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Environmental Literacy in Middle School: Ecological Knowledge, Cognitive Skills, Environmental Affect, and Pro-Environmental Behavior

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ABSTRACT

Purpose-The research examines the environmental literacy of the VIII grade students of SMP Negeri 1 Banawa based on four principal indicators: ecological knowledge, cognitive skills, environmental affect, and pro-environmental behavior. The research aims to assess the interrelations among these indicators and to provide recommendations for enhancing environmental literacy in schools with comparable settings.

Methodology-The method of study is descriptive quantitative, which describes and analyzes systematically based on the students' environmental literacy indicator measurement results. The sample was 32 students of VIII grade, who were selected by using a total sampling technique. The instrument was a questionnaire containing multiple-choice tests measuring ecological knowledge and cognitive ability and a Likert scale measuring students' environmental affects and pro-environmental behavior. The MSELS model informed the structure of each of the sections of the questionnaire. The questionnaire data were analyzed using descriptive statistics to compute percentages and the means of each indicator and simple regression analysis to compute relationships among variables.

Findings-The research results show that the overall environmental literacy students were classified as good, with a mean score of 76.64%. In particular, ecological knowledge was 77.09%, cognitive skills 67.19%, environmental affect 81.45%, and pro-environmental behavior 80.82%. The results of the regression analysis indicated that environmental affects have a significant impact on pro-environmental behavior.

Significance- Environmental affects are important in encouraging students' pro-environmental behavior and account for 54.2% of the variation in pro-environmental behavior. The findings highlight that pro-environmental behavior is better brought about by developing students' emotional engagement and worry about the environment rather than through the single-minded development of ecological knowledge.

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INTRODUCTION

Climate change, pollution, and environmental degradation have become serious global problems requiring urgent attention. Environmental awareness among the young generation is crucial to fight against these problems affectively. One of the most important strategies for enhancing this awareness is implementing environmental education at the initial level of development. In Indonesia, attempts have been made to integrate environmental education into school curriculums; however, ongoing monitoring of its implementation and affectiveness, specifically regarding environmental knowledge among students, is vital.

Environmental literacy is the capacity to know, be sensitive to, and behave responsibly towards the environment in a way that guarantees its sustainability. Environmental education aims to foster a sense of caring, capabilities, and positive behavior to protect the environment (Wisman & Santoso, 2024). With environmental literacy, individuals can acknowledge environmental issues such as pollution, global warming, and the misutilization of natural resources and engage in sustainable resolution processes. Environmental education is vital to environmental consciousness and environmentally active behavior from the early years. Therefore, environmental literacy is critical in shaping a generation that can maintain ecosystem equilibrium and address global environmental challenges (Khoirunnisa et al., 2023).

Education is a key factor in defining the environmental literacy of learners through the transmission of knowledge, attitudes, and skills necessary for environmental protection. Education for sustainable development teaches learners how to think and act towards the environment in an integrated way. Environmental education makes people understand the complexity of the ecosystem and the affects of human activities on the environment. This understanding fosters greater awareness and responsiveness to environmental issues. (Hayati, 2020). Learning activities that involve direct interaction with environmental issues encourage students to comprehend real-world problems and their solutions. Education also cultivates environmental awareness and pro-environmental behavior from an early age. Therefore, education can create a generation with high environmental literacy ready to face global environmental challenges (Wilujeng et al., 2019).

Environmental literacy research has evolved considerably in the past decades. Environmental literacy has been described as a synthesis of knowledge, cognitive skills, dispositions, and responsible behavior toward the environment that is required for making decisions and acting on environmental issues. The key competencies are recognizing and analyzing environmental issues, developing solutions, and assessing plans for sustainability (NAAEE, 2020).

Previous studies have also discovered that environmental literacy significantly influences students' environmental citizenship behavior. Students with good environmental literacy will exhibit more environmentally friendly behavior (Yudha Pratama et al., 2020). Other researchers have also pointed out that environmental education is significant in making students more aware of environmental problems, including climate change, renewable resources, and resource management. Students exposed to environmental education have a more realistic view of global environmental status, which can decrease environmental optimism but make them more responsible for sustainable development. (Edsand & Broich, 2020).

Other research has demonstrated that environmental literacy increases students' knowledge of climatic change, pollution, and loss of biological diversity, which are some of the most outstanding environmental problems. This awareness encourages students to participate in environmental conservation activities (Masruroh et al., 2024). A strong understanding of environmental issues also encourages students to participate in concrete activities, such as recycling, energy conservation, and conservation activities (Masruroh et al., 2024).

Unlike previous research, this study integrates four leading indicators of environmental literacy, adapting the Middle School Environmental Literacy Survey (MSELS) to the local context of SMPN 1 Banawa, which

faces specific environmental issues such as waste management and coastal environmental impacts. Moreover, this research delves deeply into the relationships among these indicators.

This research will examine the environmental literacy of VIII-grade students of SMPN 1 Banawa, specifically regarding ecological knowledge, cognitive skills, environmental affects, and students' behavior toward environmental problems. It will also identify the factors contributing to their environmental literacy level and suggest how it can be increased in schools with similar conditions.

