



The Effectiveness of the Outdoor Study Method in Improving Students' Ecological Intelligence in Geography Learning at SMAN 6 Muaro Jambi

Nur Sya'bani S^{1*}, Yurni Suasti¹, Dedi Hermon¹, Bayu Wijayanto¹

¹ Master of Geography Education, Universitas Negeri Padang, Padang, Indonesia

Received: June 13, 2025

Revised: October 27, 2025

Accepted: December 25, 2025

Published: December 31, 2025

Corresponding Author:

Nur Sya'bani S

nursyabani71100@gmail.com

DOI: [10.29303/jppipa.v11i12.11691](https://doi.org/10.29303/jppipa.v11i12.11691)

© 2025 The Authors. This open access article is distributed under a (CC-BY License)



Abstract: This study aimed to examine the effectiveness of the outdoor study method in improving students' ecological intelligence in geography learning at SMAN 6 Muaro Jambi. A quantitative approach with a quasi-experimental non-equivalent control group design was employed, involving 60 eleventh-grade students, divided equally into an experimental group receiving outdoor study instruction and a control group receiving conventional classroom learning. Ecological intelligence was measured using a validated five-point Likert-scale questionnaire administered as both the pretest and posttest, which served as the sole quantitative data source. Observation sheets were used only as supporting documentation of learning activities. Data analysis included descriptive statistics, normality and homogeneity tests, and Analysis of Covariance (ANCOVA) to control initial differences in pretest scores. The ANCOVA results indicated that the pretest covariate significantly influenced posttest scores, and after controlling for this effect, the outdoor study method produced a statistically significant increase in ecological intelligence ($p < 0.001$). Students in the experimental group achieved higher adjusted mean scores compared with the control group. The findings demonstrate that outdoor study is an effective experiential learning approach that meaningfully enhances ecological awareness, sensitivity, and environmentally responsible tendencies in secondary school geography education.

Keywords: Ecological intelligence; Environmental education; Geography learning; Outdoor study

Introduction

Geography education at the senior high school level plays a crucial role in shaping students' understanding of environmental systems and the increasingly complex ecological challenges of the 21st century. Students are required to develop ecological intelligence, an integrated capacity involving environmental awareness, ecological sensitivity, and sustainable behavioral decision-making. Goleman (2009) explains that ecological intelligence enables individuals to recognize ecological impacts and act responsibly toward the environment.

However, Geography instruction in many schools remains dominated by theoretical lectures and textbook-based learning. Such approaches make it difficult for

students to connect abstract concepts with real environmental phenomena. As stated by Goudie (2018), a deep understanding of environmental processes cannot be achieved without direct interaction with natural ecosystems. Studies also show that theory-centered Geography learning limits students' ecological sensitivity and problem-solving abilities related to environmental issues (Clayton, 2003; Cutter-Mackenzie & Smith, 2003).

Previous research highlights the effectiveness of experiential learning, particularly outdoor learning, in improving student engagement, conceptual understanding, and environmental attitudes. Rios & Brewer (2014) found that outdoor learning significantly increases students' comprehension of geographical concepts through direct observation and field

How to Cite:

S, N. S., Suasti, Y., Hermon, D., & Wijayanto, B. (2025). The Effectiveness of the Outdoor Study Method in Improving Students' Ecological Intelligence in Geography Learning at SMAN 6 Muaro Jambi. *Jurnal Penelitian Pendidikan IPA*, 11(12), 950–956. <https://doi.org/10.29303/jppipa.v11i12.11691>

exploration. Parker (2019) also emphasizes that outdoor study allows students to observe, explore, and reflect on real geographical phenomena, resulting in deeper and more contextualized learning. Empirical evidence by Guerrero (2024) further demonstrates that outdoor environmental education effectively enhances ecological literacy and related competencies.

Despite these insights, research examining the effectiveness of outdoor study specifically in improving ecological intelligence as a measurable integrated construct remains limited in the Indonesian context. Most previous studies focused only on environmental attitudes or interest, rather than employing a rigorous quantitative experimental design (Avcı & Gümüş, 2020). This gap indicates the need for more comprehensive empirical studies.

