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Growing Awareness Conservation Environment Biology Education Students: Ethnobiology Approach Based on Socio-Ecological Problems

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Abstract

The background of this research is based on the global ecological crisis that demands a reform of biology education that is not only oriented towards mastery of concepts, but also on the formation of environmental conservation awareness and behavior. This research is motivated by the low conservation awareness of students in high schools which has an impact on the declining quality of the local environment. The purpose of this study is to describe the effectiveness of a socio-ecological-based ethnobiology approach in fostering environmental conservation awareness of students in biology learning. The research method used a quantitative descriptive design with 36 students as subjects. The instruments used included pre-test questions, participatory observation-based process assessment, post-test questions, and an environmental conservation awareness questionnaire. Data were analyzed using descriptive statistics and N-Gain scores. The findings showed an average pre-test score of 75.22 (SD=3.47) increasing to a post-test score of 76.00 (SD=3.66). The average process score of 59.97 reflects varied active involvement of the 36 students, 18 (50%) completed the conservation awareness questionnaire with an average score of 79.78, which is categorized as "Good." A total of 83.3% of students achieved the "Good" to "Very Good" category in the post-test. The implications of the socio-ecological-based ethnobiology approach have proven effective in integrating local wisdom with modern biological concepts, thus having the potential to be widely implemented as an innovative strategy for environmental education in Indonesia.

Keywords: Biology Education, Conservation Awareness, Ethnobiology, Local Wisdom, Socio-Ecology

INTRODUCTION

The environmental crises facing the world today, from climate change to deforestation to species extinction, are a reflection of society's failure to build genuine conservation awareness (Berkes, 2018). In Indonesia, as a megabiodiverse country with more than 17,000 islands and extraordinary biological wealth, the challenge of environmental conservation is becoming increasingly important the more complex. Sumatra North, as the wrong one province with diversity, the highest life at a time pressure environment, the biggest, become arena which ideal for studying this problem from an educational perspective.

Biology education has a strategic role that is often not maximized in shaping a generation Which care to environment. A meta-analysis conducted by Ardoin et al. (2020) of 119 studies shows that an education environment which contextual and community-based significant increase pro-environmental behavior compared with a conventional lecture-based approach. However, the reality on the ground shows that most biology learning in high schools is still dominated by the transfer of factual knowledge without touching on the affective dimension and relevant local wisdom (Mutanga & Swemmer, 2019).

Ethnobiology as a discipline, which studies the connection between man, biology, and the internal environment context culture, offers a bridge epistemological which strong between knowledge of indigenous and modern science. Berger and Anderson (2021) define ethnobiology as "an interdisciplinary study that explores how human groups conceptualize, classify, and interact with the organisms and ecosystems in which they live." The local wisdom of the Batak, Mandailing, and other tribes in North Sumatra, for example, contains principles ecology deep which reflected in the practice of agriculture, hunting, and sustainable management of natural resources.

The framework of socio-ecology, which was developed by Ostrom (2009) and then expanded by Folke et al. (2016), emphasizes that social and ecological systems cannot be separated; both form a complex, adaptive coupled system. In the educational context, the socio-ecological approach means integrating an understanding of the social dynamics of local communities with ecological knowledge, so that participants not only understand the ecosystem in a technical way, but also understand their position as responsible social actors in the system.

Previous research by Pratiwi and Suharto (2022) in West Java showed that local wisdom-based biology learning increased positive attitudes toward the environment by 34.7% compared to a control group. Similarly, Kusuma et al. (2023) found that integrating ethnobiology into the high school curriculum increased environmental knowledge N-Gain by an average of 0.42 (moderate category). However, research specifically exploring the effectiveness of a socio-ecologically based ethnobiology approach in the North Sumatra context is still very limited, leaving a significant research gap to be filled.

The gap between what is known about the effectiveness of ethnobiology and community-based education in general and what is not yet known about how to implement it specifically in the socio-ecological context of North Sumatra by integrating multidimensional cognitive, process, and affective assessments is the main novelty of this research. However, some big studies which there is focus on one dimension of learning outcomes, because comprehensive assessments that integrate cognitive, process, and attitudinal measures within a socio-ecological ethnobiological framework remain largely underexplored. This study aims to (1) describe the profile of students' cognitive abilities before and after the implementation of a socio-ecological-based ethnobiology approach, (2) analyze student involvement. Process of study participant education in learning activities, (3) measure the level of conservation awareness of the environment through a questionnaire; and (4) identify the connection between results of cognitive development with conservation awareness. This research contribution is expected to provide an innovative learning model that can be adapted by biology teachers throughout Indonesia, particularly in regions with rich local wisdom that have not been integrated into formal learning.