SMPN 1 Banawa, an environmental education school, is a perfect location to examine students' environmental literacy because of its local setting, which reflects many environmental issues of concern, such as waste management and the scarcity of natural resources. It is important, therefore, to determine the degree to which environmental literacy among students can address changes in their behavior toward these environmental problems. A study in Loli Tasiburi Village, Banawa District, found community knowledge and attitudes strongly related to waste management. Most residents burn their trash or dump it along shorelines to dispose of waste. Improper waste disposal in coastal areas contaminates marine and terrestrial ecosystems, devastates natural habitats, and causes ecological imbalance (Syam, 2016).

Furthermore, improperly managed waste can block water channels and drainage systems, thereby increasing the chances of flooding during the rainy season. The problem is compounded by a lack of proper waste management infrastructure (Safitri, 2019*)*. Improperly managed waste results in blockage of water channels and drainage systems, thereby increasing the chances of flooding during the rainy season, a problem further compounded by a lack of proper waste management infrastructure. (Daud, 2022).

Therefore, students' environmental literacy analysis is needed, as children's and students' pro-environmental behavior results in their participation in activities that guarantee environmental conservation, thus adopting household waste management. (Rosanti et al., 2023). Firsthand environmental education experiences, such as organic waste management, guarantee students' competency to provide a clean and healthy environment. This is consistent with constructivist theory, which dictates that experiential learning is most significant. (Wildan & Yusuf, 2024).

This study is grounded on four elements or indicators of environmental literacy from the Middle School Environmental Literacy Survey (MSELS) developed by McBeth (2010), which include: (1) Ecological knowledge, with an emphasis on environmental concerns and assessing students' awareness of existing environmental problems, such as climate change and natural resource management; (2) Environmental affect, covering students' beliefs and attitudes regarding the significance of environmental preservation and their role in sustainability; (3) Cognitive skills, meaning the capability to use environmental knowledge to engage in actions in everyday life; and (4) Pro-environmental behavior, assessing the degree to which students involve themselves in activities for environmental conservation at individual and collective levels. (McBeth & Volk, 2010).

The MSELS instrument was modified in this study since it assesses environmental literacy in different dimensions, such as knowledge, attitudes, skills, and behaviors towards the environment. The instrument has been tested in several studies and constructed from well-established theories of environmental literacy. Modifying the MSELS tool also provides flexibility for its application in different educational settings, cultures, and geographical backgrounds of the students, which is appropriate for Banawa's local context.

In modifying the MSELS instrument for use in this research, the local situation, including the curriculum, education policies, and environmental concerns pertinent to SMPN 1 Banawa and the surrounding area, were initially examined. The instrument's language was appropriate for middle school students, as it used familiar terms and explained local environmental problems. The measured dimensions, including knowledge, attitude, and behavior, were modified to suit the real-life situation of the students, for example, by asking questions regarding everyday practices on waste management or nature preservation. Following adaptation, the instrument was pilot-tested with a small number of students, and an analysis was done to ascertain its affectiveness in SMPN 1 Banawa's environmental literacy measurement.

The environmental literacy instrument in this research was adapted to the subject's environment. Geographically, Banawa is situated in a coastal area adjacent to Teluk Palu, which gives SMPN 1 Banawa much potential to incorporate coastal environmental problems into its curriculum, including waste

management, mangrove ecosystem conservation, and coastal erosion management. Such closeness to the sea has opened many environmental issues to students, including climate change's impacts on sea level rise, tidal flooding, and coastal ecosystems. Banawa has also usually experienced problems with waste management and poor access to good quality water sources, which form significant areas to be studied under environmental education.

METHODOLOGY

Research Design

This article represents a descriptive quantitative research study (Creswell & Creswell, 2017) that displays the average percentage scores of four environmental literacy indicators. Descriptive quantitative research is a statistical analysis method geared towards systematically presenting and interpreting data to make it more understandable. It seeks to summarize, present, and analyze data without drawing general conclusions but rather to describe phenomena based on the available data (Aziza, 2023). Moreover, this research describes the analysis findings of the correlation between environmental literacy indicators. Descriptive quantitative research is employed to describe or analyze phenomena quantitatively based on numerical data without aiming to make generalizations of universal applicability. (Sugiyono, 2016). Researchers can measure and describe students' environmental literacy levels through this method. With the data from the questionnaire results, one can manipulate it to produce percentage and average values descriptive of the students' environmental literacy levels. In addition, this approach is used to examine the interconnections between parameters needed for a better understanding of factors surrounding the level of environmental literacy.

Participant

The population in this research is defined as the complete set of elements, encompassing both objects and persons, possessing distinct features that are the focal point of the research (Amin et al., 2023). This research population included 32 VIII students. The employed sampling technique is total sampling, which incorporates the entire population as the research sample (Amin et al., 2023), encompassing all students of the VIII grade. The selection of VIII-grade students as the research sample is predicated on their past knowledge of essential concepts related to ecosystems and environmental pollution, hence facilitating an accurate assessment of their environmental literacy, understanding, and awareness (Susanti & Nupus, 2022). Moreover, the theory of cognitive development postulated by Jean Piaget considers the period between 12 and 15 years as being in the formal operational phase, characterized by the ability to think abstractly, logically, and systematically. (Santrock, 2019). At this point, signs of affective maturation would already be present in the students; that is, their affective development involves changes in perception, values, and emotions. Developing practical skills is paramount in deciding how students interact with environmental issues, influencing their pro-environmental behavior. Such development correlates with environmental literacy; positive dispositions toward the environment translate into concrete actions for sustainability. These skills help students understand complicated environmental concepts and analyze the relevant issues, creating a more valid view of the characteristics of VIII-grade students at SMPN 1 Banawa.

