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INTEGRATING CONSERVATION EDUCATION IN BIOLOGY: COMMUNITY AWARENESS OF LONG-TAILED MACAQUE CONSERVATION

Haruji Satianugraha[1], **Agus Prianto**[2]

[12] Biology Education Study Program, Faculty of Teacher Training and Education, Universitas Kuningan

Email: haruji.satianugraha@uniku.ac.id, agus.prianto@uniku.ac.id

ABSTRACT

Ecosystem degradation and biodiversity loss in Indonesia are often driven by a lack of public awareness regarding conservation. One species significantly affected is the long-tailed macaque (Macaca fascicularis), whose population is threatened by habitat changes and human interactions. This study aims to compare the conservation awareness of communities in Babakan Subdistrict (Plangon), Cirebon, and Purwasari Village, Kuningan, to support conservation education integration into Biology learning. A quantitative descriptive method with a survey technique was used, collecting data through validated and reliable questionnaires. The respondents consisted of 40 individuals from each research location. Data analysis was conducted using the Mann-Whitney U test to examine differences in conservation understanding between the two communities. The findings revealed significant differences, with the Babakan Subdistrict (Plangon) community exhibiting a higher level of conservation awareness than the Purwasari Village community. This difference is likely influenced by Plangon's role as an educational tourism site, which indirectly enhances conservation awareness. The study concludes that conservation understanding can be improved through educational programs integrated into Biology learning and community activities. Therefore, it is recommended to implement more intensive and collaborative conservation education programs at the community, school, and local government levels to enhance environmental awareness.

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Introduction

Ecosystem degradation and biodiversity loss in Indonesia have become increasingly alarming issues, driven by deforestation, habitat fragmentation, and excessive exploitation of natural resources (Gamalo et al., 2024; Tambunan et al., 2025; Thiry et al., 2025). One of the species significantly affected is the long-tailed macaque (Macaca fascicularis), a primate that plays a crucial role in maintaining the balance of tropical forest ecosystems (Novianto et al., 2025; Reiss-Woolever et al., 2025). In several regions, the population of this species is threatened due to habitat degradation and human-wildlife conflicts, highlighting the need for conservation approaches that incorporate local community awareness and involvement (Rubel, Kaehrle, & Streiffer, 2025; Benson et al., 2025; Kelly, Freeman, & Rose, 2025).

* **CORRESPONDING AUTHOR.** Email: haruji.satianugraha@uniku.ac.id

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Conservation education has emerged as a strategic approach to raising public awareness about the importance of biodiversity preservation (Shafein et al., 2025; Stibraniova, Bartikova, & Dzubara, 2025; Nekaris et al., 2025). Studies have shown that integrating local wisdom into educational curricula can foster conservation attitudes among students (Damopolii et al., 2024).

Additionally, conservation education programs that combine scientific knowledge with cultural values can strengthen awareness and commitment to environmental preservation (Clauss et al., 2025). Ecosystem degradation and biodiversity loss in Indonesia have become increasingly alarming issues, driven by deforestation, habitat fragmentation, and excessive exploitation of natural resources (Gamalo et al., 2024; Tambunan et al., 2025; Thiry et al., 2025). One of the species significantly affected is the long-tailed macaque (Macaca fascicularis), a primate that plays a crucial role in maintaining the balance of tropical forest ecosystems (Novianto et al., 2025; Reiss-Woolever et al., 2025). In several regions, the population of this species is threatened due to habitat degradation and human-wildlife conflicts, highlighting the need for conservation approaches that incorporate local community awareness and involvement (Rubel, Kaehrle, & Streiffer, 2025; Benson et al., 2025; Kelly, Freeman, & Rose, 2025).

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Previous research has explored the impact of conservation education on community understanding. Studies indicate that community-based education initiatives can enhance participation in local conservation efforts (Cannings, Cannings, & Cannings, 2025). Integrating technology and local knowledge in educational approaches has also been found to deepen public understanding of conservation (Visintin et al., 2025). Furthermore, research conducted in Uganda revealed that motivation and barriers to adopting conservation practices are significantly influenced by environmental education received by the community (Ainebyona et al., 2025).

Collaborative conservation education between educational institutions and local communities has been found to yield more significant impacts (Ahmed et al., 2024). Programs that actively involve community participation can enhance understanding and foster a sense of ownership over conservation efforts. Similarly, culture-based education approaches have been shown to strengthen environmental awareness within local communities (Chowdhury et al., 2024).