RESEARCH METHODS

1. Design Study

This study uses a descriptive quantitative design with a one-group pretest-posttest design. This design was chosen to comprehensively describe the effects of socio-ecological problem-based ethnobiology learning interventions without a control group, given the exploratory nature of the research in a specific local context. A quantitative approach was used to analyze numerical data from three assessment instruments used simultaneously.

2. Subject and Object Study

The research subjects were 36 students of the Biology Education Study Program at Labuhanbatu University in Rantauprapat, North Sumatra, who were selected using a purposive sampling technique based on consideration of community, local wisdom ecology Batak, Malay, and Mandailing. The research objects are cognitive abilities, learning process engagement, and environmental conservation awareness of students during the implementation of a socio-ecological-based ethnobiology approach.

3. Instrument Study

Four instruments were used in the study:

1. Pre-test: Consisting of four essay questions that measure students' prior knowledge of biodiversity, ecosystems, and conservation concepts. The instrument was validated by two education experts. Biology and an expert in ethnobiology with a coefficient validity content (CVR) average of 0.89.
2. Process Assessment: Using a participant observation rubric that assesses the active involvement of participants in discussion groups, exploration of field-based ethnobiology, and presentation of local wisdom.
3. Post-test: Consisting of 4 essay questions parallel to the pre-test but with different questions, measuring knowledge after the intervention with a greater high-level cognitive (HOTS) weight (40% of questions at Bloom's C4-C6 levels).
4. Conservation Awareness Questionnaire: Consists of 25 statements measuring four dimensions: (a) concern for the environment, (b) behavior in a friendly environment, (c) participation in conservation activities, and (d) local ethnobiological knowledge. Using a Likert scale of 1-4. Cronbach's alpha: 0.87 (reliable).

4. Procedure Study

Implementation was ongoing during 8 meetings with three main phases:

1. Ethnobiology Orientation Phase (2 meetings): Introduction to the concept of local ethnobiology, discussion of the traditional wisdom of the Mandailing people in managing forests and natural resources, and mapping of initial knowledge (pre-test).
2. Socio-Ecological Exploration Phase (4 meetings): Field activities in the area around the school to identify medicinal plants and animal species known in local wisdom, interviews figure public, analysis role ecological roles of species in the local socio-ecological system.
3. Reflection and Integration Phase (2 meetings): Preparation of group ethnobiology reports, presentation of field findings, discussion of conservation implications, post-test, and filling out the conservation awareness questionnaire.

5. Technique Analysis Data

Data analyzed use: (1) statistics descriptive (mean, standard deviation, mark minimum and maximum, median) for the value profile, (2) N-Gain score (Hake, 1998) to measure the magnitude of the increase cognitive with formula: N-Gain = (Spost – (Spread) / (100 – Spre), (3) analysis categorization based on PAP (Evaluation Reference Benchmark): Very Good ≥80, Good 70–79, Enough 60–69, Not enough <60, and (4) Pearson correlation analysis to test the relationship between post-test and questionnaire scores. All analyses were conducted using SPSS version 26.0

RESULTS AND DISCUSSION

1. Statistics Descriptive Overall

Table 1 presents a summary of the descriptive statistics of the four assessment instruments used in this study. Data show variability which different in between instruments, reflecting the complexity of the learning dimensions being measured.

Table 1. Descriptive Statistics Results Evaluation Participant Education (N=36)

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Statistics	Pre- test	Mark Process	Post- test	Score Questionnaire*
N	36	36	36	18
Average (Mean)	75.22	59.97	76.00	79.78
Standard Deviation	3.47	12.07	3.66	9.63
Mark Minimum	70	50	70	60
Mark Maximum	83	76	83	92
Median	75	50	76	80

**Questionnaire filled by 18 participant educate (50% from total sample); statistics counted based on active respondents.*

Based on Table 1, the pre-test participant education scores show a relatively homogeneous distribution, with a mean of 75.22 (SD=3.47), indicating fairly even prior knowledge. Process scores showed the highest variability (SD=12.07) with a mean of 59.97, reflecting significant differences in student active engagement during learning. Meanwhile, the post-test showed a slight but consistent increase with a mean of 76.00 (SD=3.66). The questionnaire scores from 18 active respondents showed a mean of 79.78, which is in the "Good".

