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ANALYSIS OF THE ECOPEDAGOGICAL APPROACH IN GEOGRAPHY LEARNING ON THE LEVEL OF ECOLOGICAL INTELLIGENCE OF ADIWIYATA HIGH SCHOOL STUDENTS IN PEKANBARU

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ABSTRACT

Geography learning grounded in an ecopedagogical approach plays an important role in fostering students' ecological intelligence, particularly in the context of contemporary environmental challenges. This study aims to examine the implementation of ecopedagogical approaches in geography learning, analyse students' levels of ecological intelligence, and investigate the influence of ecopedagogical approaches on students' ecological intelligence. This research employed a survey method with a mixed-methods sequential explanatory design involving 7 geography teachers and 206 students. Data were analysed using descriptive statistics, normality tests, Pearson correlation analysis, and simple linear regression. The results indicate that: (1) the ecopedagogical approach was implemented effectively at a high level (mean scores ranging from 1.88 to 1.95), although the indicators related to the use of the environment as a learning setting (1.90) and as learning materials (1.88) showed the lowest scores; (2) students' ecological intelligence was also categorized as high (mean scores ranging from 1.59 to 1.98), with relatively lower performance in ecological systems understanding (1.59) and sustainable practice skills (1.86); and (3) correlation analysis revealed a significant positive relationship between ecopedagogical approaches and ecological intelligence ($r = 0.430$; $p < 0.05$), with a contribution of 18.5%.

Keywords: *ecopedagogical approach; ecological intelligence; geography learning*

INTRODUCTION

The environmental crisis has emerged as one of the significant challenges of the twenty-first century. Issues such as climate change, environmental degradation, large-scale exploitation of natural resources, and ecological pollution pose serious threats to global sustainability (Goleman, 2009). These challenges affect not only environmental conditions but also social, economic, and human well-being. In this context, education, particularly geography education, plays a strategic role in fostering students' environmental awareness, knowledge, and responsible actions toward environmental issues (Rakuasa & Latue, 2024).

Addressing complex environmental problems requires strengthening individuals' capacity to interact

sustainably with nature. The concept of ecological intelligence has therefore gained attention as a key foundation for developing pro-environmental behaviour. Ecological intelligence refers to the ability to understand the interrelationships between human actions and environmental impacts, accompanied by ethical and sustainable decision-making (Bahrudin & Rohmat, 2018). Thus, ecological intelligence encompasses not only ecological knowledge but also empathy and action-oriented behaviour aimed at environmental sustainability (Kastolani & Setiawan, 2018).

Ecological intelligence is reflected in concrete behaviours such as proper waste disposal, pollution prevention, participation in wildlife conservation, and engagement in environmental cleanliness activities (Akkuzu-Güven et al., 2021). Consequently, developing ecological intelligence among students through formal education is essential to prepare environmentally responsible citizens capable of contributing to sustainable development.

Geography learning provides a relevant framework for developing ecological intelligence, as geography fundamentally examines the interactions between humans and the environment within spatial contexts. Geography education is therefore not limited to spatial analysis but also emphasises ecological responsibility in responding to environmental change and degradation. Modern geography education is expected to develop environmental and spatial literacy, including critical thinking skills related to ecological issues and active participation in sustainability efforts (Kurniawan et al., 2024).

To foster comprehensive ecological intelligence, transformative and context-based learning approaches are required. Ecological intelligence cannot develop optimally without appropriate pedagogical support. The Merdeka Curriculum emphasises contextual learning and project-based activities, providing opportunities for the systematic integration of ecopedagogical approaches in schools. Previous studies indicate that the implementation of this curriculum significantly enhances students' critical thinking through participatory and real-life learning processes (Kahn, 2010). Ecopedagogy functions as a critical educational approach that not only delivers environmental knowledge but also promotes awareness, participation, and

transformative action in addressing ecological issues (Misiaszek, 2016).

Conceptually, ecopedagogy represents a synthesis of Paulo Freire's critical pedagogy, biocentric environmental ethics, and the principles of Education for Sustainable Development (ESD). Freire's critical pedagogy contributes reflective dialogue as a means of developing critical ecological awareness. Biocentric ethics strengthen the affective dimension by emphasizing the intrinsic value of nature, while ESD highlights the importance of concrete environmental actions through contextual and adaptive education. Together, these foundations position ecopedagogy as an approach that goes beyond cognitive learning by integrating critical awareness, ecological responsibility, and real-world environmental action (Berman, 2021).

Within geography education, ecopedagogical approaches are particularly relevant because geography addresses not only physical and spatial aspects but also human–environment interactions across multiple scales. Geography learning enables students to analyze the ecological consequences of development and urbanization while promoting conservation values, adaptability to environmental change, and sustainable spatial thinking (Kurniawan et al., 2024).

Ecopedagogy holds a strategic position within geography education due to the discipline's spatial and interdisciplinary nature, which conceptualizes the Earth as a complex system involving interactions between natural and human systems. Integrating ecopedagogical approaches into geography learning can effectively combine scientific understanding with environmental ethics, encouraging students to act as agents of change within their communities (Kahn, 2010).