Incorporating ethnoconservation-themed e-books in learning has been found to improve students' understanding of environmental preservation (Pratama, Kuntjoro, & Asri, 2024). The integration of conservation education into formal learning has been identified as an effective means of fostering students' positive attitudes toward nature. Additionally, folklore- and culture-based conservation practices have been recognized for their ability to enhance community awareness of natural resource preservation (Choudhury & Das, 2024).

Research has also revealed that computational approaches to conservation education can improve students' quantitative skills in understanding environmental issues (Christensen, 2025). Education methods that connect students with real-world conservation problems have been found to be particularly effective in increasing awareness and participation in conservation activities. Community-based education models further reinforce these findings, demonstrating

that locally engaged conservation education enhances public involvement in environmental sustainability efforts (Winkler-Schor et al., 2024).

Location-based games in biology education have been shown to enhance students' comprehension of ecosystems and conservation by providing direct field learning experiences (Mercan & Selçuk, 2024). This approach allows students to bridge theoretical knowledge from the classroom with real environmental conditions. Furthermore, school-based environmental clubs have been found to significantly improve students' awareness of endangered species conservation, with direct involvement in conservation activities fostering more positive environmental attitudes (Hutasoit et al., 2024).

Effective conservation education programs are those tailored to local contexts. Programs designed with cultural values in mind have been found to be more effective in increasing public understanding and participation in environmental conservation (Meierhofer et al., 2024). Community-inclusive conservation education initiatives have also been shown to raise awareness and encourage local involvement in wildlife preservation efforts (Steenweg et al., 2024).

Previous research suggests that conservation education integrated into both formal curricula and community-based programs can enhance public understanding and foster positive attitudes toward environmental preservation. However, gaps remain in the implementation of such programs at the community level, particularly in rural areas where access to conservation education is still limited (Anderson, 2025; Carroll et al., 2024; Visintin et al., 2025). Therefore, this study aims to address these gaps by developing a more inclusive and sustainable conservation education approach, specifically targeting the communities of Plangon Cirebon and Purwasari Kuningan.

However, there are still gaps in the understanding and implementation of conservation education across various communities, particularly in rural areas. A study by Christensen (2025) indicates that although conservation education has been introduced in many formal educational institutions, its implementation at the community level remains limited. This is further supported by findings from Winkler-Schor et al. (2024), who emphasize that the lack of integration of conservation education outside school settings contributes to a knowledge gap among the general public.

These gaps are also evident in studies related to the conservation of long-tailed macaques. Research by Hutasoit et al. (2024) reveals that while some communities are aware of the importance of primate conservation, their deeper understanding remains limited. Meierhofer et al. (2024) also highlight the need for more inclusive and sustainable educational approaches to ensure active community participation in wildlife conservation efforts.

In the context of Plangon Cirebon and Purwasari Kuningan, different conservation approaches are observed regarding long-tailed macaques. Plangon, which has been developed as an educational tourism site, provides visitors with direct experiences to learn about primate conservation (Steenweg et al., 2024; Damopolii et al., 2024). In contrast, in Purwasari Village, conservation efforts are more traditional and rooted in local beliefs, where long-tailed macaques are considered sacred animals (Ahmed et al., 2024; Chowdhury et al., 2024).

A research gap analysis of previous studies suggests that conservation education is still not sufficiently integrated into both formal and non-formal learning settings. Pratama, Kuntjoro, & Asri (2024) report that e-book-based learning incorporating ethnoconservation principles can enhance students' critical thinking skills, yet such an approach has not been widely implemented in rural communities. Similarly, Choudhury & Das (2024) note that conservation practices based on local cultural traditions are often overlooked in formal education curricula.

The novelty of this research lies in its approach, which integrates conservation education into biology learning by utilizing conservation sites as contextual learning media. This aligns with Anderson's (2025) perspective, emphasizing the importance of an inclusive and collaborative conservation paradigm that involves multiple stakeholders, including local communities and educational institutions.

This study is also significant in supporting environmental preservation efforts through an education-based approach that combines scientific knowledge with local wisdom. Research by Visintin et al. (2025) suggests that educational designs incorporating everyday natural elements can enhance conservation awareness and attitudes among students and the general public. Therefore, this study is expected to make a meaningful contribution to the development of more effective and sustainable conservation education strategies.