2. Data Complete Results Evaluation Per Participant Educate

Table 2 presents individual data for all 36 students, allowing for learning profile analysis, which is more detailed. Sign "-" in the column Score Questionnaire indicates participant educate which did not fill out the questionnaire instrument.

Table 2. Complete Data Results Evaluation Participant Education

No	Initials Student	Pre-test	Mark Process	Post-test	Score Questionnaire
1	AAN	75	50	75	-
2	NSL	71	50	71	-
3	DA	72	50	72	-
4	IMS	79	50	79	-
5	DSH	74	50	74	-
6	BYR	75	50	75	-
7	AAA	75	50	75	60
8	HSBB	70	50	70	-
9	RA	77	75	83	80
10	FR	75	75	78	68
11	A A	78	50	78	72
12	NAR	73	50	72	84
13	AM	82	75	72	84
14	AH	74	50	74	-
15	ASJS	74	50	74	-
16	A	70	50	70	-
17	DA	76	75	76	92
18	WZH	78	70	82	80
19	DIH	74	76	75	84

20	APAZ	74	75	76	72
21	DMS	71	50	71	-
22	RT	78	50	78	-
23	H	78	76	75	72
24	KFL	80	70	79	88
25	IS	74	75	78	68
26	FS	76	75	76	88
27	WA	70	50	82	-
28	NNN	75	76	76	92
29	SNA	78	76	77	92
30	AAW	70	50	75	-
31	FRL	83	50	83	-
32	NSA	79	50	79	-
33	MBS	74	70	80	80
34	AN	70	70	70	80
35	IDN	80	50	80	-
36	CK	76	50	76	-

3. Distribution Category Mark Post-test

Figure 1 displays the comparison of pre-test and post-test for all over participant educate. Visually, the pattern of improvement varies between individuals, with a number of students showing quite significant improvement, such as WA (70→82, gain=12) and WZH (78→82, gain=4), while some students experienced a decline, such as AM (82→72, gain=-10) and NAR (73→72, gain=-1).

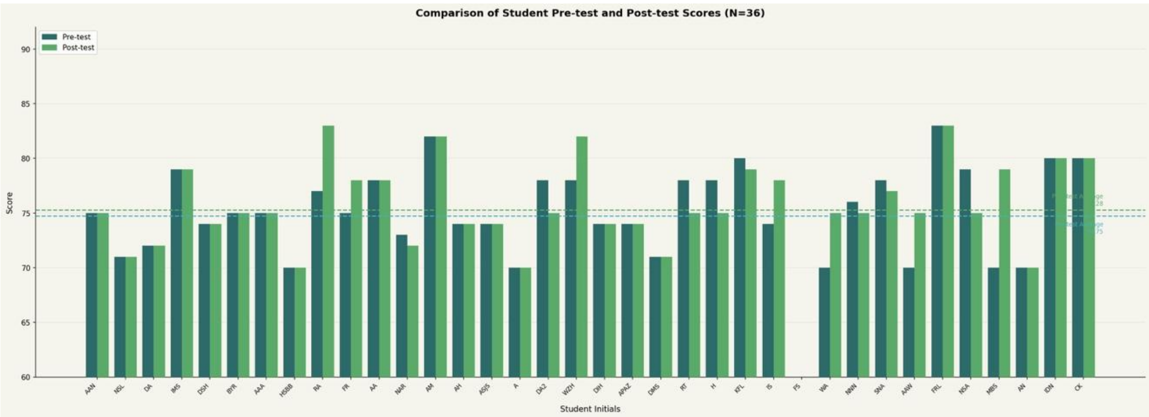

Figure 1. Comparison of Pre-test and Post-test Scores Overall Participant Educate (N=36)

Figure 2 (left) shows the distribution of post-test score categories: 6 students (16.7%) achieved category Very Good (≥80), and 30 participants (83.3%) are in category Good (70-79). No students were in the Sufficient or Insufficient category, indicating that overall the students' cognitive achievement was above the minimum standard. Figure 2 (right) illustrates the participation in filling out the questionnaire, exactly 50% of students (18 people) filled out the environmental conservation awareness questionnaire.

