The Study of Ammatoa Customary Forest Management by the Kajang Tribe for the Development of a Conservation-Based Learning (CBL) Model Integrated with Local Wisdom

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ABSTRACT

This study aims to examine the effectiveness of applying the Conservation Based Learning (CBL) model integrated with local wisdom in improving the environmental literacy of fifth-grade students at SDN 351 Kawasan Ammatoa, Bulukumba Regency, South Sulawesi. Using a quasi-experimental design with a non-equivalent control group, this study involved two classes, namely an experimental class taught using the CBL model and a control class taught using conventional methods. Data collection was conducted through learning outcome tests in the form of multiple-choice and essay questions that measured students' environmental literacy, which included understanding conservation concepts, the ability to analyze environmental problems, and the application of knowledge in daily life. The results showed that the application of the CBL model integrated with local wisdom had a significant impact on improving students' environmental literacy, with the average posttest score for the experimental group reaching 86.00, while the control group only scored 61.81. Hypothesis testing using an independent t-test showed a significant difference between the two groups (p < 0.05). In addition, N-Gain score analysis revealed a higher increase in the experimental group (0.76) compared to the control group (0.35), indicating that the CBL model is more effective in improving environmental literacy. Thus, this study confirms that the CBL model, which integrates local wisdom, can significantly improve students' understanding, analysis, and application of environmental knowledge, which is important for shaping sustainable environmental awareness.

Keywords: Conservation Based Learning (CBL), Local Wisdom, Environmental Literacy, Education, Quasi-Experimental

INTRODUCTION

Indonesia, as one of the countries with the largest forest area in the world, is currently facing major challenges related to increasing deforestation. Based on data from the Ministry of Environment and Forestry (KLHK), in 2024, deforestation reached 216,200 hectares (Ministry of Forestry 2024) . Land conversion for plantations, mining, and infrastructure development is the main cause of the loss of most of Indonesia's forest areas. This phenomenon not only threatens biodiversity, but also has implications for global climate change, an increase in natural disasters such as floods and landslides, and economic losses felt by communities that depend on forest products (Christiawan 2018; Hasyim et al. 2025)

The high rate of deforestation indicates a deep-rooted problem in the literacy and conservation character of most communities, especially the younger generation. The low level of public understanding of the importance of forest and natural resource conservation is a factor that exacerbates this situation. This deforestation crisis highlights the need for a better educational approach to improve environmental literacy. Effective conservation education can shape students' character from an early age to understand the importance of maintaining environmental sustainability and mitigating environmental damage.

In overcoming these challenges, community participation in forest management through social forestry schemes can help reduce deforestation(Rustiadi and Veriasa 2022) . An integrated approach involving various stakeholders, from government agencies to local communities and educational institutions, is needed to create sustainable forest resource management. The understanding is that effectively tackling deforestation requires collaborative efforts and innovative solutions that consider social and ecological dimensions (Gamin 2024) .

The importance of conservation character education among the younger generation cannot be overlooked. Efforts to shape conservation character should begin early through an educational curriculum that integrates conservation values. Integrating conservation values into the curriculum and fostering environmental awareness aims to develop environmentally conscious and socially responsible individuals (Utthawang, Wongchantra, and Neungchalerm 2012) . Long-term impact is achieved by creating a framework that encourages education and sustainable conservation actions for students who have basic adaptive skills in managing the environment sustainably (Rozzi et al. 2006) .

The integration of local wisdom into the elementary school curriculum can improve students' understanding of environmental issues. The eco-pedagogical approach that combines local wisdom has been proven effective in increasing students' environmental knowledge and awareness (Mulyanie and Setiawan 2024) . Research shows that environmental education themes based on local values help students better understand topics such as environmental pollution, global warming, and flora and fauna conservation (Sarbaini et al. 2022)

The development of local wisdom in schools can increase children's love for nature and strengthen conservation values in them (Katili et al. 2018) . Formal and non-formal education, including conservation-based learning, is essential to build awareness of environmental issues among the younger generation. Communication between the younger and older generations in conservation strategies must be strengthened to preserve natural resources (Habel et al. 2023) . Community involvement in teaching students about traditional environmental practices and values fosters a deeper connection with nature and promotes sustainable behavior (Acharibasam and McVittie 2023; Shabalala 2025) .