Despite the growing emphasis on environmental education and the implementation of ecopedagogical principles in schools, empirical studies examining the effectiveness of ecopedagogical approaches in geography learning remain limited. Previous research has largely focused on environmental education in general or on the implementation of Adiwiyata programs without specifically analyzing how ecopedagogical approaches are operationalized within geography instruction and how they influence students' ecological intelligence.

Several studies have highlighted the importance of ecopedagogy in fostering environmental awareness and values; however, most of these studies emphasize conceptual integration and affective outcomes rather than examining the relationship between instructional approaches and measurable ecological intelligence outcomes. Moreover, empirical evidence linking ecopedagogical approaches to students' ecological intelligence at the senior high school level, particularly within the context of Adiwiyata schools, is still scarce.

In addition, studies that explore this relationship within local and context-specific settings, such as Pekanbaru City, are limited. Given the unique environmental challenges faced by Pekanbaru, including air pollution, land-use change, and urban environmental degradation, there is a need for context-based empirical research. Therefore, this study addresses these gaps by examining the implementation of ecopedagogical approaches in geography learning and analyzing their influence on students' ecological intelligence in Adiwiyata public senior high schools in Pekanbaru City.

MATERIALS AND METHODS

This study employed a survey research method aimed at collecting data from a relatively large number of respondents. The survey method was considered appropriate for this study because the research subjects consisted of Adiwiyata public senior high schools in Pekanbaru City, which were distributed across three schools. The use of a survey enabled the researchers to obtain generalizable findings from a large respondent group.

A mixed-methods approach combining quantitative and qualitative methods was applied in this study. The quantitative component was used to test the hypothesized influence of the ecopedagogical approach on geography learning and to measure students' levels of ecological intelligence. Meanwhile, the qualitative approach was employed to describe and interpret data related to the implementation of ecopedagogical approaches by geography teachers in classroom practices.

This study adopted a sequential explanatory mixed-methods design, in which quantitative and qualitative data were collected and analyzed in successive phases (Tashakkori & Teddlie, 2010; Creswell, 2011). Quantitative data collection and analysis

were conducted in the first phase, followed by qualitative data collection and analysis in the second phase to provide deeper explanations of the quantitative findings. The mixed-methods research design is presented in **Figure 1**.

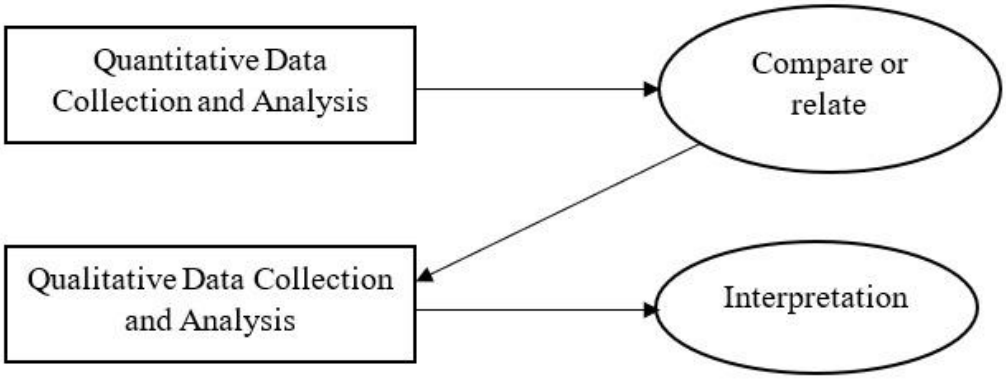

Figure 1. Sequential Explanatory Design

Source: Creswell (2011)

The population of this study consisted of all geography teachers at Adiwiyata public senior high schools in Pekanbaru City to measure the implementation of ecopedagogical approaches in geography learning (Variable X), as well as Grade XII students of Adiwiyata public senior high schools to assess students' ecological intelligence after participating in geography learning based on ecopedagogical approaches (Variable Y).

Grade XII students were selected as the population because they are considered to possess more mature and objective thinking abilities in evaluating school practices and environmental conditions. As stated by Facione (2011), as cited in Nur Aulia and Indana (2020), Grade XII students are generally capable of critical inferential thinking, including making assumptions, comparing relevant information, and identifying logical conclusions.

A total of seven geography teachers from Adiwiyata public senior high schools in Pekanbaru City constituted the population for measuring the implementation of ecopedagogical approaches in geography learning. In addition, a total of 443 Grade XII social science students (XII IPS) from three Adiwiyata public senior high schools in Pekanbaru City formed the population for assessing students' levels of ecological intelligence. **Table 1** presents the research population in detail.

Table 1 Population

No	School Name	Geography Teacher	Students
1	SMA Negeri 3 Pekanbaru	2	160
2	SMA Negeri 7 Pekanbaru	2	116
3	SMA Negeri 11 Pekanbaru	3	167
	Total	**7**	**443**

Source: Researcher (2025)

The sampling technique for teachers in this study employed a population sampling method. This approach was used to examine the strategies applied by each geography teacher in implementing ecopedagogical approaches in geography learning. Based on preliminary observations, all geography teachers were found to have implemented ecopedagogical approaches in geography. The student sample used a simple random sampling approach determined using the Isaac and Michael method (Sugiyono, 2018). The Isaac and Michael equation show in **equation 1** (Sugiyono, 2018):

$$n = \frac{\lambda^2 \cdot N \cdot P \cdot Q}{d^2(N-1) + \lambda^2 \cdot P \cdot Q} \quad (1)$$

Description:

N : Number of samples

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With a population of 443 and a significance threshold of 5%, it was determined that there were 206 respondents in the research sample. The formula used to obtain the sample for each school show in **equation 2** :

$$\mathbf{n1} = \frac{N1}{n} N \quad (2)$$

Description:

n1 = Sample size to be drawn from each school

N1 = Population size of each school

N = Total research population

N = Total number of samples to be taken

The student sample distribution is presented in **Table 2**.