Material

This research uses different relevant sources to support the study. The primary sources include academic journals that discuss environmental literacy, namely studies defining some components of environmental literacy, and other journals that examine the affects of literacy on pro-environmental behavior. Additionally, educational psychology reference books explain students' cognitive and affective development, which form the basis for understanding their ability to analyze environmental issues. Previous studies are also referenced to understand the factors influencing students' environmental behavior. Other sources include official curriculum documents explaining how environmental education is integrated into learning and primary data from questionnaires processed in percentage form to illustrate students' environmental literacy levels. Analyzing the data involves descriptive statistics. Other literature, like environmental education theories,

helps interpret the findings of this work and thus constitutes a strong theoretical background in analyzing the relationships between indicators of environmental literacy. Such sources tentatively furnish a well-rounded insight into the environmental literacy of students from SMPN 1 Banawa.

Procedure

Relevant data on environmental literacy were collected using prepared instruments, namely questionnaires. These questionnaires were designed to gather data from respondents (students) and consisted of questions aligned with the components of environmental literacy being assessed. This research is based on four components or indicators of environmental literacy from the Middle School Environmental Literacy Survey (MSELS) developed by McBeth (2010). The components include ecological knowledge, cognitive skills (covering issue identification, issue analysis, and action planning), environmental affect (including verbal commitment, intention to act, environmental sensitivity, and general feelings toward the environment), and behavior (involving actual commitment to pro-environmental actions).

The questionnaire comprises closed-ended questions in multiple-choice format and Likert scale items to measure students' knowledge, attitudes, skills, and behaviors related to environmental issues. The questionnaire is divided into test and non-test formats, with the test format used to measure ecological knowledge and cognitive skills. In contrast, the non-test format assesses environmental affects and pro-environmental behavior. The data collection procedure was carried out systematically to ensure data accuracy, starting with research preparation, instrument development, pilot testing in a trial class, instrument validation, reliability testing, and finally, the data collection phase. The entire process took six weeks to complete.

First, a blueprint based on the four components or indicators of environmental literacy is essential for developing the questionnaire. The blueprint for the environmental literacy instrument is presented in Table 1.

Table 1. Blueprint of Environmental Literacy Instrument

Indicator	Competency	Questions Number	Total
Ecological Knowledge	Understanding basic concepts related to environmental issues	1 – 8	8
Cognitive Skill	Being able to analyze, evaluate, think critically, and solve environmental problems	9 – 16	8
Environmental Affect	Demonstrating care and empathy towards environmental issues through personal awareness and a willingness to contribute to environmental preservation	17– 24	8
Behavior	Carrying out concrete actions that support environmental sustainability	25– 33	9

The prepared instrument was administered to respondents in a trial class to test its validity and reliability using SPSS. Although the SMELS instrument had previously undergone validity and reliability testing, it required retesting due to differences in several question items tailored to the local context of the research site and students' conditions. Validity testing refers to the extent to which an instrument measures what it is intended to measure, ensuring that the measurement results align with the intended purpose. Reliability testing, however, refers to the consistency or stability of the results obtained from an instrument when used under the same conditions at different times. (Gidron, 2020).

The validity test results showed that out of 40 questions tested, 7 were deemed invalid: 2 questions on ecological knowledge, two questions on cognitive skills, two questions on environmental affect, and 1 question on behavior. The remaining 33 valid questions were tested for reliability, revealing the instrument's perfect reliability. The results of the reliability test are presented in Table 2.

Table 2. Results of the Reliability Test for the Environmental Literacy Instrument

Reliability Statistics	
Cronbach's Alpha	N of Items
.925	33

The questionnaire distribution began with explaining the research aims to the students and instructions on completing the questionnaire. The surveys were administered in the classroom, with a designated completion time of 40 minutes determined by the quantity and complexity of the questions. Students received examples to guarantee their comprehension of the instructions. Students were monitored throughout the completion process to uphold order and verify data precision. Upon completion, the questionnaires were gathered, issued identifying codes, and preserved for subsequent study. The approach was executed with a focus on maintaining data confidentiality and reducing bias in data collection. This research employs the Eco-Schools value category for environmental literacy delineated by Igbokwe (2016). The classification is displayed in Table 3.

Table 3. Environmental Literacy Ability Categories

Skor	Interprets
<50	Not enough at all
50 - 59	Not enough
60 - 69	Enough
70 - 79	Good
>80	Very good

(Igbokwe, 2016)

Igbokwe (2016) developed this assessment category based on research conducted with middle school students in Ontario, whose demographic characteristics and educational levels are analogous to those of VIII-grade students. This assures that the category is appropriate for measuring environmental literacy in this age group. Furthermore, numerous studies have employed this category to evaluate environmental literacy, establishing its validity and reliability as a measurement instrument. Utilizing a thoroughly validated category significantly bolsters the credibility and consistency of the research outcomes.

