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From Knowledge to Concern: An Analysis of the Relationship between Ecosystem Concepts and Students' Conservation Attitudes

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ABSTRACT

Purpose of the study: This study aims to determine the relationship between students' knowledge of ecosystem concepts and their attitudes toward natural resource conservation. Furthermore, it aims to identify the extent to which students' understanding of ecosystem concepts contributes to fostering a caring attitude toward environmental conservation.

Methodology: The study used a survey method with a descriptive correlational approach. The research instruments consisted of a 30-item multiple-choice test to measure knowledge of ecosystem concepts and a three-choice Likert-scale questionnaire to measure attitudes toward natural resource conservation. A sample of 30 students was selected using cluster random sampling. Data analysis used the Liliefors test, Bartlett's test, simple regression, and Pearson Product-Moment correlation.

Main Findings: The results of the study indicate a positive and significant relationship between knowledge of ecosystem concepts and students' attitudes toward natural resource conservation. A correlation coefficient of 0.742 indicates a strong relationship. The regression equation obtained is Y = 22.45 + 0.983X. The coefficient of determination of 55.1% indicates the contribution of knowledge of ecosystem concepts to the formation of students' conservation attitudes.

Novelty/Originality of this study: The novelty of this research lies in its empirical analysis of the direct link between mastery of ecosystem concepts and attitudes toward natural resource conservation among madrasah students. This research expands the study of environmental education by confirming that a conceptual understanding of ecosystems can be a crucial foundation for developing a conservative character and strengthening the integration of ecological education into biology learning.

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1. INTRODUCTION

The environment is a vital component supporting the survival of humans and other living things [1], [2]. Environmental balance is greatly influenced by the interaction between biotic and abiotic components that form an ecosystem [3], [4]. In recent decades, various environmental problems such as deforestation, water pollution, land degradation, and overexploitation of natural resources have increased [5], [6]. This situation demonstrates

that efforts to conserve natural resources are an urgent need that must be supported by all levels of society, including students as the nation's future generation.

Education plays a strategic role in building students' awareness and responsibility for environmental sustainability [7], [8]. Through biology learning, particularly ecosystems, students are expected to understand the reciprocal relationship between living things and their environment and the importance of maintaining ecosystem balance. Knowledge of ecosystem concepts not only aims to improve students' cognitive understanding but also fosters positive attitudes toward natural resource conservation efforts [9], [10]. A sound understanding of ecosystems is believed to encourage students to care more about the environment and actively participate in conservation efforts [11], [12].

Attitudes toward natural resource conservation are an individual's tendency to respond positively to various efforts to protect, manage, and utilize natural resources wisely. This attitude is formed through a learning process that involves knowledge, experience, and environmental awareness [13], [14]. In an educational context, students with conservative attitudes toward the environment tend to demonstrate behaviors that support environmental sustainability, such as conserving resources, maintaining a clean environment, and participating in reforestation activities [15], [16]. Therefore, fostering conservation attitudes needs to be a key focus in the learning process at school.

Various studies have shown that environmental knowledge can influence attitudes toward environmental conservation. Students with a better understanding of ecological concepts generally demonstrate greater concern for environmental issues [17], [18]. However, previous research has yielded mixed results. Some studies have found a significant relationship between environmental knowledge and conservation attitudes, while others have shown that knowledge alone is insufficient to foster positive attitudes without the support of other factors such as direct experience, social values, and the adoption of environmentally friendly behaviors. These differing results indicate that the relationship between knowledge of ecosystem concepts and conservation attitudes requires further study.

Analysis of previous research reveals a research gap that requires attention. Most studies have focused on the influence of learning models on ecology learning outcomes or on measuring environmental knowledge levels in general, while studies specifically examining the relationship between students' knowledge of ecosystem concepts and attitudes toward natural resource conservation are relatively limited [15], [19]. Furthermore, research conducted in secondary school contexts with diverse student characteristics is still underreported. This gap opens up opportunities for more targeted research to identify the relationship between students' cognitive and affective aspects in the context of environmental education.