Table 2 Sample of Students

No	School Name	Calculation Sample	Sample Size
1	SMA Negeri 3 Pekanbaru	160/443 x 206	74
2	SMA Negeri 7 Pekanbaru	116/443 x 206	54
3	SMA Negeri 11 Pekanbaru	167/443 x 206	78
	Total		**206**

Source: Data processing (2025)

Data in this study were collected through several complementary techniques to obtain comprehensive and reliable information related to the research variables. The combination of different data collection methods allowed for triangulation and strengthened the validity of the findings:

1. Observation: In this study, research subjects were directly observed using a direct observation method. Observation was conducted to collect empirical data and factual information regarding the implementation of ecopedagogical approaches in geography teaching. Because the researcher directly observed classroom activities and obtained the required data firsthand, observation was considered a valid and reliable data collection technique and therefore did not require additional validation procedures.
2. Interviews: This study employed closed-ended interviews as part of the research instruments. In this technique, respondents were engaged in guided communication, after which their responses were summarized and recorded by the researcher as research data. Interviews were conducted to obtain information regarding the implementation of ecopedagogical approaches in geography learning as applied by geography teachers in schools.
3. Questionnaires: The questionnaire was used to measure students' ecological intelligence. To assess knowledge of ecological systems, attitudes toward environmental conservation, skills in engaging in sustainable practices, and active participation in environmental initiatives, both knowledge tests and non-test instruments were administered. Prior to data collection, the research instruments were tested for validity and reliability to ensure the consistency, accuracy, and dependability of respondents' answers.
4. Literature Review: The literature review was conducted to collect supporting information in the form of relevant theories and previous studies. This technique aimed to strengthen the theoretical foundation, support the research objectives, and provide a conceptual framework explaining how ecopedagogical approaches in

geography learning influence students' ecological intelligence at Adiwiyata public senior high schools in Pekanbaru City.

5. Documentation Study: Documentation was used as a data collection technique in schools implementing ecopedagogical approaches in geography learning. This method served as supplementary data to support the research findings. Documents examined in this study included teaching modules, lesson plans, and other relevant instructional materials required for the research.

Data analysis in this study was conducted using both quantitative and qualitative approaches to address the research objectives comprehensively. Quantitative analysis was applied to examine patterns, relationships, and effects between variables, while qualitative analysis was used to provide deeper explanations of the quantitative findings. The following data analysis techniques were employed.

1. Data collected for the ecopedagogical approach variable were summarized and generalized using descriptive analysis. Measures of central tendency, including the mean and mode, were used to identify central tendencies, while standard deviation and variance were applied to measure data dispersion. Descriptive statistical techniques were employed to interpret and present the characteristics of the research data.
2. A normality test was conducted as a prerequisite for linear regression analysis to determine whether the research data were normally distributed. In this study, the Kolmogorov–Smirnov test was applied because the sample size in each group exceeded 50 respondents. This test compares the empirical cumulative distribution of the sample data with the theoretical cumulative distribution of a normal distribution. If the significance value (p-value) is greater than 0.05, the data are considered to be normally distributed.
3. Correlation analysis was conducted to determine the presence and direction of the relationship between ecological intelligence and the ecopedagogical approach in geography learning. A positive correlation indicates a direct relationship between the two

variables, whereas a negative correlation indicates an inverse relationship. This correlation analysis uses the Pearson Correlation analysis technique with the **equation 3**:

$$r_{x,y} = \frac{\Sigma_t^n = 1(x_t - x)(y_t - y)}{\sqrt{\Sigma_t^n = 1(x_t - x)^2 \Sigma_t^n = 1(y_t - y)^2}} \quad (3)$$

Explanation:

Rx,y = Correlation coefficient
n = Number of pairs of X and Y data
Σx = Total sum of variable X
Σy = Total sum of variable Y
Σx2 = Sum of squares of variable X
Σy2 = Sum of squares of variable Y
Σxy = Product of the sum of variables X and Y.

4. Simple linear regression analysis was employed to examine the influence of the ecopedagogical approach on students' ecological intelligence in geography learning. The regression model used in this study is expressed in **equation 4**.

   $Y = a + bx + e$ (4)

   The acceptable level of error in this study was set at 0.05, corresponding to a 95
5. Qualitative analysis was used to explain and enrich the quantitative findings related to the first and second research objectives. For the first objective, qualitative analysis provided an in-depth understanding of the characteristics of ecopedagogical approach implementation in geography learning. For the second objective, qualitative analysis explored contextual factors and learning experiences that supported students' ecological intelligence at Adiwiyata public senior high schools.