The novelty of this study lies in its systematic implementation of the outdoor study method and its quantitative assessment of ecological intelligence using a quasi-experimental approach. By employing pretest-posttest measurements, this research provides empirical evidence regarding the extent to which outdoor study enhances ecological intelligence. This methodological approach addresses limitations in previous research in which outdoor learning was seldom tested through robust statistical analysis (Baierl et al., 2022).

Given the increasing importance of environmental education in fostering sustainable thinking and action, this study is highly relevant. International frameworks emphasize that direct engagement with natural environments strengthens ecological awareness and environmental responsibility (Fang et al., 2022; Hu & Mou, 2025). Conducted at SMAN 6 Muaro Jambi, a school with natural surroundings conducive to outdoor learning, this research aims to contribute to the development of effective and contextualized Geography learning strategies to enhance students' ecological intelligence.

Method

This research employed a quantitative approach using a quasi-experimental non-equivalent control group design, which is appropriate when intact classes cannot be randomly assigned to different treatment groups (Sugiyono, 2022). The design consisted of two groups: an experimental group receiving outdoor study instruction and a control group receiving conventional classroom-based learning. Both groups completed a pretest before the intervention and a posttest afterward to measure changes in ecological intelligence.

The population included five eleventh-grade classes at SMAN 6 Muaro Jambi during the 2024/2025 academic year. Two intact classes were purposively

selected based on schedule availability, administrative considerations, and similarity in academic characteristics. Each class consisted of 30 students, yielding a total sample of 60 participants. One class was assigned as the experimental group and the other as the control group. A pretest was administered prior to treatment to ensure initial comparability between the two groups.

The primary instrument for measuring ecological intelligence was a five-point Likert-scale questionnaire assessing three non-cognitive dimensions: environmental awareness, ecological sensitivity, and sustainable behavioral tendencies. The indicators were based on Goleman (2009) conceptualization of ecological intelligence as an integrated capability to understand ecological impacts and act responsibly toward the environment.

The instrument underwent expert validation prior to implementation, focusing on content relevance, clarity, and construct alignment. Necessary revisions were incorporated to ensure high representativeness of each indicator. The same validated questionnaire was used in both the pretest and posttest to maintain measurement consistency and minimize bias across time.

Observation sheets were also used to document qualitative aspects of student engagement during outdoor study activities. These sheets captured behaviors such as participation, cooperation, and responsiveness to environmental stimuli. However, they served solely as supplementary descriptive data and were not used as formal quantitative measurement tools in hypothesis testing.

The research procedure consisted of three major stages that were align with the quasi-experimental design: preparation, implementation, and evaluation. These stages are visually summarized in Figure 1, placed following the Methods section and before the Results section.

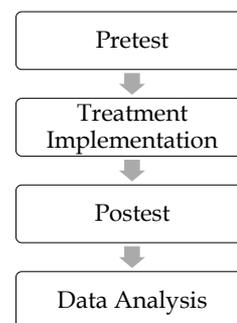


Figure 1. Research Procedure Flowchart

During the preparation stage, the researcher developed detailed lesson plans for both the outdoor study activities and the conventional learning sessions. Instschoolvalidation, permission arrangements with the

school, preparation of field activity logistics, student briefings, and safety planning were also conducted to ensure the intervention proceeded effectively.

The implementation stage began with the administration of the pretest to both groups. The experimental group then participated in outdoor study activities that involved direct field observation of vegetation, water quality characteristics, and microhabitats; identification of ecological problems; group-based data collection; and structured field discussion. These activities were designed following principles of experiential and outdoor learning (Mann et al., 2023; Parker, 2019). To provide visual clarity regarding the nature of the intervention, Figure 2 displays photographic documentation of the outdoor learning process, showing students conducting field exploration and interacting with ecological objects.



Figure 2. Outdoor Study Activities Conducted by Students at SMAN 6 Muaro Jambi.

In contrast, the control group received conventional classroom-based instruction consisting of teacher explanations, textbook learning, and guided in-class discussion. After all instructional activities were completed, both groups were administered the posttest using the same ecological intelligence instrument.