Data Analysis

Data collected through questionnaires about the four components of environmental literacy—ecological knowledge, environmental affect, cognitive skills, and pro-environmental behavior—will undergo descriptive statistical analysis. This analysis aims to furnish a comprehensive overview of the student's levels of environmental literacy. Descriptive statistics characterize these levels by computing the means and percentages for each indicator. Descriptive statistics examine the data in its current state without the intention of deriving universally applicable conclusions (Sugiyono, 2016). Additionally, simple regression analysis examines the relationships among the environmental literacy indicators.

Simple regression analysis is utilized to understand the causal relationship between one independent variable and one dependent variable (Ghozali, 2021). The outcomes of uncomplicated regression yield more profound insights into the interrelationships among the indicators. The regression coefficient (B) signifies the degree to which the independent variable affects the dependent variable, whereas the p-value assesses the significance of this relationship. The regression coefficient additionally indicates the extent to which alterations in a particular indicator can elucidate variations in students' environmental literacy levels. Simple regression analysis has been selected due to its capacity to elucidate the direct affects of individual indicators on the level of environmental literacy, thereby facilitating a more transparent comprehension of each indicator's contribution to the overall outcomes. This methodology is especially well-suited for clear and quantifiable cause-and-affect relationship investigations. This research uses simple regression to describe students' environmental literacy levels and provides insights into which indicators have the most significant influence on promoting pro-environmental behavior.

FINDINGS

The ecological knowledge indicator in environmental literacy indicates an individual's understanding of fundamental ecological principles, including the interconnections between organisms and their natural environment. This knowledge provides individuals with a basis to accurately identify and analyze environmental issues. Environmental literacy comprises four main components: ecological knowledge, cognitive skills, environmental emotion, and responsible environmental behavior. (McBeth & Volk, 2010). Ecological knowledge, as one of these components, plays a crucial role in shaping awareness and promoting pro-environmental actions. Ecological knowledge is a vital component in fostering awareness and encouraging pro-environmental behaviors. The students' ecological knowledge results, derived from the questionnaire, are displayed in Table 4.

Table 4. Environmental Knowledge Indicator Score

Number Question (Q)	Number of Students Answering Correctly	Percentage
Q1	25	78.12 %
Q2	27	84.37 %
Q3	22	68.75 %
Q4	24	75.50 %
Q5	25	78.12 %
Q6	24	75.50 %
Q7	26	81.25 %
Q8	25	78.12 %
Average		77.09 %

Note: Q = Question

Table 4 illustrates that the average percentage of students delivering correct responses reached 77.09%, signifying that the students' environmental knowledge is categorized as "good." However, a discrepancy in students' comprehension is evident across different inquiries, highlighting specific areas that necessitate improvement through more targeted educational strategies.

The next indicator pertains to cognitive skills, encompassing an understanding of ecological principles and sustainability, the ability to analyze complex environmental issues, and the competence to assess the repercussions of actions taken on the environment. (Kusumaningrum, 2020). The cognitive skills indicator of environmental literacy encompasses various tiers, ranging from fundamental knowledge of ecological principles and sustainability to the capacity to analyze intricate environmental issues, identify pragmatic solutions, and assess the repercussions of implemented actions. The outcomes of these cognitive skills are delineated in Table 5.

Table 5. Cognitive Skills Indicator Score

Number Question (Q)	Number of Students Answering Correctly	Percentage
Q9	25	78.12 %
Q10	27	62.50 %
Q11	22	68.75 %
Q12	24	65.62 %
Q13	25	56.25 %
Q14	24	59.37 %
Q15	26	75.50 %
Q16	25	71.87 %
Average		67.19 %

Note: Q = Question

Table 5 shows that the average % of students who correctly answer questions for the cognitive skills indicator is 67.19%. This places students' cognitive skills in the "moderate" category, with variations across different questions reflecting differences in their understanding of specific cognitive aspects. These findings indicate that certain areas of cognitive skills need to be strengthened through more in-depth and targeted learning strategies to enhance student comprehension.

The indicator assessed is an environmental affect, which pertains to an individual's views and attitudes regarding environmental matters, encompassing sensitivity, perspectives, accountability, values, and ecological worldview. This factor is significant since it affects individuals' motivation to participate in activities that promote environmental conservation. Environmental literacy encompasses ecological knowledge, human influence on nature, environmental tactics, and emotional dispositions related to sensitivity, attitudes, responsibilities, control, values, and ecological perspective. (Dirgantara et al., 2021). The results of the students' environmental affects are presented in Table 6 based on the questionnaire.

Table 6. Environmental Affect Indicator Score

Number Question (Q)	Score Obtained for Each Question Number	Percentage
Q17	106	82.81 %
Q18	107	83.59 %
Q19	98	76.56 %
Q20	112	87.50 %
Q21	102	79.68 %
Q22	96	75.50 %
Q23	104	81.25 %
Q24	109	85.15 %
Average		81.45 %

Table 6 shows that the average % of students providing correct answers for the environmental affect indicator is 81.45%. This reflects a relatively high environmental concern among students, with consistent understanding across most questions. This score indicates students' awareness and positive attitudes toward environmental issues, although some aspects still require strengthening to achieve uniformity in their understanding of environmental affects.