One approach that can be applied in forest management is local wisdom-based management, which not only pays attention to environmental sustainability but also upholds the social and cultural values of the local community. The Ammatoa, a tribe living in Bulukumba, South Sulawesi, has a local wisdom-based forest management system that has been proven to maintain ecological balance. This system teaches the importance of sustainability and can be an effective learning model in conservation education. An example of local wisdom-based forest management can be found in the Ammatoa customary forest managed by the Kajang tribe in Bulukumba Regency. This customary forest is maintained based on the principle of balance, which is regulated by strict customary rules, such as prohibitions on indiscriminate tree felling and hunting without a permit. This system preserves the forest and provides social and economic benefits to the surrounding community because they can utilize forest products in an environmentally friendly manner.

The research findings of Surtikanti, Syulasmi, and Ramdhani(2017) reveal that the traditional practices of the Ammatoa Kajang community in South Sulawesi demonstrate the close relationship between humans and nature in maintaining ecological balance. Through environmental conservation carried out by utilizing sacred forests, recycling waste, and using resources sustainably, this community teaches the importance of sustainable environmental management. The local wisdom values contained in these practices can serve as examples in environmental literacy education, instilling respect for nature and the importance of wise

natural resource management. The results of these traditional practices not only preserve the environment but also provide a concrete example of how to live in harmony with nature to achieve a sustainable life.

Given the importance of the values embodied in the management of the Ammatoa customary forest, these local wisdom values can be integrated into a conservation-based learning (CBL) model. The CBL learning model is designed to increase students' understanding of nature conservation through a contextual and meaningful learning process (Scarborough, Hall, and Vanderkruk 2022; Wajdi et al. 2022) .

The integration of traditional environmental knowledge and indigenous knowledge systems is essential for sustainable conservation practices. These knowledge systems offer valuable insights into sustainable resource management and ecological balance, which are integrated into the learning model to bridge the gap between modern science and traditional practices (Febriasari and Supriatna 2017; Slikkerveer and Gellaerts 2024) .

This model emphasizes the importance of integrating conservation values into the curriculum to improve environmental literacy and sustainability awareness among students (Gilleran Stephens, Antwi, and Linnane 2025; Wahzudik et al. 2020) . This model provides students with innovative pedagogical approaches such as experiential learning (Krasny et al. 2013) problem-based learning, and community-based learning to engage students with real-world environmental issues (Ruthanam 2025) (Rehman, Jabran, and Farooq 2023) . According to Balážová et al.,(2024) the CBL model combines practical activities and field-based learning experiences to enhance students' understanding of ecological principles and conservation practices (Perdinan et al. 2024) . This model is designed to be adaptive, allowing for continuous improvement based on feedback and changes in environmental conditions (Goodell and Thai 2020) . By recognizing the benefits of the CBL model, a comprehensive and effective framework for environmental education can be created, which encourages deeper understanding and commitment to conservation among students. Fifth-grade elementary school students have demonstrated scientific thinking skills in explaining environmental phenomena and shown sensitivity to small actions such as littering and planting trees (Nadiroh and Irdiyansyah 2021; Saglam 2016) . These skills support collaboration in hands-on projects in nature to shape a positive environmental identity (Marušić-Jablanović et al. 2025)

Although many studies have examined environmental-based learning, no studies have integrated the Conservation-Based Learning (CBL) model with Ammatoa local wisdom. The integration of Ammatoa local wisdom into the CBL learning model will be a unique model in strengthening the conservation character and literacy of students in environmental preservation. This approach instills cultural values that support conservation while enriching the content and cultural identity of students. This study will fill this gap by testing the effectiveness of this model on the environmental literacy of fifth-grade students. "This study aims to test the CBL model integrated with Ammatoa local wisdom and evaluate its effectiveness in improving the environmental literacy of fifth-grade elementary school students through a quasi-experimental research design. The contribution of this research is to investigate the influence of a local wisdom-based approach in relevant and contextual conservation learning.