Data analysis included descriptive statistics, normalized gain (N-Gain), and ANCOVA to control for pretest differences. Assumption testing used Shapiro-Wilk for normality and Levene’s Test for homogeneity. All assumptions were met, enabling ANCOVA as the primary inferential analysis. This statistical approach aligns with quasi-experimental standards (Letourneau, 2024). First, descriptive statistics were used to summarize pretest and posttest performance. The degree of improvement was initially examined using gain scores and the Normalized Gain (N-Gain) Formula 1.

$$g = \frac{\text{Posttest} - \text{Pretest}}{\text{max} - \text{Pretest}} \quad (1)$$

This calculation provided a proportional indicator

of improvement relative to the maximum possible score. Although N-Gain supported preliminary interpretation, the main hypothesis test was conducted using ANCOVA to control pretest differences, which is the most appropriate analytic technique for non-equivalent groups.

Before conducting ANCOVA, assumption testing was performed. The normality of data distributions for both groups was assessed using the Shapiro-Wilk test, expressed mathematically as represented by Formula 2.

$$w = \frac{(\sum_{i=1}^n a_i x_{(i)})^2}{\sum_{i=1}^n (x_i - \bar{x})^2} \quad (2)$$

The resulting significance values exceeded 0.05 for both pretest and posttest scores, indicating normally distributed data. Homogeneity of variance between groups was evaluated using Levene’s Test, estimated using Formula 3.

$$F = \frac{(N-k)}{(k-1)} \cdot \frac{\sum_{i=1}^k N_i (Z_i - \bar{Z})^2}{\sum_{i=1}^k \sum_{j=1}^{N_i} (Z_{ij} - Z_i)^2} \quad (3)$$

The resulting significance value of 0.219 indicated equal variances between groups. Additionally, the homogeneity of regression slopes assumption—a prerequisite for ANCOVA—was tested and confirmed, ensuring that the relationship between pretest and posttest scores was parallel across groups. Because all assumptions were met, the main inferential test proceeded using ANCOVA.

ANCOVA was performed using the posttest score as the dependent variable, the instructional method (outdoor study vs. conventional) as the independent variable, and the pretest score as the covariate. The ANCOVA model followed Formula 4.

$$Y_{ij} = \mu + \tau_i + \beta(X_{ij} - \bar{X}) + \varepsilon_{ij} \quad (4)$$

ANCOVA calculated adjusted mean posttest scores, F-statistics, p-values, and effect sizes (partial eta squared). This analytical method allowed the researcher to determine whether the outdoor study method produced a statistically significant increase in ecological intelligence after controlling for initial group differences. The ANCOVA results demonstrated a significant effect on the outdoor study intervention, fully consistent with the descriptive gains reported earlier.

Ethical procedures were followed throughout the research. Students were informed about the study’s purpose and procedures, participation was voluntary, and confidentiality of student identity was maintained. Permission to conduct the study was formally granted by school administration.

Through these comprehensive methodological procedures—sampling, measurement consistency, structured intervention, assumption testing, and ANCOVA analysis—the study established strong internal validity and ensured accurate evaluation of the effectiveness of the outdoor study method in enhancing students’ ecological intelligence.

Results and Discussion

This study was conducted in two eleventh-grade classes at SMAN 6 Muaro Jambi during the 2024/2025 academic year with a total of 60 students, consisting of 30 students in the experimental class and 30 students in the control class. The experimental class received instruction using the outdoor study method, while the control class taught geography through conventional classroom-based learning. Prior to the implementation of the treatment, both groups were given a pretest to

measure their initial level of ecological intelligence. After the instructional intervention was completed, both groups administered a posttest to identify changes in ecological intelligence levels.

The findings revealed that the experimental group had a slightly higher pretest mean than the control group, although the difference was relatively small. After the outdoor study activities were implemented, the experimental group exhibited a substantially greater improvement in scores compared to the control group (Lacoste et al., 2021; Latino et al., 2023). The mean pretest score of the experimental group was 41.23, which increased significantly to 84.66 on the posttest. Meanwhile, the control group improved from a pretest mean of 39.54 to a posttest mean of 72.14. These results indicate that the outdoor study method contributed more effectively to enhancing students’ ecological intelligence than conventional classroom learning.