   Qualitative analysis served an explanatory function, as quantitative data were able to indicate levels and effects but could not fully explain how and why certain factors contributed to the research outcomes.

   The qualitative data analysis in this study followed the framework proposed by Miles and Huberman, as cited in Tashakkori and Teddlie (2010), which consists of three main stages: data reduction, data display, and conclusion drawing. The qualitative data analysis process is illustrated in Figure 2.

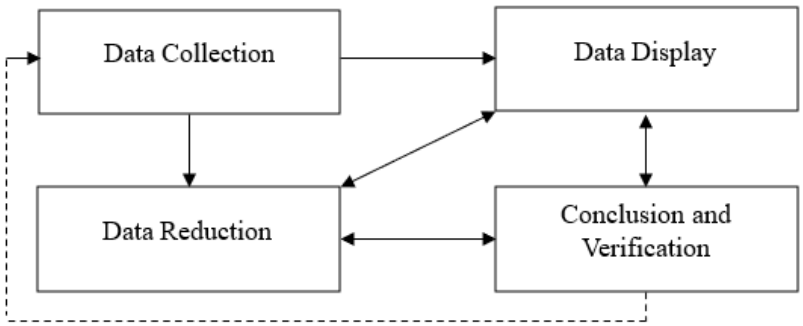

Figure 2. Qualitative Data Analysis

Source: Tashakkori & Teddlie (2010)

The research instruments were developed based on the research variables and their respective indicators to ensure alignment between the objectives, data collection, and analysis. This study involved two variables: the ecopedagogical approach as the independent variable and ecological intelligence as the dependent variable.

The ecopedagogical approach was measured using an observation sheet, a teacher questionnaire, and semi-structured interviews. This variable was operationalized into four indicators: (1) geography learning oriented toward natural and human environmental issues; (2) the use of natural and social environments as learning settings; (3) the utilization of environmental topics as learning resources; and (4) the cultivation of ecocentric and sustainability-oriented attitudes in geography learning.

Students' ecological intelligence was measured using a questionnaire administered to Grade XII students. This variable consisted of four indicators: (1) knowledge of ecological systems; (2) attitudes toward environmental conservation; (3) skills in engaging in sustainable practices; and (4) active participation in environmental initiatives. The knowledge indicator was measured using a Guttman scale, while the attitude, skills, and participation indicators were measured using a Likert scale.

All instruments were developed based on relevant theoretical frameworks and were tested for validity and reliability prior to data collection to ensure the accuracy and consistency of the measurements.

The study employed Likert and Guttman scales as measurement instruments. The Likert scale was used to assess attitudes, skills, and levels of participation, while

the Guttman scale was applied to measure students' knowledge. The categories and scoring of the Likert are presented in **Table 3** and Guttman scales are presented in **Tables 4**.

Table 3 Likert Scale

Positive Statement	Score	Negative Statement	Score
Strongly agree	5	Strongly agree	1
Agree	4	Agree	2
Undecided	3	Undecided	3
Disagree	2	Disagree	4
Strongly disagree	1	Strongly disagree	5

Source: Sugiyono (2019)

The Guttman scale was also used in this study to assess knowledge indicators in the ecological intelligence variable. In the research instrument, true and false questions were assessed using this scale. A score of 1 was given for correct answers to questions or statements in the form of positive sentences, and 0 for incorrect answers.

Table 4. Guttman Scale

Questions or statements	Score	
Positive questions or statements	1	0
Negative questions or statements	0	1

Source: Sugiyono (2014)

Validity testing was performed to examine the appropriateness of each questionnaire item, while reliability testing was conducted to evaluate the precision and consistency of the instrument when applied at different times. The tests involved 40 non-sample student respondents. The reliability test was also conducted using Cronbach's Alpha formula show in **equation 4**:

$$r_{11} = \left[\frac{k}{k-1}\right]\left[1 - \frac{\sum\sigma_n^2}{\sigma_t^2}\right] \quad (4)$$

Description:

r11 = Instrument Reliability

k = Number of questions

$\sum\sigma_n^2$ = Total variance

σ_t^2 = Total variance

The reliability test results indicate that the rtable value for N = 40 in the rtable value distribution at a significance level of 5% is 0.312 are reliable.

In qualitative research, rigor is established through trustworthiness rather than statistical validity and reliability. In accordance with the criteria proposed by Guba and Lincoln (Creswell & Creswell, 2018) this study ensured trustworthiness through credibility, transferability, dependability,

and confirmability within a sequential explanatory mixed-methods design.

Credibility was achieved through prolonged engagement, classroom observations, and data triangulation involving interviews, observations, and school documents until data saturation was reached. Transferability was supported by providing a clear description of the research context, participants, and learning settings. Dependability was ensured through systematic documentation of research procedures, allowing consistency if the study were replicated. Confirmability was maintained by grounding findings in empirical data and minimizing researcher bias through transparent data analysis.

RESULTS AND DISCUSSION

This study was conducted in three public high schools (SMAN) in Pekanbaru City that have been awarded the title of Adiwiyata School, namely SMAN 3, SMAN 7, and SMAN 11 Pekanbaru. The location of the research area is shown in the following **Figure 3**.

