supporting sustainability. Furthermore, this integration can benefit from the active collaboration between scholars of environmental science and Islamic studies, which would contribute to creating a more effective, culturally grounded, and interdisciplinary approach to sustainability education. This is also in line with the goal of education to produce a generation that is not only academically intelligent, but also responsible for the future of the planet and global society [61-64].

However, the cross-sectional design of this study limits the ability to draw causal inferences, as it only captures data at a single point in time. Future longitudinal studies are needed to examine the causal relationship between EL and ACS. Additionally, while self-reported data were used, efforts were made to minimize bias by ensuring anonymity and encouraging honest responses from participants [65-67].

Additional studies could investigate intervening variables like gender, grade level, or prior experience with environmental education because these are potentially powerful modifying variables that influence the strength of association between action competence for sustainability and environmental literacy. For instance, gender differences might be involved in determining how men and women respond to environmental concerns and whether men and women are willing to act towards sustainability [68-70]. Similarly, age or grade could have an effect on the knowledge and ability of a student to turn environmental knowledge into actions, with higher grade students maybe possessing more developed competencies by way of deeper awareness of the issues [71, 72]. Prior experience in studying environmental education may also be a key factor since those students who have studied environmental education beforehand would have enhanced action competence [6, 73, 74]. By considering these moderating factors, future research will be better able to define more precisely the interplay among diverse variables to affect the development of environmental literacy and sustainability behavior to enable teachers to design more effectively interventions across diverse student groups.

4. CONCLUSIONS

The conclusion of this analysis shows that there is a strong and significant relationship between EL and ACS among junior high and senior high school students in Muhammadiyah schools. This strong positive correlation confirms that increasing EL directly contributes to increasing ACS. The regression model built is able to explain more than half of the variation in ACS, which is statistically significant, thus strengthening the position of EL as the main predictor of ACS. This emphasizes that increasing environmental literacy among students can have a direct impact on their behavior and actions towards more positive environmental issues.

Recommendations for further research are to expand the scope of this study by integrating other variables, such as the role of religious values, culture, and family support in strengthening the relationship between EL and ACS. In addition, longitudinal studies are also recommended to understand how the influence of environmental literacy on action competence develops over time. Similar studies in non-Islamic schools or in the context of multicultural societies can also be conducted to see whether these findings are universal or specific to certain contexts. Future studies could benefit from a mixed-methods approach to gain a more comprehensive understanding of the relationship between EL and ACS.

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