The final indicator measured is student behavior. In terms of behavior, this study focuses on actual commitment or pro-environmental behavior, which refers to the actions taken by students related to environmental issues, such as the willingness to participate in activities that support environmental conservation, like recycling, water conservation, or waste reduction. (McBeth & Volk, 2010). Based on the questionnaire distributed to VIII-grade students, the results of students' behavior are presented in Table 7.

Table 7. Behavior Indicator Score

Number Question (Q)	Score Obtained for Each Question Number	Percentage
Q25	104	81.25 %
Q26	97	75.78 %
Q27	98	76.56 %
Q28	102	79.68 %
Q29	103	80.46 %
Q30	97	75.78 %
Q31	115	89.84 %
Q32	104	81.25 %
Q33	111	86.71%
Average		80.82 %

Note: Q = Question

Table 7 shows that the average score for the environmental behavior indicator among students is 80.82%. This percentage reflects that, in general, students exhibit positive environmental behavior. This is evident from the scores, which indicate that most students tend to engage in environmentally friendly behaviors in their daily lives. However, there is still room for improvement in certain aspects of behavior to achieve consistency and optimization in sustainable environmental actions.

In addition to the results presented above, an influence test between the indicators was also conducted to examine the relationships and determine how much each indicator affects the others. This analysis provides

deeper insights into how ecological knowledge, cognitive skills, environmental affect, and behavior interact and contribute to shaping students' overall environmental literacy.

The influence test used simple linear regression to evaluate the affect of ecological knowledge on students' cognitive skills. Ecological knowledge is defined as students' understanding of basic environmental concepts, such as biodiversity, ecosystem cycles, and the impact of human activities on nature. Cognitive skills include students' ability to analyze, evaluate, and solve environmental problems logically and systematically. The results of the influence test are presented in Table 8.

Table 8. Results of the Influence of Ecological Knowledge on Cognitive Skills

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	84.909	9.071		9.360	<.001
Ecological Knowledge	-0.050	0.120	-0.076	-0.417	0.680
a. Dependent Variable: Keterampilan Kognitif					

The regression analysis results in Table 8 show that the ecological knowledge variable does not significantly influence students' cognitive skills (p-value = 0.680 > 0.05). This interpretation indicates that ecological knowledge is not a strong predictor of cognitive skills within the context of this research.

The next influence test examines the relationship between the ecological knowledge indicator and environmental affect. The environmental affect indicator reflects students' awareness and concern for environmental protection, manifested in daily attitudes and behaviors such as waste management, energy conservation, and participation in environmental preservation activities. The results of the influence test are presented in Table 9.

Table 9. Results of the Influence of Ecological Knowledge on Environmental Affect

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	84.909	9.071		9.360	<.001
Pengetahuan Ekologi	-0.050	0.120	-0.076	-0.417	0.680
a. Dependent Variable: Environmental Affect					

The regression analysis results in Table 9 indicate that ecological knowledge does not significantly influence students' environmental affects (p-value = 0.680 > 0.05). A constant value of 84.909 suggests that students' environmental affect scores remain high without a direct contribution from ecological knowledge. These findings indicate that other factors are more relevant in influencing students' levels of environmental affect.

The next influence test examines the relationship between the ecological knowledge indicator and students' behavior, specifically pro-environmental behavior. It helps determine whether students' ecological knowledge contributes significantly to their pro-environmental behavior. The results of the influence test are presented in Table 10.

Table 10. Results of the Influence of the Ecological Knowledge on Behavior

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	79.583	4.270		18.637	<.001
Pengetahuan Ekologi	0.017	0.056	0.054	0.298	0.768
a. Dependent Variable: Behavior					

The regression analysis results in Table 9 show that ecological knowledge does not significantly influence students' environmental behavior (p-value = 0.768 > 0.05). Theoretically, environmental affect is considered one of the key factors driving pro-environmental behavior. The results of the influence test are presented in

Table 11.

Table 11. Results of the Influence of the Environmental Affect on Behavior

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	60.118	5.930		10.138	<.001
Pengetahuan Ekologi	0.255	0.072	0.542	3.531	0.001
a. Dependent Variable: Behavior					

The regression analysis results in Table 10 show that environmental affect significantly influences students' environmental behavior (p-value = 0.001 < 0.05). These findings indicate that environmental affects are important in promoting pro-environmental behavior.

DISCUSSION

A questionnaire comprising test and non-test instruments was used to obtain data on the environmental literacy of eighth-grade students at SMPN 1 Banawa, which consisted of 32 students. The test instrument consisted of multiple-choice questions, with eight questions designed to measure ecological knowledge and another eight to assess students' cognitive skills. Students who answered correctly received 1 point, while those who answered incorrectly received 0 points. Based on the data in Table 3, students' literacy skills in the ecological knowledge indicator can be categorized according to the overall percentage of correct answers. Referring to the existing literature, students' ecological literacy is evaluated in three categories: high, moderate, and low. High ecological literacy is characterized by a percentage of correct answers exceeding 80%, indicating a strong understanding and the ability to relate ecological concepts to real-life situations. Students with percentages between 60% and 80% are considered to have moderate literacy, reflecting a good basic understanding, although some aspects need improvement. Low ecological literacy, typically with a percentage below 60%, indicates a lack of understanding of key ecological concepts (Pitman & Daniels, 2016).