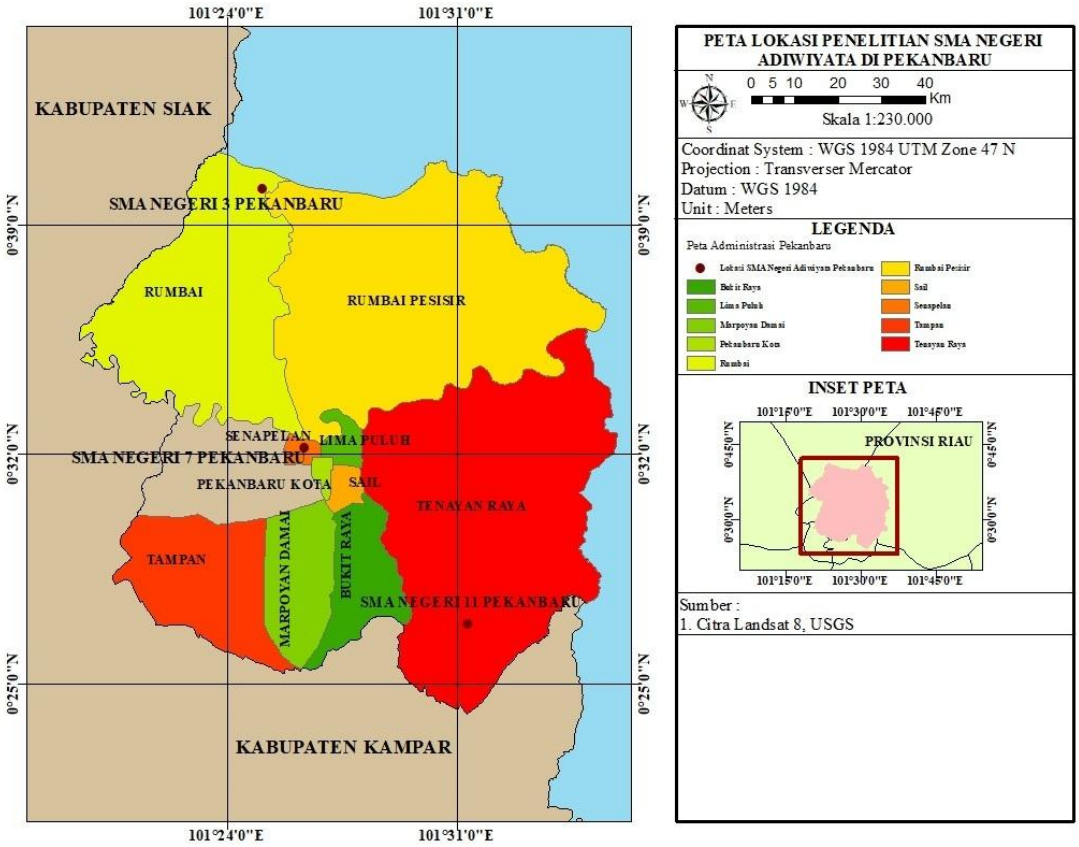

Figure 3. Research Location Map

Source: Researcher (2025)

1. The Application of the Ecopedagogical Approach in Geography Education at Adiwiyata State High School in Pekanbaru City

The implementation of ecopedagogical approaches in geography learning at Adiwiyata schools in Pekanbaru was measured using four indicators: orientation toward natural and human environmental issues, utilization of the environment as a learning setting, use of environmental topics as learning resources, and the cultivation of ecocentric and sustainability-oriented attitudes. The level of implementation was classified into three categories high, moderate, and low based on grouped frequency distribution, as the analysis was conducted at the school level. The classification of data for the ecopedagogical approach variable is presented in **Table 5**.

Table 5. Classification of Data for the Ecopedagogical Approach Variable

No	Score	Categories
1	0-0,69	Low
2	0,70-1,39	Medium
3	1,40-2,08	High

Source: Data processing (2025)

Based on the descriptive analysis, the implementation of the ecopedagogical approach in geography learning at Adiwiyata public senior high schools in Pekanbaru City was classified as high, with a mean score of 1.94. This value falls within the high-category range (1.40–2.08), indicating that ecopedagogical principles have been effectively applied in the geography learning process.

a. Geography Learning Focused on Natural and Human Environmental Issues

Geography learning oriented towards natural and human environmental issues is the utilization of natural and human environmental issues as learning material content. The following are the findings of the research on indicators of geography learning oriented towards natural and human environmental issues is presented in **Table 6**.

Table 6. Results on Indicators of Geography Learning Oriented Towards Natural and Human Environmental Issues

No	School Name	Score	Categories
1	SMAN 3 Pekanbaru	1,94	High
2	SMAN 7 Pekanbaru	1.88	High
3	SMAN 11 Pekanbaru	2.02	High
	Total	1.94	High

Source: Data processing (2025)

For the indicator Geography Learning Focused on Natural and Human Environmental Issues, the highest score was achieved by SMA Negeri 11 Pekanbaru (2.02), followed by SMA Negeri 3 Pekanbaru (1.94). Meanwhile, the lowest score was obtained by SMA Negeri 7 Pekanbaru (1.88). Despite these variations, all Adiwiyata schools in Pekanbaru were classified in the high category, with an overall mean score of 1.94.