Table 1. Results of the Normality Test for Pretest and Posttest Data

Group	Type of test	Mean	SD	D count	D table	Description
Experiment	Pretest	62.10	6.98	0.968	0.935	Normal
	Posttest	86.70	6.79	0.972	0.935	Normal
Control	Pretest	57.43	5.60	0.963	0.935	Normal
	Posttest	69.13	6.33	0.957	0.935	Normal

The results of the normality test using the Shapiro-Wilk procedure for the pretest and posttest ecological intelligence data are presented in Table 2. Based on the table, the pretest data of the experimental group, which had a mean of 62.10 and a standard deviation of 6.98, produced a D-calculated value of 0.968. This value was greater than the D-table value of 0.935 at the 5% significance level, indicating that the pretest scores of the experimental group were normally distributed. A similar finding was observed for the posttest data of the experimental group, which had a mean of 86.70 and a standard deviation of 6.79, yielding a D-calculated value

of 0.972 that exceeded the D-table value.

The control group showed the same pattern. The pretest data, with a mean of 57.43 and a standard deviation of 5.60, produced a D-calculated value of 0.963, which was higher than the D-table value, thus indicating normal distribution. The posttest data of the control group were also normally distributed, as evidenced by a D-calculated value of 0.957 that exceeded the D-table value.

Therefore, all pretest and posttest data in both groups met the normality assumption required for parametric statistical analysis.

Table 2. Results of the Homogeneity of Variance Test of Ecological Intelligence Pretest and Posttest

Variable	N (Experiment/Control)	F Count	F Table	Description
Pretest	30 / 30	1.17	4.01	Homogen
Posttest	30 / 30	1.54	4.01	Homogen

Furthermore, the results of the homogeneity of variance test are presented in Table 2. The homogeneity test was conducted to determine whether the variances of the experimental and control groups were equivalent before and after the treatment. The pretest homogeneity test produced an F-calculated value of 1.17, while the F-table value at the 5% significance level with degrees of freedom (df1 = 1 and df2 = 58) was 4.01. Since the F-calculated value was lower than the F-table value, the pretest variances of the two groups were declared

homogeneous. A similar condition was found in the posttest data, where the F-calculated value of 1.54 was also smaller than the F-table value. Therefore, the posttest variances were likewise homogeneous.

These results indicate that both before and after the intervention, the experimental and control groups had comparable variances. Because the assumption of homogeneity was fulfilled, further analysis using ANCOVA could be conducted appropriately.

Table 3. ANCOVA Results

Variance	JK Tipe III	df	MK	F	Sig
Pretest (covariate)	5956.12	1	5956.12	162.44	0.000
Method (experiment vs Control)	2025.44	1	2025.44	55.21	0.000
Error	2094.53	57	36.74		
Total	32312.0	60			

ANCOVA was conducted to examine the effectiveness of the outdoor study method while controlling initial differences in ability using pretest scores as a covariate. The ANCOVA results showed that the covariate (pretest) had a significant effect on the posttest scores ($F = 162.44$, $p < 0.001$). After controlling for initial ability, the instructional method produced a significant effect on students' ecological intelligence ($F = 55.21$, $p < 0.001$). The partial eta squared value of 0.492 indicates that the learning method accounted for nearly 49% of the variation in the posttest scores, which falls within the category of a large effect.

The adjusted means also revealed a significant difference between the two groups. The experimental group obtained an adjusted mean of 84.66, which was substantially higher than the control group, which had an adjusted mean of only 72.14.

The results of this study clearly demonstrate that the outdoor study method has a significant effect on improving students' ecological intelligence. Environment-based learning allows students to engage directly with real ecological objects, such as vegetation, soil conditions, water sources, and ecological activities surrounding the school environment (Andriani et al., 2025; Dillon & Herman, 2023; Waite, 2011). This direct interaction provides authentic experiences that cannot be obtained through conventional classroom-based instruction.

This finding is consistent with Kolb (1984) experiential learning theory, which states that effective learning occurs when learners undergo a cycle of concrete experience, reflection, conceptualization, and application (Williams & Dixon, 2013). In the outdoor study approach, students engage in field observations, record ecological findings, discuss environmental changes, and reflect on ecological behaviors in everyday life (Ayotte-Beaudet et al., 2023; Zimmerman & Land, 2022). These stages reinforce conceptual understanding while simultaneously developing emotional awareness toward environmental issues.