From the available data, the average percentage of correct answers is 77.09%, indicating that students' ecological literacy is at a moderate level overall. With a percentage slightly below 80%, students demonstrate a reasonably good understanding of ecological topics, but there is still room for improvement. Students with percentages between 70% and 80% have adequate ecological literacy, but deeper comprehension and application of these concepts in real-life contexts need to be further strengthened.

The cognitive skills indicator in environmental literacy includes analyzing, evaluating, and addressing environmental issues and taking appropriate actions. In this indicator, students must also have high analytical skills to solve each problem. (McBeth & Volk, 2010). In Table 4, the average percentage of students answering correctly on the cognitive skills indicator is 67.19%, with an average of 23 students providing correct answers. Since environmental literacy consists of various indicators, categorization is determined based on criteria appropriate for each indicator.

The basis for categorizing students' cognitive skills and attitudes is based on the percentage obtained, namely between 0% - 20% categorized as very poor, between 21% - 40% categorized as poor, between 41% - 60% categorized as fair, between 61% - 80% categorized as good, and between 80% - 100% categorized as excellent. (Sugiyono, 2016). The average score of 67.19% shows that although students have a reasonably sound basic understanding, there are gaps in their ability to apply environmental concepts in real-life contexts. This may be due to a lack of direct learning experiences or the use of problem-based learning approaches.

Interactive and experiential learning approaches are highly recommended to enhance students' cognitive skills in environmental literacy. Research shows that case studies and simulations can improve students' understanding of sustainable development by allowing them to apply knowledge in more realistic and complex situations. (Prado et al., 2020). These strategies will enable students to improve their comprehension, not only theoretically but also in practical applications. The environmental affect and behavior indicators were measured using non-test instruments in statements scored on a scale of 1 to 4. The

environmental affect indicator consisted of 8 statements with response options ranging from strongly disagree, disagree, agree, to agree strongly. Meanwhile, the behavior indicator comprised nine statements with response options of never, occasionally, often, and always. The maximum score for each question on both indicators was 128 points.

The score results presented in Table 5 show that the achievement percentage for each item in the environmental concern attitude category ranges from 75.0% to 87.5%, with an average percentage of 81.45%. This average indicates that most students demonstrate a good level of environmental affects. Based on Sugiyono's (2016) categorization, these results show that students' attitudes toward environmental concerns are excellent. These results show that an excellent environmental affect reflects consistent actions in protecting and preserving the environment. Students with an excellent attitude toward environmental concern understand the importance of environmental issues. They are actively involved in efforts to prevent environmental damage and repair any damage that has already occurred, as reflected in their daily actions. (Purwanti, 2017).

The behavior indicator in students' environmental literacy reflects the level of students' concrete actions toward environmental conservation. The score results presented in Table 6 show that the percentage of achievement for each question ranges from 75.78% to 89.84%, with an overall average of 80.82%. This average indicates that students' behavior toward environmental issues falls into the good category; pro-environmental behavior among students is significantly influenced by experiential education and their social environment, such as support from families and schools. These results highlight the need for a more integrated approach, such as school environmental awareness campaigns, to consistently encourage students to demonstrate optimal behavior in every behavioral indicator.

Pro-environmental behavior is shaped by students' understanding of environmental issues and the support they have from their families, educational institutions, and communities. The social environment, encompassing family, school, and community, is crucial in encouraging students' pro-environmental behavior. A community-oriented environmental education strategy and active engagement in experiential activities, including outdoor events and practical exercises, can facilitate students' internalization of environmental ideals and acquiring the skills necessary to tackle environmental challenges. (Fang et al., 2023). Affective environmental education must integrate genuine and pertinent activities that resonate with students' lives. This methodology seeks to cultivate a robust pro-environmental identity by incorporating practical experiences into multiple facets of daily living. Involving children in activities directly related to the environment enhances the internalization of environmental ideals and fosters consistent environmentally responsible behavior in various circumstances. Moreover, engaging prominent individuals in students' growth, including educators and classmates, is imperative to strengthen environmental identity via social interactions and shared experiences. (McGuire, 2015).

The results of each environmental literacy indicator indicate that ecological knowledge reached 77.09%, cognitive skills 67.19%, environmental affect 81.45%, and behavior 80.82%. The average percentage of all indicators is 76.64%. According to the environmental literacy competency categories established by Ikbokwe (2016), the study's findings regarding the environmental literacy of eighth-grade students at SMPN 1 Banawa are deemed suitable.

In order to gain a deeper understanding of the interconnections among various aspects of environmental literacy, an analysis was performed to examine the influence exerted by different indicators. This analysis is crucial for determining the degree to which indicators such as ecological knowledge, cognitive abilities, environmental affect, and behavior interact and exert influence on one another. Examining the interrelationships among variables provides valuable insights into how one variable influences another, especially within educational research. (Creswell & Creswell, 2017). Pro-environmental behavior is influenced by knowledge and affective factors such as environmental concern and sensitivity. By implementing an influence test, it is possible to figure out which indicators significantly enhance overall environmental literacy, thereby establishing a more robust basis for developing affective environmental education intervention strategies. Based on Table 7, the coefficients indicate that the ecological knowledge variable does not significantly influence cognitive skills. This is demonstrated by a significance value (Sig.)

of 0.680, more significant than 0.05. Therefore, the hypothesis that ecological knowledge significantly influences cognitive skills cannot be accepted.