Furthermore, this research could serve as a foundation for the development of a biology curriculum that is more contextual and relevant to local needs. According to Carroll et al. (2024), education that connects students with environmental issues in their surroundings fosters a greater sense of responsibility and participation in conservation efforts. In the long term, the findings of this study are expected to support more inclusive and participatory conservation policies. This aligns with the perspective of Mercan & Selçuk (2024), who emphasize the importance of collaboration between the government, educational institutions, and local communities in developing sustainable conservation education programs.

This study aims to bridge the knowledge and practice gaps related to conservation education in local communities, particularly in the context of long-tailed macaque conservation. By doing so, it is expected to contribute to the development of more effective, sustainable, and community-relevant conservation strategies.

Methods

This study employs a descriptive quantitative approach using a survey method to analyze community understanding of long-tailed macaque (Macaca fascicularis) conservation in Babakan Subdistrict (Plangon), Cirebon, and Purwasari Village, Kuningan. This approach was chosen as it allows for direct data collection from respondents to assess their knowledge, attitudes, and behaviors regarding conservation (Damopolii, Nunaki, Jeni, Rampheri, & Ambusaidi, 2024; Tambunan, Rianti, Darusman, & Kyes, 2025; Gamalo et al., 2024).

The study was conducted in two locations: Babakan Subdistrict (Plangon), Cirebon, and Purwasari Village, Kuningan, West Java. These locations were selected due to the differences in conservation approaches implemented in each area. Plangon has been developed as an educational tourism site, providing visitors with direct experiences to learn about primate conservation (Steenweg, Lee, Duke, & Hughes, 2024), while Purwasari relies more on traditional and cultural beliefs in conservation efforts (Ahmed et al., 2024; Chowdhury et al., 2024). The research was conducted in April 2024.

The study population consists of residents living around the conservation areas in Babakan Subdistrict (Plangon) and Purwasari Village, Kuningan. The sample comprises 40 respondents from each location, totaling 80 respondents. The purposive sampling technique was used, selecting respondents who have lived in the area for at least five years to ensure they have sufficient experience and knowledge of local conservation efforts (Hutasoit et al., 2024).

The primary instrument used in this study was a structured questionnaire, designed to assess community knowledge, attitudes, and behaviors toward conservation. The questionnaire consisted of 40 items, and its validity and reliability were tested prior to implementation.

- *Validity Test*: 31 out of 40 items were found valid with a 95% confidence level.
- *Reliability Test*: The split-half method produced a reliability coefficient of 0.857,

indicating high instrument reliability (Pratama, Kuntjoro, & Asri, 2024).

The data collection process was conducted in three stages:

1. *Preparation Stage*: This included site surveys, questionnaire development, research permit applications, and enumerator training (Christensen, 2025).
2. *Implementation Stage*: The questionnaires were distributed to selected respondents. Each respondent was informed about the study's purpose and asked to complete the questionnaire independently (Ainebyona et al., 2025).
3. *Data Processing Stage*: The collected data were classified, coded, and entered into statistical software for analysis (Visintin et al., 2025).

Data Analysis Technique

The collected data were analyzed quantitatively using the Mann-Whitney U Test, a non-parametric statistical method suitable for analyzing ordinal data. This test was selected because the study involves comparing two independent groups—the communities of Babakan Subdistrict (Plangon) and Purwasari Village—to assess differences in their understanding of conservation. Given that the data are not assumed to follow a normal distribution, the Mann-Whitney U Test provides a reliable alternative to parametric tests, ensuring that meaningful insights can be drawn from the responses.

The analysis process involved ranking the total responses from both groups and comparing them to determine whether there were statistically significant differences in conservation knowledge, attitudes, and behaviors. By applying this method, the study was able to identify key factors influencing community conservation awareness, offering a robust statistical assessment of the effectiveness of conservation education efforts in each region (Hutasoit et al., 2024; Meierhofer et al., 2024).

Results

The results of this study indicate a difference in conservation understanding between the community of Purwasari Village and the residents of Babakan Subdistrict in their efforts to preserve the long-tailed macaque (Macaca fascicularis). Conservation efforts should not only focus on species protection but also on preserving the ecosystem that serves as the natural habitat for these animals. This aligns with the findings of Gamalo et al. (2024), who highlighted that habitat exploitation and destruction contribute to the decline in Macaca fascicularis populations, emphasizing the need for a comprehensive conservation strategy that actively involves local communities.