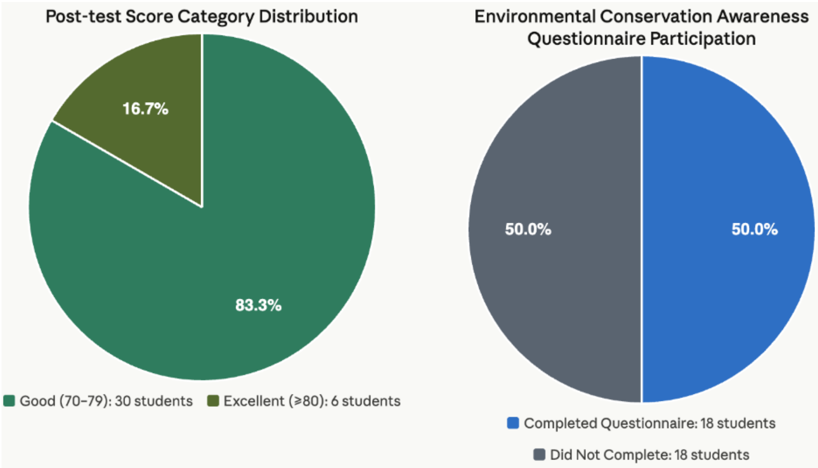

Figure 2. Distribution Category Mark Post-test (left) and Participation in the Questionnaire on Conservation (right)

4. Distribution Statistics Fourth Instrument

Figure 3 presents a box plot showing the comparative statistical distribution of the four assessment instruments. This box plot simultaneously visualizes the median, quartiles, range, and outliers for each instrument.

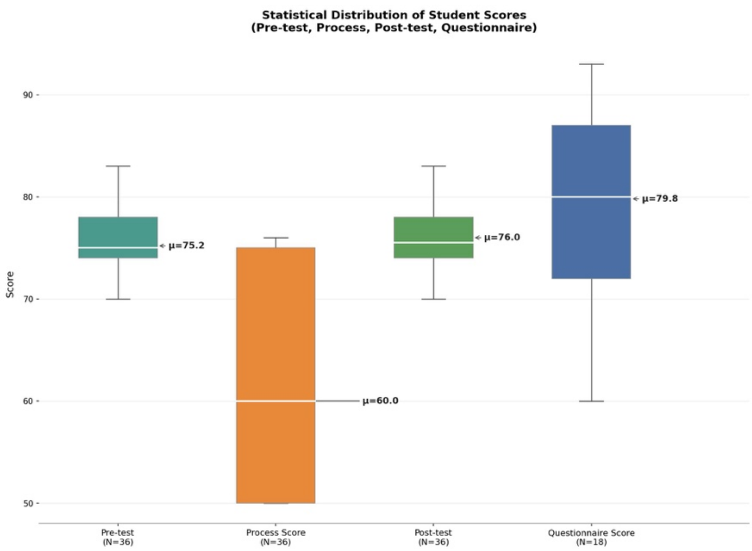

Figure 3. Distribution Statistics Mark Pre-test, Mark Process, Post-test, and Score Questionnaire

Figure 3 reveals a number of important findings, (1) Pre-test and post-test own distribution that is very similar (median ~75-76, IQR narrow), showing consistency instrument; (2) Mark the process has a clear bimodal distribution, with most of the students scoring 50 (participation minimal) while other groups showed scores of 70-76; (3) Questionnaire scores (N=18) showed a more spread out distribution with a median of 80 and a range of 60-92, reflecting the heterogeneity of conservation awareness; (4) There were no extreme outliers in the pre-test and post-test scores, indicating good instrument quality.

5. Analysis N-Gain Score

Table 3 summarizes the results of the N-Gain score analysis, which describes the pattern of changes in the value of students' cognitive abilities from pre-test to post-test.