The high achievement of the indicator related to geography learning focused on natural and human environmental issues indicates that geography instruction in Adiwiyata schools in Pekanbaru has successfully integrated environmental themes into the curriculum. This finding is consistent with the perspective of Kurniawan, Saputra, and Akhyar (2024), who emphasize that modern geography education should develop environmental and spatial literacy by examining interactions between human activities and environmental systems. Similarly, Misiaszek (2016) argues that ecopedagogical practices encourage learners to critically engage with socio-environmental issues as a response to global ecological crises. The alignment between the findings of this study and previous research suggests that issue-oriented geography learning plays a crucial role in fostering students' ecological awareness and critical understanding.

b. Geography Learning Using the Natural and Human Environment as a Learning Environment

The highest score was recorded by SMA Negeri 3 Pekanbaru (1.94), followed by SMA Negeri 11 Pekanbaru (1.92), while the lowest score was obtained by SMA Negeri 7 Pekanbaru (1.85). Overall, Adiwiyata schools in Pekanbaru were classified in the high category, with an average score of 1.90.

Despite being categorized as high, the relatively lower scores on the indicator of utilizing the environment as a learning setting indicate that geography learning remains largely classroom-centered. This finding supports the results of Yunansah and Herlambang (2017), who found that the implementation of ecopedagogical approaches in schools often emphasizes conceptual understanding rather than experiential learning. According to Bowers (2010), direct engagement with real environmental contexts is essential for developing ecological intelligence and transformative learning. Therefore, the limited use of the surrounding environment as a learning space highlights a gap between ecopedagogical principles and instructional practices, suggesting the need for more field-based and contextual learning activities. Research Findings on Geography Learning Indicators Using the Natural and Human Environment as a Learning Environment is presented in **Table 7**.

Table 7. Research Findings on Geography Learning Indicators Using the Natural and Human Environment as a Learning Environment

No	School Name	Score	Categories
1	SMAN 3 Pekanbaru	1,94	High
2	SMAN 7 Pekanbaru	1.85	High
3	SMAN 11 Pekanbaru	1.92	High
	Total	1.90	High

Source: Data processing (2025)

c. Geography Learning Utilizing Natural and Human Environment Topics as Teaching Materials

The highest score was achieved by SMA Negeri 3 Pekanbaru (1.90), followed by SMA Negeri 11 Pekanbaru (1.88), while the lowest score was recorded by SMA Negeri 7 Pekanbaru (1.87). Overall, Adiwiyata schools in Pekanbaru were categorized as high, with an average score of 1.90 is presented in **Table 8**.

Table 8. Research Findings on Indicators of Geography Learning Utilizing Natural and Human Environment Topics as Teaching Materials

No	School Name	Score	Categories
1	SMAN 3 Pekanbaru	1,90	High
2	SMAN 7 Pekanbaru	1.87	High
3	SMAN 11 Pekanbaru	1.88	High
	Total	**1.88**	**High**

Source: Data processing (2025)

The relatively lower performance of the indicator related to the use of environmental topics as learning resources indicates that environmental issues have not yet been fully utilized as core instructional materials. This finding aligns with Berman (2021), who notes that environmental education often remains informative rather than problem-based, limiting students' opportunities for inquiry and critical analysis. Furthermore, Akkuzu-Güven and Uyulgan (2021) demonstrate that the use of contextual environmental issues as learning resources significantly contributes to students' ecological understanding and environmental actions. These findings suggest that optimizing local environmental topics as learning resources is essential to strengthen the effectiveness of ecopedagogical approaches in geography learning.

d. Geography Learning Instills an Ecocentric and Sustainable Attitude

The highest score was obtained by SMA Negeri 3 Pekanbaru (2.02), followed by SMA Negeri 11 Pekanbaru (1.94), while the lowest score was recorded by SMA Negeri 7 Pekanbaru (1.91). Overall, Adiwiyata schools in Pekanbaru were classified in the high category, with an average score of 1.95 (see **Table 9**).

Table 9. Research Findings on Indicators of Geography Learning that Instills an Eco-centric and Sustainable Attitude

No	School Name	Score	Categories
1	SMAN 3 Pekanbaru	2,02	High
2	SMAN 7 Pekanbaru	1.91	High
3	SMAN 11 Pekanbaru	1.94	High
	Total	1.95	High

Source: Data processing (2025)

The strong results obtained for the indicator related to the cultivation of ecocentric and sustainability-oriented attitudes indicate that geography learning in Adiwiyata schools has been effective in fostering positive environmental values among students. This finding is consistent with Taylor's (1986) theory of biocentric ethics, which emphasizes recognizing the intrinsic value of nature as a foundation for environmental responsibility. In addition, Kastolani and Setiawan (2018) report that ecology-oriented geography learning contributes significantly to the development of students' environmental attitudes and ethical awareness. However, as noted by Sterling (2001), the internalization of environmental values must be accompanied by consistent practices to ensure that positive attitudes are translated into sustainable behaviors.

2. Students' Ecological Intelligence Level

Through four indicators related to knowledge of ecological systems, attitudes toward environmental conservation, skills to engage in sustainable practices, and active participation in environmental initiatives, the ecological intelligence level of students at three Adiwiyata public high schools in Pekanbaru City was assessed.