METHOD

This study uses a quantitative approach employing a quasi-experimental design with a non-equivalent control group (Abraham and Supriyati 2022) . This design was chosen because the researchers will test causal hypotheses about the effects of intervention (Krass 2016) , according to (Andrade 2021) if researchers are unable to randomly intervene in the composition of students in each class, they can choose a quasi-experimental approach, but researchers can still control the existing control and experimental classes (Arib et al. 2024; Sugiyono 2019) . This design is considered relevant for testing the effectiveness of the conservation-based learning (CBL) model integrated with local wisdom with the dependent variable of environmental literacy by minimizing bias and increasing the internal validity of the research.

The population in this study was all 5th grade students at SDN 351 Kawasan Ammatoa, Bulukumba Regency, South Sulawesi, with 64 students enrolled in the 2025/2026 academic year. The selection of fifth grade as the population was based on the consideration that fifth grade students (1) are at the stage of scientific thinking skills and are able to explain in more detail environmental phenomena such as air pollution, plastic waste, or weather changes that they see every day, (2) children have the social skills to collaborate in project activities ( ), and (3) the implementation of the independent learning curriculum allows for the design of activities in parallel with intracurricular learning materials and extracurricular activities in the form of projects. The sampling method used in this study was purposive sampling with the following criteria: (1) schools that have implemented the Merdeka Curriculum, (2) classes that have homogeneous characteristics in terms of students' initial abilities, measured based on the average scores in related subjects from the previous semester, and (3) the availability of adequate facilities for the implementation of the intervention.

From this population, two classes will be selected as research samples, one class as an experimental group that will be taught using the conservation-based learning (CBL) model integrated with local wisdom and one class as a control group that will be taught using conventional learning commonly used by teachers. The number of students in each group will be balanced to ensure the validity of the comparison.

Data in this study will be collected using several instruments that have been tested for validity and reliability. The learning outcome test to measure student learning outcomes will use objective tests in the form of multiple-choice and/or essay questions that have been validated by subject matter experts and evaluation experts (Prasetyo and Anitra 2020) . The exam questions will be designed to measure environmental literacy skills with indicators covering several important aspects, (1) understanding of environmental concepts, where students can explain basic conservation concepts such as recycling, preservation of flora and fauna, and the importance of biodiversity, and are aware of environmental issues around them, such as water pollution, climate change, or forest destruction (Elliott 2017; Slozhenkina et al. 2021) , (2) the ability to analyze environmental problems, where students can identify existing environmental problems, such as waste pollution in schools or communities, as well as suggest appropriate solutions and connect human behavior with its impact on the environment (Ruthanam 2025, Tapilouw et al. 2017) , (3) the application of knowledge in daily life, where students can apply proper waste disposal, energy conservation, for example, turning off lights when not needed, and water conservation in daily life, such as turning off the tap when not needed, making posters to educate others about the importance of protecting the environment (Costa and Rocha 2017; Nurramadhani et al. 2022) .

The collected data will be analyzed using inferential statistical methods with the help of statistical software, SPSS version 26. Before conducting hypothesis testing, the normality of the pre-test and post-test data from both groups will be examined using the Shapiro-Wilk test, while the homogeneity of variance will be tested with the Levene test (Mann 2010) . This test is important to determine whether the data meets parametric assumptions or whether non-parametric tests are required (Arib et al. 2024; Asrin 2022) . Next, descriptive analysis will be conducted to provide an overview of the initial and final conditions of both groups. To test for significant differences between the average learning outcomes of the experimental group and the control group after the intervention, an independent t-test will be used. In addition, a pre-test comparison between the two groups will also be conducted to ensure the equivalence of the conditions of both groups before the intervention. To measure the effectiveness of the CBL model in improving students' environmental literacy, an N-Gain Score test will be conducted by calculating the N-Gain score for each group. According to Meltzer(2002) , the N-Gain Score will illustrate the level of improvement in learning outcomes after the intervention and will then be compared between the experimental group and the control group.

RESULTS AND DISCUSSION

In parametric analysis, assumption testing is an important step that must be fulfilled before performing parametric statistical tests (Sedgwick 2015) . One of the tests required is a

normality test for the experimental and control class data, which aims to determine whether the data is normally distributed or not. Given that the amount of data in each class is less than 50, the normality test was performed using the Shapiro-Wilk test. If the significance value (sig) is greater than 0.05, it can be concluded that the data is normally distributed (Bernadett and Csaba 2024; Shapiro, Wilk, and Chen 1968).