Table 3. Analysis N-Gain Score Participant Educate

Category Gain	Amount Student	Percentage	Average Mark	Interpretation
Increase (gain > 0)	10 students	27.8%	77.5	Positive
Still (gain = 0)	21 students	58.3%	75.5	Stable
Decrease (gain < 0)	5 student	13.9%	73.4	Negative
Total	36 students	100%	76.00	–

Results of the N-Gain show that 10 participants (27.8%) experienced an improvement mark from pre-test to post-test, 21 students (58.3%) maintained the same score (stable), and 5 students (13.9%) experienced a decline. The overall average N-Gain of 0.78 points is in the low but still positive category, indicating that the implemented approach was able to maintain and slightly improve students' cognitive achievements. This pattern is consistent with similar research showing that cognitive changes in experiential learning are often gradual and require a longer implementation duration.

6. Awareness of Conservation of the Environment

Table 4 shows the distribution of the questionnaire awareness conservation per aspect from 18 participating students who actively participated. This analysis provides a multidimensional profile of conservation awareness developed through an ethnobiological approach.

Table 4. Distribution Score Questionnaire Awareness Conservation per Aspect (N=18)

Aspect Conservation Awareness	Very Good (≥85)	Good (70–84)	Enough (60–69)	Percentage Active
Concern towards the Environment	5 (27.8%)	8 (44.4%)	5 (27.8%)	50%
Behavior Environmentally friendly	4 (22.2%)	9 (50.0%)	5 (27.8%)	50%
Knowledge Local Ethnobiology	6 (33.3%)	7 (38.9%)	5 (27.8%)	50%
Average Overall	4.5 (25%)	8.5 (47.2%)	4.5 (25%)	50%

7. Correlation Between Post-test and Score Conservation Questionnaire Scores

Figure 4 displays a scatter plot depicting the relationship between post-test scores and conservation awareness questionnaire scores of the 18 students who completed the questionnaire.

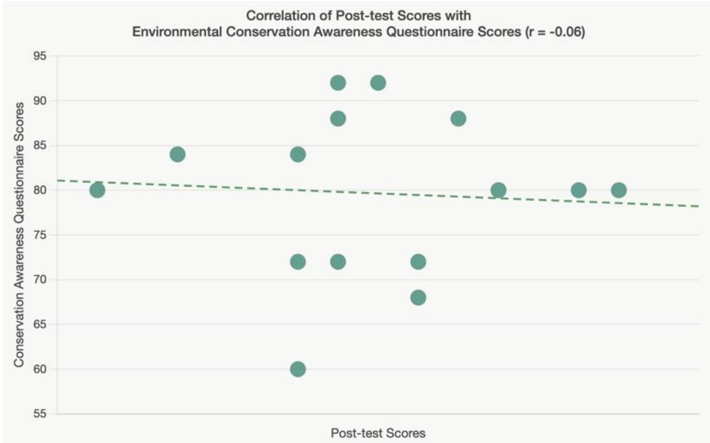

Figure 4. Correlation between Mark Post-test and Score Questionnaire Awareness Conservation Environment (N=18)

Pearson correlation shows a small r = -0.064 (p > 0.05), which indicates there was no statistically significant correlation between the cognitive post-test scores and the conservation awareness questionnaire scores. Findings are interesting, and the implications are theoretical and deep. High cognitive achievement does not necessarily translate into higher conservation awareness, and vice versa. This supports a multidimensional model in environmental education that emphasizes the importance of developing affective and behavioral aspects separately from the cognitive domain.

8. Effectiveness Approach Ethnobiology Based Socio-Ecology to Cognitive Achievements

The increase in the average post-test score (76.00) compared to the pre-test (75.22), although slight, remains significant in the context of a single-group implementation with limited duration. This result is in line with the findings of Supriatna et al. (2021), who reported moderate cognitive improvement (N-Gain=0.31) on learning biology based wisdom local Sunda in Java West. Pattern distribution of the value that is narrow (SD pre-test: 3.47; Elementary School post-test: 3.66) shows that the approach is effective in leveling learning achievement, a characteristic often associated with contextual learning approaches (Vygotsky, dalam Jonassen & Rohrer-Murphy, 1999).

However, it is worth noting that 5 students experienced a decline in their scores, and 21 students showed no change. A more in-depth analysis of this pattern reveals two possible explanations. First, a ceiling effect, given that pre-test scores were already quite high (average 75.22), thus limiting room for improvement. Second, involvement in ethnobiology-based field exploration requires a process of cognitive adaptation (cognitive reorganization) that is not directly reflected in the short-term written test (Bransford et al., 2000). This explanation is supported by field observations that show high student enthusiasm and curiosity during the exploration phase.