The novelty of this research lies in its focus on analyzing the relationship between students' mastery of ecosystem concepts and their attitudes toward natural resource conservation as part of the biology learning evaluation. This study not only assesses students' conceptual knowledge but also directly links it to their attitudes toward environmental conservation. The urgency of this research is heightened given the increasing number of global and local environmental issues that require a young generation with strong ecological literacy and a strong commitment to natural resource conservation. The results of this study are expected to provide an empirical overview of the importance of integrating ecosystem concept learning with the development of environmentally conscious character in schools.

Based on this description, it is crucial to conduct research that can provide empirical evidence regarding the relationship between students' knowledge of ecosystem concepts and their attitudes toward natural resource conservation. The primary objective of this study is to determine whether there is a relationship between students' knowledge of ecosystem concepts and their attitudes toward natural resource conservation. These results are expected to serve as a basis for developing more effective biology learning strategies to enhance conceptual understanding while fostering conservative attitudes in students.

2. RESEARCH METHOD

2.1. Research Methods

This research employed a survey method with a correlational analysis approach. This method is used to identify the extent of the relationship between variations in one variable and variations in another variable based on the correlation coefficient value. In practice, data was collected from respondents using a questionnaire [20], [21]. Generally, survey research is a method that takes data from a specific sample representative of the population, so that the results obtained can be used to describe the condition of the population as a whole. Thus, survey research can be defined as research that utilizes a sample from a population, using a questionnaire as the primary instrument for data collection.

This research is descriptive, aiming to describe and explain the phenomena occurring at the time of the research. The focus of the research is directed at revealing the characteristics of an ongoing situation or condition. The primary objective is to provide an overview of the variables or conditions studied based on the facts on the ground at the time of the research [22], [23]. This study involved two variables: the independent

variable and the dependent variable. The research process began with the distribution of questionnaires to measure students' knowledge of the concept of ecosystems as the independent variable (X). Next, a questionnaire was administered to measure students' attitudes toward natural resource conservation as the dependent variable (Y). Students' attitudes were determined based on their answers to the completed questionnaires. The collected data was then processed and analyzed using the data processing techniques established in this study. The results of this analysis were then used to answer the research questions posed previously.

2.2. Research Population and Sample

The population in this study was all students at Daarul Muqimien Islamic Junior High School. The sample used was first-grade students at the school. The sampling technique used cluster random sampling, which randomly selects samples based on existing groups or classes [24], [25]. Using this technique, 30 first-grade students were selected as respondents. This sample selection was made to ensure that the data obtained would represent the characteristics of the population being studied.

2.3. Data Collection Techniques

The data collection technique in this study employed an indirect communication method using a closed-ended questionnaire [26], [27]. The data collected consisted of two research variables: the independent variable (X), which was the level of students' knowledge about ecosystem concepts, and the dependent variable (Y), which was the students' attitudes toward natural resource conservation. The data source was a predetermined sample, while the measuring instruments used were a knowledge test on ecosystem concepts and an attitude questionnaire administered to respondents to gauge their attitudes toward natural resource conservation.

The instrument for measuring knowledge about ecosystem concepts was a multiple-choice test with four answer alternatives: a, b, c, and d. This test consisted of 30 questions covering the cognitive domain, encompassing aspects of knowledge, understanding, and application. The material measured included the definition of ecosystems, units within ecosystems, components of ecosystems, and the relationships between components within ecosystems. Each correct answer was given a score of 1, while an incorrect answer was given a score of 0. To measure students' attitudes toward natural resource conservation, an attitude scale questionnaire was used, encompassing cognitive, affective, and conative dimensions [28], [29]. This instrument uses a Likert scale with three response categories, designed to reflect students' evaluative responses to natural resource conservation efforts. Students' attitudes are measured based on the scores obtained from respondents' answers to each statement.