Three categories high, medium, and low were used to describe the level of ecological intelligence among students. This classification was determined through the frequency distribution of group data, as the data presented here is group data (school). **Table 10** shows the classification based on frequency distribution.

Table 10. Classification of Variable Y Data

No	Skor	Kategori
1	0-0,69	Low
2	0,70-1,39	Medium
3	1,40-2,08	High

Sources: Data processing (2025)

The results of the descriptive analysis show that students' ecological intelligence was also categorized as high, with an average score of 1.86. This score falls within the predefined high-category range, indicating that students generally demonstrate strong ecological awareness, attitudes, and behaviors.

a. Knowledge of Ecological Systems

The aspect of knowledge of ecological systems measures students' knowledge or cognitive understanding of the natural and human environment. **Table 11** shows the findings from the study on students' knowledge of ecological systems.

Table 11. Research Findings on Aspects of Ecological System Knowledge

No	School Name	Score	Categories
1	SMAN 3 Pekanbaru	1,64	High
2	SMAN 7 Pekanbaru	1.59	High
3	SMAN 11 Pekanbaru	1.54	High
	Total	**1.59**	**High**

Source: Data processing (2025)

The highest score was obtained by SMA Negeri 3 Pekanbaru (2.02), followed by SMA Negeri 11 Pekanbaru (1.94), while the lowest score was recorded by SMA Negeri 7 Pekanbaru (1.91). Overall, Adiwiyata schools in Pekanbaru were classified in the high category, with an average score of 1.95.

b. Attitude Toward Environmental Conservation

The aspect of attitude toward environmental conservation needs to be measured because ecological intelligence is not only about knowledge but also about the attitude of concern for environmental sustainability that emerges after students have acquired knowledge. **Table 12** shows the findings of the research on the aspect of attitude toward environmental conservation among students.

Table 12. Research Findings on the Aspect of Attitude Toward Environmental Conservation

No	School Name	Score	Categories
1	SMAN 3 Pekanbaru	2,04	High
2	SMAN 7 Pekanbaru	1,95	High
3	SMAN 11 Pekanbaru	1,97	High
	Total	**1.98**	**High**

Source: Data processing (2025)

The highest score was achieved by SMA Negeri 3 Pekanbaru (2.04), followed by SMA Negeri 11 Pekanbaru (1.97), while the lowest score was recorded by SMA Negeri 7 Pekanbaru (1.97). Overall, Adiwiyata schools in Pekanbaru were

categorized as high, with an average score of 1.98.

c. Skills for Engaging in Sustainable Practices

The aspect of skills for engaging in sustainable practices refers to practical environmental conservation skills possessed by students, such as choosing more environmentally friendly products and setting examples of more environmentally friendly lifestyles, such as recycling waste and planting trees. This aspect is also one of the keys to ecological intelligence, in addition to knowledge and attitude, because ecological intelligence is expected to have practical impacts on environmental conservation efforts. **Table 13** shows the research findings on the aspect of skills to engage in sustainable practices among students:

Table 13. Research Findings on the Aspect of Skills to Engage in Sustainable Practices

No	School Name	Score	Categories
1	SMAN 3 Pekanbaru	1,88	High
2	SMAN 7 Pekanbaru	1.85	High
3	SMAN 11 Pekanbaru	1.86	High
	Total	**1.86**	**High**

Source: Data processing (2025)

The highest score was obtained by SMA Negeri 3 Pekanbaru (1.88), followed by SMA Negeri 11 Pekanbaru (1.86), while the lowest score was recorded by SMA Negeri 7 Pekanbaru (1.85). Overall, Adiwiyata schools in Pekanbaru were classified in the high category, with an average score of 1.86.

d. Active Participation in Environmental Initiatives

This indicator is an additional indicator in the ecological intelligence variable, as ecological intelligence indicators typically consist of only three indicators: knowledge, attitude, and skills. This indicator measures efforts to influence others to participate in environmental conservation. **Table 14** shows the research findings on the aspect of active participation in environmental initiatives among students.

Table 14 Research Findings on the Aspect of Active Participation in Environmental Initiatives

No	School Name	Score	Categories
1	SMAN 3 Pekanbaru	1,95	High
2	SMAN 7 Pekanbaru	1.90	High
3	SMAN 11 Pekanbaru	1.89	High
	Total	**1.91**	**High**

Source: Data processing (2025)

The highest score was achieved by SMA Negeri 3 Pekanbaru (1.95), followed by SMA Negeri 7 Pekanbaru (1.90), while the lowest score was recorded by SMA Negeri 11 Pekanbaru (1.89). Overall, Adiwiyata schools in Pekanbaru were categorized as high, with an average score of 1.91.

3. The Influence of the EcoPedagogical Approach in Geography Education on Ecological Intelligence

In this study, a normality test was conducted to determine whether the data were normally distributed. This test was required as a prerequisite for further statistical analysis. The normality test was performed using the Kolmogorov–Smirnov test with IBM SPSS version 27.0. According to the Kolmogorov–Smirnov criterion, the data are considered normally distributed if the significance value (p-value) is greater than 0.05 at the 5% significance level. The results of the normality test indicate that:

Table 15. Normality Test Results

	Test of Normality		
	Kolmogorov-Smirnov		
	Statistic	**df**	**Sig.**
SMAN 3	.086	74	.200
SMAN 7	.092	54	.170
SMAN 11	.081	78	.218

Source: Data processing (2025)

Based on the **Table 15** of normality test results, it shows that the significance value of all schools is > 0.05, so it can be concluded that the data is normally distributed.