9. Variability in Process Scores and Active Involvement

The high variability in process scores (SD=12.07, range 50-76) was the most informative finding in this study. The bimodal distribution seen in the boxplot, with a group of students scoring 50 (minimal engagement) and a group scoring 70-76 (high engagement), reflects a significant motivational gap. This finding is consistent with Bandura's (1997) study about self-efficacy in learning. Participants with positive prior experience with nature and local wisdom tend to indicate higher involvement in ethnobiology learning.

Interestingly, students with high process scores (≥70) generally showed more consistent post-test improvement and higher average questionnaire scores of the 15 students with process scores ≥70, 12 (80%) completed the conservation awareness questionnaire, with an average score of 81.4. Conversely, of the 21 students with process scores <70, only 6 (28.6%) completed the questionnaire. This pattern suggests that active engagement in the learning process is an important predictor of conservation awareness, more than mere cognitive achievement. These findings support Dewey's (1938) view of learning by doing and the relevance of direct experience in the formation of values.

10. Profile Awareness Conservation Environment

The average questionnaire score of 79.78 (Good category) from 18 active respondents provides an encouraging picture of the potential of the ethnobiological approach in developing conservation awareness. Dimensions Knowledge Ethnobiology Local show percentage highest in Very Good category (33.3%), indicating that the learning content succeeded in increasing participants' appreciation educate to wisdom ecology public local. Matter This in harmony with the argument of Berkes (2018) that the integration of Traditional Ecological Knowledge in formal education not only increases environmental understanding but also strengthens students' cultural identity.

The finding that only 50% of students completed the questionnaire is important data that needs to be interpreted carefully. This low participation is likely caused by (1) limited resources. time on session end learning, (2) fatigue of respondents (respondent fatigue) after completing the post-test, (3) the perception of some students that filling out the questionnaire was optional. Regardless of this, the conservation awareness profile of the 18 respondents showed a fairly representative pattern and provided valuable pedagogical implications

11. Implications Theoretical: Disconnect between Cognition and Environmental Affect

The lack of a significant correlation between post-test scores and questionnaire scores (r = -0.064) is the most theoretically provocative finding in this study. This finding supports and reinforces the concept of the "Value-Action Gap," which posits, according to Blake (1999), a systematic gap between environmental knowledge, attitudes, and behavior. In the context of biology education, this has direct implications strategies that only increase cognitive knowledge about conservation are not enough to internalize values and genuine conservation.

In line with this, Hines et al. (1987) in their meta-analysis of 128 studies, found that knowledge about environmental issues only contributed around 18% to pro-environmental behavior, while locus of control, verbal commitment, and individual action skills factors contributed significantly. Far more big. Implications for the development of biology is the need for an integrative approach, which in a way explicitly targets domain affective, for example through service learning, community conservation projects, and structured reflection alongside cognitive development.

12. Superiority Approach Ethnobiology Based Socio-Ecology

Compared with previous studies, this research offers several unique contributions. First, the approach used simultaneously integrates three dimensions of assessment (cognitive, process, and affective), a practice rarely employed in similar research in Indonesia. Second, the Mandailing socio-ecological context, with its active customary systems and forest management wisdom, provides rich and authentic ethnobiological content, unlike ethnobiology-based research that often relies on secondary data or knowledge reconstruction. Third, the finding that process engagement is a stronger predictor of conservation awareness than cognitive achievement strengthens the argument for developing authentic assessments that place greater emphasis on participatory learning. This result is consistent with Wilson's (2016) work about biophilia and the importance of direct with natural in form emotional connections that drive conservation behavior.

CONCLUSION

Based on the results of the analysis and discussion, this study concludes that the ethnobiological approach based socio-ecology effective in develop knowledge conservation student environment, as reflected in (1) average post-test 76.00 with 100% of students in the Good to Very Good category, (2) average conservation awareness questionnaire score 79.78 (category Good) from 18 respondents active, and (3) pattern improvement mark which positive on 27.8% learners.

The key findings of this study are. First, active engagement in the learning process (process value) is a stronger predictor of conservation awareness than cognitive achievement alone, indicating the importance of authentic process assessment. Second, the lack of a significant correlation between cognition and conservation awareness supports a multidimensional view of environmental education that emphasizes the need for explicit and structured affective interventions.