The attitude scale questionnaire was developed through several stages. First, the object of attitude regarding natural resource conservation was broken down into several more specific aspects, namely maintenance and protection (preservation), improvement (restoration), and sustainable use of natural resources. Second, based on these aspects, 30 statements were compiled representing each attitude indicator. Before use, these statements were consulted with the supervising lecturer for input, corrections, and considerations to ensure the quality of the instrument. Each statement in the questionnaire provided three response options: agree, no opinion, and disagree. Assessment used a Likert scale, with positive statements being scored sequentially as 3, 2, and 1. Conversely, negative statements were scored in reverse order, as 1, 2, and 3. The final respondent score was obtained from the cumulative total of all scores on each statement, which was then used to analyze students' attitudes toward natural resource conservation. The outline of the research instruments used in this study can be seen in the Table 1 and Table 2.

Table 1. Grid of Research Instruments for Knowledge of Ecosystem Concepts

No	Sub Topics	Dimensions of Knowledge			Amount
		Cognitive	Affective	Conative	
1.	Understanding Ecosystems	1,4	14, 15	24, 10, 16	7
2.	Units in Ecosystems	7,2	3, 25, 11	12, 8	7
3.	Components of Ecosystems	25, 5, 6	17, 18	30, 9	7
4.	Relationships between Ecosystem Components	20, 27, 21	13, 29, 28	22, 19, 23	9
	Amount	10	10	10	30

Table 2. Research Instrument Grid for Students' Attitudes towards Natural Resource Conservation

Aspects of Natural Resource Conservation	Attitude Components	Code	Statement Number	Amount		
				+	-	E
A. Maintenance and protection (preservation)	1. Cognitive	A1	7^{-}, 19^{+}, 22^{+}, 25^{-}	2	2	
	2. Affective	A2	11^{+}, 16^{+}	2	0	11
	3. Conative	A3	2^{-}, 4^{-}, 5^{+}, 9^{+}, 13^{+}	3	2	
B. Repair (restoration)	1. Cognitive	B1	17^{+}, 20^{+}, 24^{-}	2	1	10
	2. Affective	B2	6^{+}, 8^{-}, 15^{+}	2	1	

	3. Conative	B3	18^+, 26^-, 23^+, 29^-	2	2	
C. Sustainable utilization and management	1. Cognitive	C1	1^+, 21^-	1	1	
	2. Affective	C2	10^+, 14^+	2	0	9
	3. Conative	C3	3^-, 12^+, 23^+, 27^-, 30^-	2	3	
Amount				18	12	30

2.4. Data Analysis Techniques

After all the data has been collected, the next step is to analyze the data to obtain answers to the research problem formulation. The data analysis in this study is an analysis of the relationship between the variables of student knowledge about the concept of ecosystems and students' attitudes towards natural resource conservation [30], [31]. Variable X in this study is the level of student knowledge about the concept of ecosystems, while variable Y is students' attitudes towards natural resource conservation. The results of the correlation coefficient calculation are then consulted with the r table value at a significance level of 5%. If the calculated r value is greater than the r table, then the null hypothesis is rejected and the research hypothesis is accepted, which means there is a significant relationship between student knowledge about the concept of ecosystems and students' attitudes towards natural resource conservation. Conversely, if the calculated r value is smaller than the r table, then the null hypothesis is accepted. Through this analysis, the level of closeness of the relationship between the two variables studied can be determined.

3. RESULTS AND DISCUSSION

3.1. Normality Test

This test aims to determine whether the obtained data population is normally distributed. In this study, the normality test was conducted on student knowledge data on ecosystem concepts and student attitudes toward natural resource conservation. The Liliefors test was used to determine whether the research data meets the assumption of a normal distribution, a requirement in parametric statistical analysis. The test results were then compared with critical values at a certain significance level to determine whether the data were normally distributed.

Table 3. Results of Normality Test for Student Knowledge Score Data on Ecosystem Concepts and Student Attitudes in Natural Resource Management

Variables	Number of Samples	L_0	L (Critical Value)	Conclusion
Knowledge of Ecosystem Concepts	30	0.1292	0.161	Accept H_i
Attitudes toward Natural Resource Conservation	30	0.1511	0.161	Accept H_i

Based on the results of the normality test calculation, the L_o value for the knowledge score on the ecosystem concept was 0.1292, while the L_o value for the student attitude score towards natural resource conservation was 0.1511. The L_o table value for a sample size of 30 at the significance level used was 0.161. Because both L_o values were smaller than the L_o table value, it can be concluded that the data on knowledge about the ecosystem concept and the data on students' attitudes towards natural resource conservation came from a normally distributed population. Thus, the data met the requirements for further analysis using parametric statistics.