Table 1 Normality Test for Experimental and Control Classes

Class	Statistic	df	Sig.
Pre-test Control Class	0.961	32	0.299
Posttest Control Class	0.942	32	0.084
Experimental Class Pretest	0.962	32	0.304
Posttest Experimental Class	0.962	32	0.307

In this study, a normality test was conducted to examine whether the pretest and posttest data from the experimental and control classes followed a normal distribution, which is a basic assumption of the parametric statistical analysis ( ). Based on the normality test results obtained from the Shapiro-Wilk test, all data from the pretest and posttest, both in the control class and the experimental class, showed a Sig. value greater than 0.05. The Sig. value for the control class pretest was 0.299, the control class posttest was 0.084, the experimental class pretest was 0.304, and the experimental class posttest was 0.307. Thus, it can be concluded that the pretest and posttest data in both classes are normally distributed, because Sig. values greater than 0.05 indicate that there is insufficient evidence to reject the null hypothesis that the data come from a normal distribution. These results show that the normality assumption is met and further parametric analysis can be performed on the data.

To verify the similarity of variances between the experimental and control groups in improving students' environmental literacy learning outcomes, a homogeneity test was applied to the pretest and posttest data (Sianturi 2022) . Homogeneity was determined by looking at the P value, where if the significance value (sig.) was greater than 0.05 on Based on Mean, then the variance between groups was considered similar (homogeneous). Conversely, if the sig. value was less than 0.05, then the variance between groups was considered different (Usman et al. 2023) .

Table 2 Homogeneity Test for Experimental and Control Classes

		Levene Statistic	df1	df2	Sig.
Learning Outcomes of Control and Experimental Classes	Based on Mean	0.001	1	62	0.971
	Based on Median	0.020	1	62	0.888

Table 2 shows the results of the homogeneity test between the experimental and control classes for the learning outcome variable. The homogeneity test was conducted using the Levene test, which tests the similarity of variances between the two groups. Based on the Levene test results for "Based on Mean," a statistical value of 0.001 was obtained with degrees of freedom (df1) of 1 and df2 of 62, and a significance value (Sig.) of 0.971. Because the significance value is greater than 0.05, it can be concluded that the variances of the two groups (experimental and control) are homogeneous. Similarly, for "Based on Median," the statistical value is 0.020, df1 is 1, df2 is 62, and the significance value is 0.888. With a significance value that is also greater than 0.05, these results indicate that the variance between the experimental and control classes remains homogeneous based on the median. Overall, this test shows that there is no significant difference in the variance of learning outcomes between the two groups, which supports the assumption of variance homogeneity for further analysis.

Table 3. Descriptive Data for the Experimental and Control Classes

Item	Pre-test Control Class	Posttest Control Class	Experimental Class Pretest	Posttest for the Experimental Class
N	32	32	32	32
Mean	40	62	41	86

Standard Error of Mean	0.46	0.48	0.54	0.51
Median	40	60	41	86
Mode	39	62	39	86
Standard Deviation	2.61	2.71	3.08	2.89
Variance	6.83	7.38	9.53	8.38
Range	11	9	14	11
Minimum	35	57	36	81
Maximum	46	66	50	92
Sum	1293	1978	1324	2752

Table 3 shows descriptive data on pretest and posttest results in the control class and experimental class. Each class consisted of 32 students, with calculations of mean, standard deviation, and variance describing the distribution of test results. In the control class, the pretest mean score was 40, which increased to 62 on the posttest. Meanwhile, in the experimental class, the pretest mean score was 41, and it increased significantly to 86 on the posttest. This shows that there was a greater increase in the experimental class compared to the control class. In terms of standard deviation, the control class had a value of 2.61 on the pretest and 2.71 on the posttest, indicating relatively small variation in test results. In the experimental class, the standard deviation was higher, at 3.08 on the pretest and 2.89 on the posttest, indicating a wider spread of values, despite a slight decrease on the posttest.