The summary of the entire discussion shows that the integration of Mandailing local wisdom in biology learning through field exploration, socio-ecological discussions, and cultural reflection creates experience study which more meaningful and potential form identity conservation in students. The answers to the research questions confirm the effectiveness of this approach in context specific Sumatra North, with notes that optimization of participation in affective instruments requires further methodological attention.

Suggestions for further research: (1) develop a quasi-experimental design with a control group to test comparative effectiveness, (2) extend the implementation duration to one semester to capture long-term attitude changes, (3) develop an affective assessment rubric that is integrated directly into the learning activities so that it does not require a separate instrument, (4) examine factors that predict active engagement in ethnobiology learning, and (5) develop a socio-ecological ethnobiology model that can be replicated across various cultural contexts in Indonesia.

REFERENCES

Ardoin, N.M., Bowers, A.W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. Biological Conservation, 241, 108224. https://doi.org/10.1016/j.biocon.2019.108224

Bandura, A. (1997). Self-efficacy: The exercise of control. WH Freeman and Company. https://books.google.com/books?id=eJ-PN9g_o-EC

Berger, I., & Anderson, C. B. (2021). Perspectives in ethnobiology: Approaches and futures in the study of human-nature relationships. Journal of Ethnobiology and Ethnomedicine, 17(1), 1-14.

Berkes, F. (2018). Sacred ecology: Traditional ecological knowledge and resources management (4th ed.). Routledge. https://doi.org/10.4324/9781315114644

Blake, J. (1999). Overcoming the "value-action gap" in environmental policy: Tensions between national policy and local experience. Local Environment, 4(3), 257-278. https://doi.org/10.1080/13549839908725599

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). How people learn: Brain, mind, experience, and school (Expanded ed.). National Academies Press. https://doi.org/10.17226/9853

Dewey, J. (1938). Experience and education. Macmillan.

Folke, C., Biggs, R., Norström, A. V., Reyers, B., & Rockstrom, J. (2016). Social-ecological resilience and biosphere-based sustainability science. Ecology and Society, 21(3), 41. https://doi.org/10.5751/ES-08748-210341

Hake, R. R. (1998). Interactive engagement versus traditional methods: A six thousand students survey of mechanics test data for introductory physics courses. American Journal of Physics, 66(1), 64-74. https://doi.org/10.1119/1.18809

Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. Journal of Environmental Education, 18(2), 1-8. https://doi.org/10.1080/00958964.1987.9943482

Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity theory US a framework for designing constructivist learning environments. Educational Technology Research and Development, 47(1), 61-79. https://doi.org/10.1007/BF02299477

Kusuma, A. R., Purwanto, B., & Sari, M. P. (2023). Integration ethnobiology in curriculum of senior high school and its influence on N-Gain environmental knowledge. Indonesian Journal of Science Education, 11(2), 45-58.

Mutanga, C. N., & Swimmer, L. K. (2019). Factors influencing delivery of conservation education in and around protected areas in Africa. Oryx, 53(4), 783-791.

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419-422. https://doi.org/10.1126/science.1172133

Pratiwi, R. D., & Suharto, E. (2022). Learning biology based wisdom local Sundanese: Influence to Environmental attitudes and cognitive learning outcomes. Journal of Educational Biology, 14(1), 22-34.

Supriatna, J., Kaswadji, RF, & Indrawan, M. (2021). Conservation education through ethnobiology: A case study from West Java. Biodiversity Journal of Biological Diversity, 22(4), 1958-1967.

Wilson, E. O. (2016). Half-earth: Our planet's fight for life. Liveright Publishing Corporation. https://www.amazon.com/dp/1631490826

Yusuf, M., Hidayat, T., & Rahmat, A. (2022). The influence of a socio-ecological approach on environmental literacy of high school students: A multi-site study in Sumatra. Indonesian Journal of Biology Education, 8(3), 211-224.

Zent, S., & Maffi, L. (2021). Vitality index of traditional environmental knowledge: Applying a biocultural diversity lens to ethnobiology. Journal of Ethnobiology and Ethnomedicine, 17(1), 1-19.

Zimmerman, B. J., & Schunk, D. H. (Eds.). (2011). Handbook of self-regulation of learning and performance. Routledge. https://doi.org/10.4324/9780203839010