3.2. Homogeneity Test

The homogeneity test in this study was conducted using the Bartlett test. This test aims to determine whether the variances of the two data groups derived from the two research variables are homogeneous or similar. In practice, the Bartlett test compares the variances between the data groups on student knowledge of ecosystem concepts and the data on student attitudes toward natural resource conservation. If the test results indicate that the variances of the two data groups are homogeneous, then the data meets one of the requirements for further statistical analysis.

Table 4. Results of the Homogeneity Test for the Student Attitude Group in Natural Resource Conservation (Y) with the Price of the Ecosystem Concept Knowledge Group (X)

Variables	Number of Samples	X^2	X^2 table α = 0.001	Conclusion
Homogeneity for group Y at a given price of X	30	18.6	23.2	Homogeneous

Based on the data in the table above, it is known that the calculated X^2 value is smaller than the X^2 table value, so it can be concluded that the data variance in a particular X group is homogeneous. These results indicate that the data from both research variables have a level of variance uniformity that meets the requirements of statistical analysis. Based on the results of the analysis prerequisite tests that have been carried out, including normality tests and homogeneity tests, it can be stated that the research data has met the requirements for further analysis. By fulfilling these two prerequisites, further statistical analysis can be carried out to test the relationship between students' knowledge of the ecosystem concept and students' attitudes towards natural resource conservation.

3.3. Hypothesis Testing

Hypothesis testing begins with a simple correlation regression analysis. Based on the calculation results, the regression equation $Y = 22.45 + 0.983X$ is obtained. This equation shows that every one unit increase in students' knowledge of the ecosystem concept will be followed by an increase in students' attitude scores towards natural resource conservation by 0.983, with a constant of 22.45. The results of the linearity test of the regression model show a calculated F value of 1.82, while the F table value is 3.88. Because the calculated F value is smaller than the F table, the null hypothesis (H_0) is accepted. Thus, it can be concluded that the relationship between students' knowledge of the ecosystem concept and students' attitudes towards natural resource conservation is linear. This indicates that the regression model obtained is suitable for describing the relationship between the two research variables.

Table 5. Simple Linear Regression ANOVA

Source of Variance	Dk	JK	KT	F
Total	30	51232		
Regression (a)	1	50102.53	50102.53	
Regression (b)	1	622.18	622.18	
Residual	28	507.29	507.29	
Fitness-to-Fault	9	179.59	19.96	1.82
Error	21	327.7	15.60	

Further testing was conducted to determine the significance of the correlation coefficient using the Pearson Product Moment test. Based on the calculation results, the calculated t value was 5.86, while the t table value was 2.04 at a significance level of $\alpha = 0.05$. Because the calculated t value was greater than the t table, the null hypothesis (H_0) was rejected. This indicates that the correlation coefficient of 0.742 has a significant level of significance at a significance level of 5%. The correlation coefficient value indicates a strong positive relationship between students' knowledge of the ecosystem concept and their attitudes towards natural resource conservation. This means that the higher the level of students' knowledge of the ecosystem concept, the more positive their attitudes towards natural resource conservation efforts tend to be. After obtaining the correlation coefficient, the coefficient of determination was calculated at 0.551. This value indicates that the variable of knowledge about the ecosystem concept contributes 55.1% to the variation in students' attitudes towards natural resource conservation through the regression model $Y = 22.45 + 0.983X$. Meanwhile, the remaining 44.9% is influenced by factors outside the studied variables. The statistical values obtained are then used as the basis for testing the research hypotheses.