The median and mode showed a similar central tendency to the mean in each test, although there were slight differences. In the control class, the pretest had a median and mode of 40 and 39, respectively, while in the posttest, these two values rose to 60 and 62. In the experimental class, the pretest showed a median and mode of 41 and 39, while the posttest had a higher median and mode of 86. The range shows the difference between the highest and lowest scores in the test. In the control class, the pretest range was 11, while the posttest range was 9. In the experimental class, the pretest range was 14, which was greater than the posttest range of 11. This indicates a more even improvement in the test results of students in the experimental class . Overall, this descriptive data illustrates that the application of the learning model in the experimental class showed more significant changes in the posttest results compared to the control class, with higher score increases and slightly greater variation.

Based on the data presented in the table, several conclusions can be drawn regarding the application of the Conservation Based Learning (CBL) model integrated with local wisdom in fifth-grade elementary school students. This data includes pretest and posttest scores for the control class and the experimental class. On the pretest, the control class had a mean score of 40.41 with a standard deviation of 2.613, indicating a relatively uniform level of initial understanding among students. The median and mode values, which were close to the mean, also showed consistency in the pretest results. Meanwhile, the experimental class showed a similar pretest score of 41.38, with a slightly higher standard deviation (3.087), indicating a slight variation in initial understanding among students.

After implementing the CBL model, in the posttest, the experimental class showed a significant increase, with an average score of 86.00, a drastic increase compared to the pretest score of only 41.38. The standard deviation of the experimental class after the intervention also decreased to 2.896, indicating that despite the large increase, the variation between students decreased slightly, meaning that most students experienced a significant increase in their understanding. On the other hand, the control class only experienced a smaller increase, with an average posttest score of 61.81 and a relatively high standard deviation (2.717).

Table 4. Results of the hypothesis test on the application of the CBL model on students' environmental literacy

Levene's Test for Equality of Variances	Calculated t	df	Sig	Mean difference	95% Confidence Interval of the Difference	Cohen's d Effect Size

						Lower	Upper	
Learning Outcomes	Equal variances assumed	34.455	62	0.001	24.188	25.591	22,784	8,614
	Equal variances not assumed	34,455	61.7	0.001	24.188	25.591	22.784	

Table 4 presents the results of the hypothesis test regarding the application of the CBL model on students' environmental literacy. This test was intended to examine the difference in learning outcomes between the experimental group using the CBL model and the control group. In the "Levene's Test s for Equality of Variances" section, a statistical value of 34.455 was obtained with a degree of freedom (df) of 62 and a significance value (Sig.) of 0.001. Since the Sig. value is less than 0.05, it can be concluded that the variances between the two groups are not equal (variance heterogeneity), which means that the assumption of equal variances cannot be accepted. The t-test results for "Equal variances assumed" show a t-value of 34.455 with df 62 and a Sig. value of 0.001, which is also less than 0.05. This indicates that there is a significant difference between the learning outcomes of students in the experimental and control classes. The mean difference is 24.188, with a 95% confidence interval between 22.784 and 25.591. This shows that the difference between the two groups is quite large and within a statistically significant range.

The effect size for this test is 8.614, which shows a very large effect of the CBL model on students' environmental literacy. This high effect size indicates that the CBL model has a strong influence in improving the environmental literacy of students in the experimental class compared to the control class. Overall, these results support the hypothesis that the application of the CBL model has a significant effect on improving students' environmental literacy.

To measure the effectiveness of learning outcome improvement, the N-Gain score was calculated using a formula that compares the change in student scores (the difference between the post-test and pre-test) with the maximum potential in both the experimental and control groups. N-Gain measures the extent of learning outcome improvement after intervention, normalized based on the maximum achievable score. By comparing the changes before and after learning, N-Gain provides an objective picture of the effectiveness of the CBL model. A higher N-Gain score indicates a more significant improvement, indicating that the CBL model is more effective than conventional learning in improving students' environmental literacy outcomes.

Table 5. N-Gain scores for students' environmental literacy learning outcomes

Group	Average N-Gain	Category
Experimental	0.76	High
Control	0.35	Low

Based on the results presented in Table 5, the N-Gain score shows a significant difference between the experimental group and the control group in terms of improving students' environmental literacy. The experimental group, which was taught using the Conservation- - Based Learning (CBL) model integrated with local wisdom, showed an average N-Gain of 0.76, which is in the High category. This indicates that students in the experimental group experienced a significant improvement in environmental literacy learning outcomes, particularly in terms of understanding basic conservation concepts, the ability to analyze environmental problems, and the application of environmental knowledge in daily life. With a high N-Gain value, it can be concluded that the CBL model implemented was successful in effectively improving students' environmental literacy.