The specific nature of cognitive skills within certain domains can explain the finding that ecological knowledge does not significantly affect cognitive skills. Ecological knowledge may not be directly relevant if the measured skills require knowledge from different domains. Additionally, knowledge transfer across domains often requires metacognitive skills, which may not yet be fully developed, thereby limiting the significant influence of ecological knowledge on cognitive skills. This highlights the importance of contextual learning and metacognitive strategies to support this relationship.

Based on Table 8, the B coefficient for ecological knowledge is -0.050. This value indicates that each one-unit increase in ecological knowledge is predicted to decrease environmental affects by 0.050 points. However, the significance value (p-value) of 0.680, more significant than 0.05, suggests that this relationship is not statistically significant. Therefore, there is insufficient evidence to conclude that ecological knowledge directly affects students' environmental affects.

A simple linear regression test was also conducted to evaluate the influence of ecological knowledge on students' behavior. Behavior reflects the concrete actions of students in supporting environmental conservation, such as managing waste, reducing single-use plastics, and participating in environmental activities. The influence test helps determine whether students' ecological knowledge significantly contributes to their pro-environmental behavior. While theory suggests that knowledge is the foundation of action, previous studies indicate that knowledge alone is often insufficient to drive behavior without the presence of other factors, such as attitudes and social norms.

Table 9 indicates that the ecological knowledge indicator does not significantly influence students' behavior. This is evident from the significance value (p-value) of 0.768, more significant than 0.05, indicating no strong relationship between ecological knowledge and students' behavior. These results suggest that while ecological knowledge is important as a foundation in environmental literacy, knowledge alone is insufficient to drive pro-environmental behavior.

Practical experience, such as involvement in environmental activities, is crucial for internalizing environmental values. If students receive knowledge only in theoretical form without practical application, its impact on behavior tends to be weak (Rahmawati, 2022). Although ecological knowledge is essential, other factors such as practical experience, attitudes, and social norms play a more significant role in fostering pro-environmental behavior.

Other studies indicate that environmental knowledge does not consistently correlate with environmentally conscious attitudes and behaviors. Although environmental knowledge is significant, it is insufficient on its own to affect behavior without the reinforcement of additional factors directly. Factors including social norms, environmental emotions, situational constraints, and ingrained behavioral patterns frequently exert a more significant influence than knowledge alone. For instance, a person may have a high level of environmental knowledge but fail to act environmentally friendly due to situational barriers or a lack of emotional motivation. (Geiger et al., 2019). Many individuals emphasize personal environmental behavior, such as upholding individual hygiene, rather than engaging in collective environmental initiatives, such as participating in community efforts aimed at environmental protection. Behaviors like engaging in public activities to safeguard the environment often receive less attention, even among those with good environmental knowledge. (Xie & Lu, 2022).

Basic knowledge is often insufficient without specific, actionable knowledge on how to mitigate environmental impacts. Furthermore, many individuals feel that their actions do not significantly impact or are not their responsibility. Constraints such as financial limitations, time, and lifestyle habits also hinder the application of this knowledge. A lack of awareness about the long-term consequences of environmental behavior and the gap between theoretical understanding and practical skills exacerbate the situation. (Jayasekara et al., 2024).

As shown in Table 10, the influence test results indicate that the environmental affect indicator significantly influences students' behavior. This is observed via the significance value (p-value) of 0.001, which is lower than 0.05, indicating the statistical significance of the relationship between environmental

affect and behavior. The Standardized Coefficient (Beta) of 0.542 reveals that environmental affect significantly contributes to behavior, accounting for 54.2% of the variance, which further means that changes in students' behavior are roughly 54.2% contributed by their level of environmental affect, which is considered strong. Furthermore, the B coefficient for the environmental affect variable is 0.255, meaning that an increase of one unit in environmental affect would increase behavior scores by 0.255.

The measuring instrument for environmental literacy was subjected to validity and reliability testing to ascertain its accuracy and reliability. From the 40 questions subjected to testing in the trial class, 33 were found to be valid according to the results of the data analysis. The experts validated the instrument before the trial phase to ascertain its conformity to the measurement goals and content relevance. The expert validation involved the review of the question phrasing, the appropriateness of the indicators applied, and the ease of understanding of the language applied. The instrument is thus deemed reliable for accurately measuring environmental literacy against known benchmarks.

Utilizing a Likert scale in measuring affect and behavior necessitates clarifying the degree to which the level of affective awareness and behavior as measured reflects actual actions. Affective awareness typically means students' attitudes or feelings towards environmental matters; however, it does not necessarily reflect actual action. Similarly, student responses to statements of pro-environmental behavior may be intentions or wishes and not always representations of actual daily life behaviors. Bias in the responses of the students to the questionnaire is another risk. Social desirability bias is a type of such bias, which means that the students will provide responses that they perceive as being "correct" or socially appropriate and not necessarily responses that depict reality.