From the perspective of ecological intelligence, Goleman (2009) explains that ecological intelligence involves the integration of environmental understanding, emotional awareness, and the capacity to make responsible and sustainable behavioral choices. Outdoor study plays a crucial role in activating these components simultaneously because it exposes students to real ecological conditions rather than abstract

representations (Eriksson et al., 2023; Gilbertson et al., 2022). Through direct field engagement, students not only construct stronger conceptual knowledge but also develop emotional sensitivity toward ecological issues and a reflective awareness of their relationship with the environment, ultimately encouraging more responsible environmental behavior.

This result is further supported by previous research by Kaplan & Kaplan (1989), which suggests that direct engagement with nature strengthens emotional attachment to the environment, promotes positive ecological behavior, and enhances ecological empathy. Clayton (2003) also emphasizes that direct interaction with physical environments can increase an individual's environmental identity.

Methodologically, the use of ANCOVA provides more accurate results than a simple t-test because it can control initial differences in ability, which commonly occur in quasi-experimental designs. Therefore, the differences in posttest scores can be attributed to the outdoor study intervention rather than to variations in students' initial abilities.

Overall, this study demonstrates that outdoor study not only enhances cognitive aspects but also develops effective and behavioral dimensions of sustainable ecological intelligence. Therefore, this method is highly relevant for geography learning and environmental education in secondary schools. The implication is that teachers should incorporate more environment-based learning activities, especially those that integrate direct observation, ecological phenomenon analysis, and reflective practice.

Conclusion

The results of this study indicate that the outdoor study method is an effective instructional approach for improving students' ecological intelligence in geography learning. After controlling initial differences through ANCOVA, students who participated in outdoor activities demonstrated higher levels of ecological awareness, sensitivity, and environmentally responsible behavioral tendencies compared with those who received conventional classroom instruction. These improvements reflect the value of experiential learning, in which direct interaction with real environmental phenomena and guided reflection enables students to build deeper ecological understanding and internalize

pro-environmental attitudes. Aligned with the study's quantitative design, these findings confirm that outdoor study meaningfully strengthens the non-cognitive dimensions of ecological intelligence measured through the validated Likert-scale instrument. Overall, this research supports the integration of outdoor, environment-based learning as a pedagogical strategy that enriches geography education and promotes the development of ecologically conscious learners in secondary schools.

Acknowledgments

The researcher would like to express sincere gratitude to the principal of SMAN 6 Muaro Jambi, as well as the teachers and students, for providing the opportunity and support needed to carry out this study on the effectiveness of the outdoor study method in enhancing students' ecological intelligence in Geography learning. Their cooperation and willingness to participate made this research possible.

Author Contributions

Conceptualization; Methodology; Formal Analysis: N. S; Investigation: Y. S; Writing- Original Draft: D. H.; Writing- Review & Editing: B. W Supervision: N.S.

Funding

No external Funding.

Conflicts of Interest

No Conflict of Interest.