The control group that did not receive the intervention only recorded an average N-Gain of 0.35, which falls into the Low category. This shows that although there was an increase in the control group, the increase was much smaller than that of the experimental group and was more limited in terms of the aspects of environmental literacy tested. These results show that the application of the CBL model, which integrates local wisdom, has a strong influence on improving students' environmental literacy, which includes understanding recycling,

preserving flora and fauna, identifying environmental problems, and implementing concrete actions to protect the environment. Thus, this model has been proven effective in equipping students with the knowledge and skills necessary to face environmental challenges around them.

DISCUSSION

In terms of conceptual understanding, the CBL model has been proven effective in improving students' environmental knowledge (Deveci and Karteri 2022) . Research by Miterianifa and Mawarni(2024) established that environmental literacy learning models can facilitate students in developing a deeper understanding of environmental issues. Through the application of active and interactive learning, students are challenged to answer questions and problems relevant to their environment, leading to an increase in strong conceptual understanding. This is in line with previous research showing that students who are able to connect social studies concepts to real-life situations experience an increase in their perception of the material being taught (Laily 2023) .

Students' analytical skills also improve with the application of CBL. In this context, students are encouraged to analyze environmental problems around them and find solutions (Isnawati et al. 2025) . This model emphasizes the connection between the learning context and real-life situations, which can trigger students to think critically and analytically about the problems they face. Research by Zulfa et al.(2020) shows that the laws of physics can be adopted to improve students' understanding of complex environmental issues. This indicates that a challenge-based approach not only makes students responsive but also equips them with in-depth analytical skills. The results of research by Riskawati et al. (Riskawati et al. 2021) show that the application of CBL can encourage students to apply the knowledge they have acquired in their daily activities, such as clean and healthy living behaviors. In addition, this creates a corridor for students to actively participate in protecting their surrounding environment. Students not only learn about theory, but also engage directly in real actions, such as environmental maintenance or waste management, which leads to positive behavioral changes along with increased environmental awareness among students (Safitri, Habibi, and Matlubah 2024) .

The application of the Conservation Based Learning (CBL) model integrated with local wisdom has proven effective in improving the environmental literacy of fifth and sixth grade elementary school students. This model encourages group work and collaboration among students to solve local environmental problems, which not only improves teamwork skills but also allows students to learn from each other's perspectives and experiences (Tadena and Salic-Hairulla 2021) (Anwar et al. 2024) . In addition, this model provides students with a comprehensive understanding of environmental science by linking it to local wisdom, which helps students understand the relationship between ecological systems and human activities (Ningrum, Nandi, and Sungkawa 2018) .

The concept and application of the conservation-based learning (CBL) model has a significant positive impact on improving students' environmental literacy. This model involves educational methods that focus on integrating local values and developing environmental awareness, equipping students with understanding, analytical skills, and the application of knowledge that is relevant to everyday life. Conceptual understanding, CBL supports students in internalizing knowledge related to environmental concepts in a more contextual way. This method facilitates project-based learning that links environmental issues to students' daily lives, so that students can understand environmental impacts in the context of their culture and location (Devecchi et al. 2024) Through activities that integrate local history and ecology, students not only understand theory but also see its application in practice. Students are trained to critically analyze existing information (Bian et al. 2024) . This enables them to develop strong critical and analytical skills, which are essential for understanding the complex interactions between humans and the environment. The application of CBL in schools demonstrates the importance of collaboration between education and field practice to increase environmental awareness and positive action among students. This is in line with research showing that

interaction between students and a contextual and socially relevant learning environment can improve learning outcomes and commitment to environmental conservation (D'eon et al. 2024).

The integration of local wisdom in environmental education has also been proven to increase students' understanding and awareness of environmental issues, as shown in research on local wisdom-based eco-pedagogy in Kampung Naga, which successfully increased students' environmental knowledge and awareness significantly (Mulyanie and Setiawan 2024). Learning models that integrate local wisdom have been proven effective in improving students' environmental awareness, for example through the use of Subject Specific Pedagogy (SSP) based on local wisdom, which improves environmental awareness in various aspects such as natural balance and anti-anthropocentrism (Suryani, Muryani, and Yusup 2020) . Local wisdom-based learning also ensures that education is culturally relevant and interesting for students (Noviana et al. 2023) , which helps maintain their interest in learning and makes the learning experience more relevant (Usmeldi and Amini 2020) .