Environmental education profoundly impacts environmental attitudes and can act as a mediator in the development of pro-environmental action. This aligns with the premise that environmental attitudes are shaped by significant events and education, subsequently fostering heightened awareness and more responsible environmental activities. It is advisable to implement educational measures, including green campaigns, reforestation, and trash management, to enhance this link and promote sustainable behavior among the youth. Environmental education increases students' knowledge and awareness of environmental issues and shapes a positive and adequate attitude toward environmental preservation. (Nuringsih & N., 2021).

Moreover, a significant environmental impact frequently serves as the main driver for behavior, especially when reinforced by experiential education initiatives, such as reforestation efforts or waste management practices. Environmental knowledge and concern are closely linked to pro-environmental behaviors, mainly when individuals engage in significant environmental activities. This study highlights the significance of experiential education in closing the divide between environmental beliefs and pro-environmental actions. Consequently, to improve students' environmental awareness, experiential education methodologies must be employed to attain maximum results.

Integrating experiences into the curriculum can be accomplished through several activities that enable students to engage directly with their surroundings. Students may explore local ecosystems, including woods, rivers, or beaches, to examine biodiversity and comprehend the affects of human activities on the environment. These activities enable students to observe environmental conditions firsthand and foster ecological awareness. (Hayati, 2020). Engaging students in practical projects, such as recycling initiatives, tree planting, or establishing school gardens, facilitates the connection between theory and practice, thus deepening their comprehension of their responsibilities in conserving the environment. (Rahayu et al., 2024). Incorporating environmental topics into multiple subjects, such as science, geography, and social studies, provides a comprehensive understanding of environmental issues. (Ferdyan et al., 2021). Additionally, methods such as group discussions, debates, and collaborative projects focusing on environmental issues actively involve students in the learning process and decision-making related to the environment. (Miterianifa & Mawarni, 2024). Thus, integrated with direct experiences, environmental education equips students with the knowledge, skills, and attitudes necessary to become responsible and proactive individuals in preserving the environment.

Previous research has provided valuable insights into environmental literacy analysis and efforts to

improve it through various learning models or methods. One research study showed that the STM approach affectively enhances students' understanding of environmental literacy and fosters greater responsibility toward environmental conservation. (Hudha et al., 2021). Another research developed an e-booklet based on the domains of environmental literacy (knowledge, cognitive skills, attitudes, and behavior). The findings indicated that using the e-booklet improved students' overall environmental literacy, with an n-gain value of 0.37 (moderate category). (Nursa'adah et al., 2021). A subsequent research study aimed to describe students' environmental literacy related to environmental pollution, revealing that students' environmental literacy fell into the high category, with an average score of 77.1% (Utami et al., 2023).

This research assesses the degree of students' environmental literacy according to four primary indicators and examines the interrelationships among these indicators. The findings indicate that environmental factors substantially influence students' behavior. Furthermore, this research explores the interplay among these indicators, illustrating that students' attitudes, emotions, and environmental awareness significantly influence their propensity to engage in concrete actions aimed at environmental protection. In other words, the greater the students' emotive engagement with environmental issues, the more inclined they are to demonstrate environmentally responsible behavior in their daily activities.

CONCLUSION

This descriptive quantitative research analyzes the environmental literacy of VIII grade students at SMP Negeri 1 Banawa, involving 32 respondents and focusing on four primary indicators: ecological knowledge, cognitive skills, environmental affect, and pro-environmental behavior. Based on the research findings, the average percentage scores for each indicator are as follows: ecological knowledge (77.09%), cognitive skills (67.19%), environmental affect (81.45%), and pro-environmental behavior (80.82%). These results indicate that, overall, students' environmental literacy falls into the "good" category, although there are significant variations across the indicators.

The influence test results between indicators showed mixed findings. Ecological knowledge did not significantly influence cognitive skills or pro-environmental behavior, as evidenced by p-values of 0.680 and 0.768, respectively, both exceeding the 0.05 significance threshold. On the other hand, the environmental affect significantly influenced pro-environmental behavior, with a p-value of 0.001 and a standardized coefficient (Beta) of 0.542. This indicates that their level of environmental affect can explain 54.2% of the variance in students' pro-environmental behavior. This strong relationship highlights the importance of fostering emotional engagement and personal connections to environmental issues, as these factors significantly motivate concrete actions.

These results underscore several key implications. First, while ecological knowledge is important, it must be integrated with interactive and experiential learning strategies to enhance cognitive skills and bridge the gap between understanding and action. Second, programs that increase environmental affects, such as community-based activities, campaigns, and practical conservation efforts, are crucial for promoting meaningful pro-environmental behavior.

Experiential education programs and collaborative initiatives involving schools, families, and communities are recommended to enhance environmental literacy. Teaching materials must emphasize practical and locally pertinent environmental issues to enhance student engagement. The study was confined to a limited cohort of eighth-grade students at SMP Negeri 1 Banawa and depended exclusively on questionnaires, perhaps leading to response bias. Additional studies utilizing larger samples and varied data collection techniques are necessary to further comprehension of the factors affecting environmental literacy.

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