To ensure the accuracy and reliability of the research instrument, a validity and reliability test was conducted on the questionnaire used to assess community knowledge, attitudes, and behaviors toward conservation. The validity test aimed to determine whether each item in the questionnaire effectively measured the intended variables, while the reliability test assessed the consistency of the instrument. The validity test results were obtained by comparing the correlation coefficient (rxy) of each item with the critical t value at a 95% confidence level. Meanwhile, the reliability of the instrument was evaluated using the split-half method, which produced a high reliability coefficient. Table 1 presents the validity test results, showing which items were deemed valid or invalid based on statistical analysis.

Table 1. Instrument Validity Test Results

Item No.	rxy	t-test Result vs. t-table	Conclusion
1	0.3233	2.240 > 2.02	Valid
2	0.095	0.625 < 2.02	Not Valid
3	0.2953	2.027 > 2.02	Valid
4	0.3469	2.426 > 2.02	Valid
5	0.177	1.179 < 2.02	Not Valid
6	0.3997	2.589 > 2.02	Valid
7	0.5465	4.279 > 2.02	Valid
8	0.2407	1.626 < 2.02	Not Valid
9	0.1792	1.194 < 2.02	Not Valid
10	0.1305	0.863 < 2.02	Not Valid
11	0.2343	1.581 < 2.02	Not Valid
12	0.5801	4.670 > 2.02	Valid
13	0.2915	1.998 < 2.02	Not Valid
14	0.5457	4.271 > 2.02	Valid
15	0.3788	2.684 > 2.02	Valid
16	0.4513	3.317 > 2.02	Valid
17	0.4513	3.317 > 2.02	Valid
18	0.2333	2.241 > 2.02	Valid
19	0.5227	4.020 > 2.02	Valid
20	0.5801	4.670 > 2.02	Valid
21	0.4513	3.317 > 2.02	Valid
22	0.5457	4.271 > 2.02	Valid
23	0.5457	4.271 > 2.02	Valid
24	0.2343	1.581 < 2.02	Not Valid
25	0.4513	3.317 > 2.02	Valid
26	0.5801	4.670 > 2.02	Valid
27	0.5457	4.271 > 2.02	Valid
28	0.2915	1.998 < 2.02	Not Valid
29	0.3788	2.684 > 2.02	Valid
30	0.5801	4.670 > 2.02	Valid
31	0.4211	3.045 > 2.02	Valid
32	0.5801	4.670 > 2.02	Valid
33	0.5227	4.020 > 2.02	Valid
34	0.5457	4.271 > 2.02	Valid
35	0.3788	2.684 > 2.02	Valid
36	0.5457	4.271 > 2.02	Valid
37	0.3233	2.241 > 2.02	Valid
38	0.5227	4.020 > 2.02	Valid
39	0.4211	3.045 > 2.02	Valid
40	0.4513	3.317 > 2.02	Valid

Reliability Test

The reliability analysis conducted in this study yielded a reliability coefficient of 0.857, which falls within the very high reliability category. This result indicates that the research instrument demonstrates strong internal consistency and stability in measuring respondents' understanding of conservation concepts. A high reliability coefficient suggests that the questionnaire items are well-correlated and consistently assess the intended variables across different respondents.

Reliability testing was conducted using the split-half method, where the questionnaire was divided into two equal halves, and the correlation between the two sets of responses was analyzed. The high reliability score confirms that the instrument is dependable for evaluating conservation knowledge, attitudes, and behaviors, minimizing the risk of measurement errors. This finding aligns with best practices in survey research, ensuring that the collected data accurately reflect respondents' conservation awareness and engagement levels.

Table 2. Reliability Test Results

Test Type	Method Used	Reliability Coefficient	Interpretation
Internal Consistency	Split-Half Method	0.857	Very High Reliability

These results reinforce the credibility of the instrument, ensuring that it can be used confidently to assess conservation understanding among different community groups. The high level of reliability also enhances the study's validity, supporting robust and reproducible conclusions about conservation awareness in Babakan Subdistrict (Plangon) and Purwasari Village.

Mann-Whitney U Test Results

To determine whether there is a significant difference in conservation understanding between the communities of Babakan Subdistrict (Plangon), Cirebon, and Purwasari Village, Kuningan, this study employed the Mann-Whitney U Test. This test is particularly suitable for ordinal data, which was collected through a Likert-scale questionnaire measuring conservation awareness in both communities. The Mann-Whitney U Test was chosen because it allows for comparison between two independent groups without requiring the assumption of a normal distribution, making it an appropriate method for analyzing conservation understanding levels.