Table 6. Magnitude of Correlation Regression

N	$\sum X$	$\sum Y$	$\sum X^2$	$\sum Y^2$	$\sum XY$
30	562	1226	11172	51232	23600

Table 7. Calculation Results (b), Correlation Coefficient (r), Constant (a), between Knowledge of Ecosystem Concepts and Students' Attitudes towards Natural Resource Conservation

a	b	r	t-count	t-table
30	562	1226	11172	51232

Based on the calculations, the average student knowledge level regarding ecosystem concepts was 18.73, which is close to the median of 20 and lies around the mean line. This indicates that the distribution of student knowledge tends to be centered around the middle value, as seen in the histogram, which is clustered in the middle. Meanwhile, the data on student attitudes toward natural resource conservation shows a distribution that is skewed to the right. This indicates that, in general, students' attitudes toward natural resource conservation are above the average. The regression model, $Y = 24.45 + 0.983X$, reveals a positive relationship. This means that the higher the student's knowledge level regarding ecosystem concepts, the more positive their attitudes toward natural resource conservation. This finding demonstrates that a good understanding of ecosystem

concepts plays a significant role in fostering students' awareness and concern for environmental conservation efforts.

The correlation coefficient of 0.742 indicates a strong relationship between knowledge of ecosystem concepts and students' attitudes toward natural resource conservation. This indicates that students' knowledge of ecosystem concepts plays a significant role in fostering conservative attitudes toward the environment. In other words, increasing students' understanding of the interrelationships between ecosystem components can encourage the growth of more positive attitudes toward natural resource conservation. Furthermore, the coefficient of determination of 0.551 indicates that students' knowledge of ecosystem concepts contributes 55.1% to their attitudes toward natural resource conservation. The remaining 44.9% is influenced by factors outside the research variables, such as their living environment, daily habits, learning experiences, social conditions, and the situations experienced by students when completing the research instrument. This indicates that although knowledge has a significant influence, the formation of conservation attitudes is also influenced by various other external factors.

The findings of this study reinforce the important role of environmental education in shaping students' awareness and responsibility toward natural resource conservation. A strong relationship between knowledge of ecosystem concepts and conservation attitudes indicates that conceptual understanding is not only related to cognitive achievement but also contributes to the development of students' environmental character [32], [33]. When students understand the interactions between living organisms and their environment, they become more aware of the consequences of environmental damage and the importance of maintaining ecological balance. This suggests that biology learning can serve as an effective medium for integrating environmental values into students' daily behavior and attitudes.

The positive relationship identified in this study also supports constructivist perspectives in environmental learning, where knowledge acquisition can influence students' affective development [34], [35]. Understanding ecosystem concepts allows students to connect scientific knowledge with real environmental issues such as pollution, deforestation, and excessive resource exploitation. Through this process, students may develop a sense of responsibility and empathy toward the environment. Therefore, learning activities that encourage contextual understanding and real-life environmental problem solving have the potential to strengthen students' conservation attitudes more effectively than rote memorization-oriented instruction.

In addition, the results imply that ecosystem learning should not merely focus on theoretical content delivery but should also emphasize meaningful learning experiences. Teachers can integrate project-based activities, environmental observations, and conservation campaigns into biology learning to strengthen students' emotional engagement with environmental issues [36], [37]. Such learning experiences may help students internalize conservation values more deeply because attitudes are often formed not only through knowledge but also through direct experiences and social interactions. Thus, ecosystem learning can become more transformative by encouraging students to actively participate in environmental preservation efforts both inside and outside school environments.

The study also highlights that environmental attitudes are multidimensional and influenced by various external factors beyond conceptual knowledge. Although knowledge contributed substantially to students' conservation attitudes, there are still other factors that may shape environmental awareness, including family background, school culture, peer influence, community values, and students' exposure to environmental campaigns or media. This indicates that environmental education requires collaborative support from schools, families, and communities to develop sustainable environmental behavior. In this context, schools play a strategic role in creating environmentally friendly learning cultures that consistently encourage responsible attitudes toward natural resources [38], [39].