References

- Andriani, N., Maison, & Nazarudin. (2025). Activities, Resources, and Learning Environment: A Case Study of Science Learning at Sekolah Alam. *Jurnal Penelitian Pendidikan IPA*, 11(1), 1075-1091. <https://doi.org/10.29303/jppipa.v11i1.9569>
- Avci, G., & Gümüş, N. (2020). The effect of outdoor education on the achievement and recall levels of primary school students in social studies course. *Review of International Geographical Education Online*, 10(1 (Special Issue)), 171-206. <https://doi.org/10.33403/rigeo.638453>
- Ayotte-Beaudet, J. P., Chastenay, P., Beaudry, M. C., L'Heureux, K., Giamellaro, M., Smith, J., & Paquette, A. (2023). Exploring the impacts of contextualised outdoor science education on learning: the case of primary school students learning about ecosystem relationships. *Journal of Biological Education*, 57(2), 277-294. <https://doi.org/10.1080/00219266.2021.1909634>
- Baierl, T.-M., Johnson, B., & Bogner, F. X. (2022). Informal Earth education: Significant shifts for environmental attitude and knowledge. *Frontiers in Psychology*, 13, 819899. <https://doi.org/10.3389/fpsyg.2022.819899>
- Clayton, S. (2003). Environmental identity: A conceptual and an operational definition. In *Identity and the natural environment: The psychological significance of nature* (pp. 45-65). MIT Press.
- Cutter-Mackenzie, A., & Smith, R. (2003). Ecological literacy: The 'missing paradigm' in environmental education (part one). *Environmental Education Research*, 9(4), 497-524. <https://doi.org/10.1080/1350462032000126131>
- Dillon, J., & Herman, B. (2023). Environmental education. In *Handbook of research on science education* (pp. 717-748). Routledge. <https://doi.org/10.4324/9780367855758-27>
- Eriksson, M., Kärkkäinen, S., & Tahvanainen, V. (2023). Technology-mediated outdoor learning for primary school student teachers: Focusing on biodiversity. *Journal of Computer Assisted Learning*, 39(6), 1819-1833. <https://doi.org/10.1111/jcal.12841>
- Fang, W.-T., Hassan, A., & LePage, B. A. (2022). Outdoor education. In *The Living Environmental Education* (pp. 135-154). Springer. https://doi.org/10.1007/978-981-19-4234-1_8
- Gilbertson, K., Ewert, A., Siklander, P., & Bates, T. (2022). *Outdoor education: Methods and strategies*. United State: Human Kinetics.
- Goleman, D. (2009). *Ecological intelligence: How knowing the hidden impacts of what we buy can change everything*. Broadway Books.
- Goudie, A. (2018). *The human impact on the natural environment: Past, present and future* (8th ed.). Wiley-Blackwell.
- Guerrero, G. (2024). *Critical scientific and environmental literacies: Exploring opportunities from outdoor education* [Thesis: UCL (University College London)]. Retrieved from <https://discovery.ucl.ac.uk/id/eprint/10200507/>
- Hu, R., & Mou, S. (2025). Outdoor education for sustainable development: A systematic literature review. *Sustainability*, 17(8), 3338. <https://doi.org/10.3390/su17083338>
- Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge University Press.
- Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.
- Lacoste, Y., Dancause, K., Bernard, P., & Gadais, T. (2021). A quasi-experimental study of the effects of an outdoor learning program on physical activity patterns of children with a migrant background: the PASE study. *Physical Activity and Health*, 5(1). <https://doi.org/10.5334/paah.133>
- Latino, F., Saraiello, E., & Tafuri, F. (2023). Outdoor Physical Activity: A Training Method for Learning

- in an Experiential and Innovative Way. *Journal of Physical Education and Sport*, 23(7), 1852–1860. <https://doi.org/10.7752/jpes.2023.07225>
- Letourneau, S. (2024). Outdoor education is essential: Increased exposure to nature reduces students' anxiety and increases classroom engagement. *Arca: Discover BC's Digital Treasures*. Retrieved from <https://arcabc.ca/islandora/object/tru%3A6509>
- Mann, J., Gray, T., & Truong, S. (2023). Does growth in the outdoors stay in the outdoors? The impact of an extended residential and outdoor learning experience on student motivation, engagement and 21st century capabilities. *Frontiers in Psychology*, 14, 1102610. <https://doi.org/10.3389/fpsyg.2023.1102610>
- Parker, C. (2019). *Teaching geography outdoors: A practical guide for educators*. Sage Publications.
- Rios, J. M., & Brewer, J. (2014). Outdoor education and science achievement. *Applied Environmental Education & Communication*, 13(4), 234–240. <https://doi.org/10.1080/1533015X.2015.975084>
- Sugiyono. (2022). *Metode Penelitian Pendidikan: Pendekatan Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.
- Waite, S. (2011). Teaching and learning outside the classroom: Personal values, alternative pedagogies and standards. *Education*, 39(1), 65–82. <https://doi.org/10.1080/03004270903206141>
- Williams, D. R., & Dixon, P. S. (2013). Impact of garden-based learning on academic outcomes and environmental attitudes: A meta-analysis. *Journal of Environmental Education*, 44(4), 270–284. <https://doi.org/10.3102/0034654313475824>
- Zimmerman, H. T., & Land, S. M. (2022). Supporting children's place-based observations and explanations using collaboration scripts while learning-on-the-move outdoors. *International Journal of Computer-Supported Collaborative Learning*, 17(1), 107–134. <https://doi.org/10.1007/s11412-022-09366-w>