Data Ranking

Each respondent from both communities was assigned a score based on their level of understanding of long-tailed macaque conservation and ecosystem preservation. These scores were then ranked from lowest to highest. In cases where respondents had identical scores (ties), the ranking was averaged among them to maintain statistical integrity.

Statistical Test Calculation

The Mann-Whitney U Test was performed by computing the sum of ranks for both groups and analyzing the differences. The test evaluates whether one group has consistently higher or lower rankings than the other, indicating a significant difference in conservation understanding. The results provide quantitative insights into the effectiveness of conservation education and awareness efforts in each community.

The given formula and explanation in English:

$$U = n_1 \times n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

where:

- n_1 = the sample size of the first group (Plangon)
- n_2 = the sample size of the second group (Purwasari)
- R_1 = the total rank sum for the first group

From the calculation results, the value of $U_2 = 2872$ was obtained, which is greater than $U_1 = 642$. In the Mann-Whitney U Test, the smaller U value is used for comparison with the critical U table value, so $U_1 = 642$ is selected for further analysis.

Conversion to Z-Test

To obtain a more accurate result, the U value is then converted to a Z-score, which is calculated using the following formula:

$$Z = \frac{U - \mu_U}{\sigma_U}$$

Where

$$\mu_U = \frac{n_1 n_2}{2}, \quad \sigma_U = \sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}$$

- μ_U = the mean of U
- σ_U = the standard deviation of U
- n_1 = the sample size of the first group
- n_2 = the sample size of the second group

This formula is used to convert the Mann-Whitney U value into a Z-score, which allows for comparison with standard normal distribution values to determine statistical significance.

To compare the understanding of conservation between the communities of Babakan Subdistrict (Plangon) and Purwasari Village, a Mann-Whitney U Test was conducted. This statistical test was chosen because it effectively analyzes ordinal data and compares two independent groups. The test results provide insights into whether there are significant differences in conservation knowledge, attitudes, and behaviors between the two communities. Table 2 presents the ranking comparison based on the Mann-Whitney U Test, highlighting variations in the respondents' scores and their respective rankings.

Table 3. Comparison of Community Rankings in Plangon and Purwasari Based on the Mann-Whitney U Test"

	No (Plangon)	Plangon (Score)	Plangon Rank	No (Purwasari)	Purwasari (Score)	Purwasari Rank
0	1	102	119	1	90	90.5
1	2	95	106	2	84	65
2	3	58	3	3	72	18.5

3	4	101	116	4	85	69.5
4	5	48	1	5	61	5
5	6	107	120	6	87	75.5
6	7	90	90.5	7	82	56.5
7	8	92	92	8	78	43.5
8	9	72	18.5	9	73	23
9	10	92	97	10	84	65
10	...	...	...	...	...	...
11	60	101	116	60	88	79
12	R1	4788		R2	2558	

Discussion

The findings of this study reveal significant differences in conservation understanding between the communities of Plangon and Purwasari. The higher level of conservation awareness among Plangon residents can be attributed to their exposure to ecotourism activities, which serve as an informal educational platform for conservation awareness (Carroll et al., 2024). The study by Choudhury & Das (2024) supports this notion, emphasizing that integrating environmental education into cultural practices enhances community engagement and long-term conservation efforts.

Furthermore, the results align with research conducted by Ahmed et al. (2024), which highlights the importance of open educational resources in enhancing biology education, particularly in conservation. The presence of structured learning experiences in Plangon, whether through direct interactions with conservationists or indirect exposure via ecotourism, has provided the community with an enriched understanding of biodiversity preservation. This contrasts with Purwasari, where conservation education remains rooted in traditional beliefs rather than structured learning initiatives.

A critical factor influencing conservation attitudes is the role of economic incentives. Studies by Ainebyona et al. (2025) and Reiss-Woolever et al. (2025) indicate that communities are more likely to engage in conservation efforts when they perceive direct economic benefits. Plangon's ecotourism framework has provided financial incentives for residents to participate in conservation activities, fostering a more proactive stance on environmental protection. Conversely, Purwasari lacks such economic motivators, resulting in lower community involvement in conservation initiatives.