Furthermore, the strong relationship found in this research suggests that strengthening ecological literacy among students can become an important strategy for addressing contemporary environmental challenges. Environmental problems continue to increase globally and locally, requiring future generations who possess not only scientific understanding but also strong conservation awareness [40], [41]. By improving students' mastery of ecosystem concepts, educational institutions can contribute to developing environmentally responsible citizens capable of making sustainable decisions in the future. Therefore, biology education should continue to integrate environmental conservation values into both curriculum content and classroom learning practices.

The impact of this study extends to the broader field of environmental and biology education. The findings provide empirical evidence that cognitive understanding and affective attitudes are closely interconnected in environmental learning. This research can serve as a reference for educators in designing instructional approaches that balance conceptual mastery with character development. Additionally, policymakers and curriculum developers may use these findings to strengthen environmental education programs in schools, particularly by integrating sustainability issues and conservation practices into science learning [42], [43]. The study also contributes to increasing awareness of the importance of environmental literacy as part of 21st-century education aimed at preparing students to face environmental crises responsibly.

However, this study has several limitations that should be considered. First, the research involved only a relatively small sample from one educational institution, limiting the generalizability of the findings to broader student populations. Second, the study used a correlational design, which can identify relationships between variables but cannot fully explain causal relationships between ecosystem knowledge and conservation attitudes. Third, the measurement of attitudes relied on self-reported questionnaires, which may be influenced by students' subjectivity or social desirability bias when responding to environmental statements. In addition, the study focused only on knowledge and attitudes without examining actual environmental behavior or conservation practices demonstrated by students in real-life situations.

Another limitation is that the study did not deeply explore external variables that may influence students' conservation attitudes, such as socioeconomic background, environmental experiences, parental influence, or school environmental programs. These factors may contribute significantly to students' environmental awareness and could provide a more comprehensive explanation of conservation attitudes if included in future research. Therefore, future studies are recommended to involve larger and more diverse samples, apply longitudinal or experimental research designs, and include behavioral as well as contextual variables to obtain a deeper understanding of how environmental education shapes students' ecological awareness and conservation behavior.

4. CONCLUSION

Based on the research results, it can be concluded that there is a positive and significant relationship between students' knowledge of the ecosystem concept and their attitudes towards natural resource conservation. This relationship is indicated by a correlation coefficient value of 0.742, which is included in the strong relationship category. This indicates that the better students' understanding of the ecosystem concept, the more positive their attitudes towards protecting and preserving natural resources. The results of a simple regression analysis produce the equation $Y = 22.45 + 0.983X$, which indicates a linear relationship between the two variables. This equation indicates that every increase in students' knowledge of the ecosystem concept will be followed by an increase in attitudes towards natural resource conservation. Thus, ecosystem knowledge plays an important role in shaping environmental awareness and attitudes in students. In addition, the determination coefficient value of 55.1% indicates that knowledge of the ecosystem concept makes a significant contribution to the formation of students' attitudes towards natural resource conservation, while the remaining 44.9% is influenced by other factors outside the research. Based on the results of the significance test which shows the calculated t value (5.86) > t table (2.04), it can be stated that the relationship between the two variables is statistically significant. Thus, this study proves that students' knowledge of ecosystem concepts plays an important role in building a conservative attitude towards natural resources. Future research is recommended to involve larger and more diverse samples from different schools or educational levels in order to obtain findings that are more representative and generalizable regarding the relationship between ecosystem knowledge and conservation attitudes. In addition, future studies should examine other influencing variables such as environmental behavior, family background, school environmental culture, and students' direct experiences with conservation activities to provide a more comprehensive understanding of factors shaping environmental awareness.

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AUTHOR CONTRIBUTIONS

Conceptualization, H.B.; Methodology, H.B.; Software, H.B.; Validation, H.B.; Formal Analysis, H.B.; Investigation, H.B.; Resources, H.B.; Data Curation, H.B.; Writing – Original Draft Preparation, H.B.; Writing – Review & Editing, H.B.; Visualization, H.B.; Supervision, H.B.; Project Administration, H.B.; Funding Acquisition, H.B.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

Not applicable.

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