The development of teaching materials based on local wisdom, such as ethnobotany in the Temedak forest, has shown valid and feasible results for application in biology learning, which also plays a role in improving students' competence in science (Sari, Sriyati, and Solihat 2020) . Science learning based on local wisdom, such as that practiced by the Samin tribe in land conservation, has also been proven to improve students' conservation character from poor to good (Khusniati, Parmin, and Sudarmin 2017) . Additionally, media such as digital comics based on folk tales that integrate local wisdom are effective in increasing students' environmental awareness by introducing relevant ecological principles (Hudhana, Sumarlam, and Sumarwati 2025)

Problem-based approaches that integrate local wisdom can also improve students' conceptual knowledge and environmental literacy, (Sarbaini et al. 2022) , which underlines the importance of approaches that are relevant to the local context in education (Lubis et al. 2022) . This local wisdom-based learning model has proven effective in fostering critical thinking, problem-solving skills, and building positive attitudes toward environmental conservation among students. Thus, this model not only provides an understanding of culturally relevant real-world issues but also instills important environmental awareness values for sustainable environmental management (Munjiatun et al. 2020).

Through hands-on experiences and real-world projects, such as Prairie Science Class, students can develop a deeper connection with nature, which enhances their cognitive and affective outcomes (Ernst and Stanek 2006) . Experience-based learning involving real activities, such as caring for plants or animals, also significantly increases students' concern for the management of their environment (Alt, Alt, and Hadar-Frumer 2020; Triyandana et al. 2024) . All these findings confirm that learning that integrates local cultural knowledge and local environmental issues results in significant improvements in students' environmental behavior and attitudes, as well as increasing their understanding of cultural diversity and its role in environmental conservation (Tadena and Salic-Hairulla 2021) . The Conservation-Based Learning Model is a model that effectively promotes cultural diversity and environmental awareness by combining practical, community-based, and culture-centered educational strategies. This approach not only improves students' knowledge and attitudes towards the environment, but also fosters a deeper understanding and appreciation of cultural diversity.

The application of a conservation-based learning model integrated with local wisdom has proven effective in improving students' conservation character and environmental literacy. The use of relevant media, such as digital comics and traditional games, as well as problem-based learning approaches, can have a significant positive impact on the development of students' character and environmental literacy. The integration of local wisdom into the elementary school curriculum is essential for creating sustainable environmental awareness and strengthening conservation values among students.

CONCLUSION

The application of the Conservation Based Learning (CBL) model integrated with local wisdom significantly improved the environmental literacy of fifth-grade elementary school

students. This model succeeded in improving students' understanding of basic conservation concepts, their ability to analyze environmental problems, and the application of environmental knowledge in their daily lives. In addition, the integration of local wisdom in learning has been proven effective in improving students' environmental awareness, critical thinking, and teamwork skills. This local wisdom-based approach provides a more holistic understanding of the relationship between ecological systems and human activities, while introducing conservation practices relevant to the local cultural context. Thus, this learning model not only increases students' environmental awareness and knowledge but also equips them with the attitudes and skills necessary to contribute to sustainable environmental management. A limitation of this study is the small sample size, with only 32 students in each group, which may affect the generalization of the results. In addition, this study was only conducted on fifth-grade elementary school students, so the results may not be directly applicable to higher levels of education. Another limitation relates to the duration of the intervention, which may not have been long enough to see the long-term impact of the CBL model. In the future, further research with a larger sample size and longer duration could provide more in-depth insights into the effectiveness of this model.

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AUTHORS' CONTRIBUTION STATEMENT

This research is the result of collaboration between several individuals, with each author making a significant contribution at various stages of formulating the research idea, designing the experimental methodology, and taking full responsibility for data analysis. actively participated in the development of research instruments, assisted in data collection in the field, and provided crucial input in the discussion of the interpretation of results and refinement of the manuscript, as well as participating in the revision and final editing of the article.

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