The Kolmogorov-Smirnov value recommendation can also be used to determine the strength of the relationship. The Correlation Test results show in **Table 16**.

Table 16. Correlation Test Results

		Approach Ecopedagogical	Ecological Intelligence
Approach Eco pedagogical	Pearson Correlation	1	.430**
	Sig. (2-tailed)		.000
	N	280	280
Ecological Intelligence	Pearson Correlation	.430**	1
	Sig. (2-tailed)	.000	
	N	280	280

** Correlation is significant at the 0.01 level (2-tailed)

Source: Data processing (2025)

Based on the table above, it is known that the significance value is 0.00, meaning that the significance value is 0.00 < 0.05. In addition to the fact that the Pearson correlation score is 0.430, it is also known that the relationship between variable X and variable Y has a moderate correlation level. The results of the simple linear regression test show in **Table 17**.

Table 17. Variables Entered

Model	Variables Entered	Variables Removed	Method
1	Ecopedagogical Approach		Enter

a. All requested variables entered

b. Dependent Variable: Ecological Intelligence

Source: Data processing (2025)

Based on the table above, it shows that the variable entered is the ecopedagogical approach (variable X), while the dependent variable is ecological intelligence (variable Y) and the method used is the Enter method.

Table 18. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.432	.185	.182	.09997

a. Predictors: (Constant), Ecopedagogical Approach

Source: Data processing (2025)

The **Table 18** shows the proportion of the influence of variable X on variable Y, which is displayed in the R Square table as 0.185, as well as the correlation or relationship between variables X and Y, which is presented in the R table as 0.432. The table above shows that the variable of pedagogical techniques in

geography learning influences the variable of ecological intelligence by 18.5%, with other variables not studied in this research accounting for the remaining influence.

Table 19. ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1.	Regression	.887	1	.898	89.888	.000*
	Residual	3.784	378	.010		
	Total	4.751	398			

a. Predictors: (Constant), Ecopedagogical Approach

b. Dependent Variable: Ecological Intelligence

Source: Data processing (2025)

The significance value in the **Table 19** is 0.000, so there is clearly a significant relationship between variable X and variable Y if the significance value is between 0.000 and 0.05. As a result, the participation variable can be predicted using a regression model.

Table 20. Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.342	.071		19.403	.000
	Ecopedagogical Approach	.302	.037	.430	8.232	.000

a. Dependent Variable: Ecological Intelligence

Source: Data processing (2025)

Table 20 show the value of the constant (a) is 1.342, while the value of the ecopedagogical approach (b) is 0.302, so the regression equation can be written as:

Y = a + bX or Y = 1.342 + 0.302X

In addition to describing the regression equation, this table shows the significance value to determine the real effect between the ecopedagogical approach variable in geography learning (variable X) and the ecological intelligence variable (variable Y). As shown in the table, the significance value is 0.000 < 0.05, so Ha is accepted, meaning there is an influence between the ecopedagogical approach variable in geography learning (variable X) and the ecological intelligence variable (variable Y).

The statistical analysis results indicate a positive and significant relationship between the ecopedagogical approach (X) and ecological intelligence (Y) of students at SMA Negeri Adiwiyata in Pekanbaru. The level of correlation is also known using the Pearson Correlation coefficient, which yields a value of $r = 0.430$ with a significance level of $p < 0.05$, indicating that the correlation between the independent and dependent variables is moderate.

Overall, the results of the simple linear regression test show that the ecopedagogical approach contributes 18.5% to students' ecological intelligence ($R^2 = 0.185$). This means that there is a significant influence, although most of it is influenced by other factors such as the home environment, school programs, and individual student characteristics.

CONCLUSIONS

Based on the research findings, several conclusions can be drawn. First, the ecopedagogical approach has been effectively implemented in geography learning at Adiwiyata public senior high schools in Pekanbaru City. However, relatively lower performance was identified in indicators related to the use of environmental topics as learning resources and the utilization of the environment as a learning setting compared to other indicators.

Second, students' ecological intelligence at Adiwiyata public senior high schools in Pekanbaru City was categorized as high. Nevertheless, the indicators of ecological knowledge and sustainable practice skills showed lower levels than other dimensions, indicating areas that require further pedagogical reinforcement.

Third, hypothesis testing revealed a significant influence of the ecopedagogical approach on students' ecological intelligence, with a coefficient of determination of 18.5%. This finding indicates that while the ecopedagogical approach contributes meaningfully to the development of ecological intelligence, a substantial proportion of variance is influenced by other external factors not examined in this study.

Despite these findings, this study has several limitations. The research was conducted in a limited number of Adiwiyata schools within a single city, which may affect the generalizability of the results. In addition, the explanatory power of the model remains moderate, suggesting that future studies should

incorporate additional variables such as school culture, family environment, and extracurricular environmental activities. Further research using longitudinal designs or experimental approaches is recommended to obtain a deeper understanding of the causal mechanisms underlying the relationship between ecopedagogical approaches and ecological intelligence.

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