Social media and digital platforms have also been recognized as powerful tools for raising conservation awareness. Research by Chowdhury et al. (2024) and Rubel, Kaehrle, & Streiffer (2025) indicates that conservation messaging delivered through digital channels can significantly impact public attitudes and behaviors. The disparity in conservation understanding between the two study sites may partly be explained by differences in access to digital information. Plangon residents, with greater exposure to ecotourism and digital campaigns, are more likely to be informed about conservation efforts compared to those in Purwasari, who primarily rely on traditional knowledge transfer.

Another significant determinant of conservation awareness is formal education. Christensen (2025) argues that computational thinking and quantitative skill development in marine biology education enhance students' ability to engage with conservation-related topics. Similarly, Nekaris et al. (2025) found that the integration of student engagement strategies into primate education programs leads to better learning outcomes. The structured exposure to conservation education in Plangon likely plays a role in shaping community perceptions and fostering a greater sense of responsibility toward biodiversity protection.

The findings also suggest that integrating conservation education within local school curricula could be an effective strategy for enhancing awareness in Purwasari. This aligns with the recommendations by Damopolii et al. (2024), who advocate for the inclusion of indigenous knowledge in problem-based learning to empower students with conservation attitudes. By incorporating traditional ecological knowledge alongside scientific principles, conservation programs can achieve broader community acceptance and participation.

The influence of habitat degradation on conservation attitudes cannot be overlooked. Gamalo et al. (2024) highlight the detrimental impact of habitat destruction on long-tailed macaque populations, underscoring the urgency of conservation education. The communities studied in this research have experienced varying levels of habitat disturbance, which may influence their perceptions of conservation importance. Purwasari, with a less structured conservation framework, may not fully recognize the long-term consequences of habitat loss, whereas Plangon, due to its proximity to an ecotourism site, may be more attuned to these issues.

Behavioral and ecological studies also provide insights into the relationship between conservation awareness and human-wildlife interactions. Benson et al. (2025) found that environmental and intrinsic factors shape social cohesion in wild animal populations. A similar dynamic is evident in human communities, where direct experiences with wildlife influence conservation attitudes. Plangon's engagement with ecotourism and conservation initiatives allows for greater exposure to wildlife, reinforcing positive attitudes towards conservation. In contrast, Purwasari's reliance on traditional beliefs may not foster the same level of engagement with conservation principles.

Further supporting these findings, Legrand et al. (2024) advocate for incorporating ecological awareness into business and education sectors, emphasizing that interdisciplinary approaches enhance conservation efforts. The success of Plangon's conservation model illustrates how economic, educational, and community-driven strategies can converge to create sustainable conservation outcomes. Expanding similar interdisciplinary approaches to Purwasari could help bridge the conservation awareness gap.

In conclusion, the significant difference in conservation awareness between Plangon and Purwasari underscores the importance of integrating education, economic incentives, digital outreach, and interdisciplinary strategies into conservation efforts. Future initiatives should focus on expanding conservation education in Purwasari through formal and informal learning platforms, digital campaigns, and economic incentives to ensure a more widespread and sustainable approach to biodiversity conservation. By addressing these factors, conservation efforts can be made more inclusive and impactful across diverse communities.

Conclusion

This study highlights the significant differences in conservation awareness between the communities of Babakan Subdistrict (Plangon) and Purwasari Village, Kuningan, particularly regarding the preservation of long-tailed macaques (Macaca fascicularis). The findings suggest that Plangon's role as an ecotourism site has positively influenced conservation awareness among its residents, while Purwasari Village, which lacks structured conservation programs, exhibits lower levels of understanding. These differences underscore the importance of integrating conservation education into both formal learning and community-based initiatives to foster broader environmental awareness and engagement.

To enhance conservation education, strategies should be tailored to local contexts, incorporating both scientific knowledge and traditional ecological wisdom. In communities like Purwasari, where conservation perspectives are rooted in cultural beliefs, educational programs should align with local traditions to increase acceptance and participation. Meanwhile, leveraging

experiential learning models, as seen in Plangon, can provide more direct exposure to conservation efforts. Strengthening collaborations between schools, conservation organizations, and local governments will be essential in ensuring the sustainability of conservation initiatives.

This study emphasizes the need for inclusive and adaptive conservation education approaches to bridge gaps in environmental awareness. By integrating interdisciplinary strategies, digital outreach, and economic incentives, conservation education can be more effectively implemented across diverse communities. Future research should focus on evaluating the long-term impacts of conservation education programs and exploring innovative methods to engage communities in sustainable environmental practices.

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