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DEVELOPMENT OF A PLANT ECOLOGY BOOK BASED ON NIAS ETHNOSCIENCE TO IMPROVE SCIENCE LITERACY OF BIOLOGY STUDENTS

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K E Y W O R D

Development, Plant Ecology;
Ethnoscience;
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A B S T R A C T

The purpose of this study is to develop a plant ecology book based on Nias ethnoscience to improve the scientific literacy of biology students that is valid, practical and effective. The type of research used in this study is research and development (Research and Development). The development model of this research is using the iADDIE i (Analysis, Design, Development, Implementation, Evaluation) model which is designed to produce valid, practical and effective learning products. The ADDIE model was chosen because it is highly flexible in various educational contexts, including integration with ethnoscience content. The study was conducted in the Department of Biology Education, Faculty of Teacher Training and Education, Nias Raya University. The results of this study are the development of a plant ecology book containing ethnoscience is declared very valid with an average score of 4.15. While the practicality of lecturers is 83.2 and is stated to be very practical. While the practicality for students is 82.5 and is stated to be very practical. For the effectiveness test with parametric statistical data in measuring student scientific literacy with an N-Gain value of 0.49 for the experimental class and 0.03 for the control class, it is stated that there is an increase in student scientific literacy. The conclusion of this study is that the Nias ethnoscience-based plant ecology textbook developed is highly valid, with practical value for both lecturers and students. Meanwhile, the effectiveness of student scientific literacy from the pretest, posttest, hypothesis testing, and N-Gain can improve the scientific literacy of biology students.

INTRODUCTION

Plant ecology is a branch of biology that studies the interrelationships between plants and their environment, both biotic and abiotic. Through plant ecology, students are not only required to understand basic concepts such as plant adaptation, population, community, vegetation, ecosystem, productivity, and succession, but also to be able to relate these concepts to real-world phenomena, particularly in the Nias region. Plant ecology should not only focus on mastering theory but also be able to measure students' understanding of analyzing and applying scientific concepts in the Nias Islands. Scientific literacy is crucial for the development of learning processes. Scientific literacy relates to students' knowledge in scientific research and learning, explaining natural phenomena scientifically, being authentic and realistic scientifically, and having the courage to make scientific decisions (Imjai et al., 2026). Biology learning is closely related to scientific and scientific knowledge, so a teaching process that directs students' scientific literacy, especially in the Nias Islands, is required.

Student learning, particularly in plant ecology, remains conventional and fails to connect culture to everyday life. This results in learning being purely theoretical and lacking involvement in daily life activities in the area where they live, which are in contact with the learning environment (Videnović et al., 2026). Several theories suggest that low scientific literacy is due to the lack of contextual and meaningful cultural connections. Examples include the topic of plant ecology, which is easily linked to the local wisdom of the surrounding community. Plant ecology, in particular, offers significant potential that can be explored further, particularly in the Nias Islands, which could enhance students' scientific literacy.

The Ethnoscience approach is a learning approach that links local community knowledge, culture, traditions, and community practices to scientific concepts in the Nias Islands. In biology, ethnoscience can be used to understand several natural phenomena that are close to the lives of the Nias Community, such as plant adaptation, plant populations, ecosystems, conservation of the local cultural environment, the relationship between humans, nature, and culture, and community habits in managing agriculture and forestry. Ethnoscience studies are closely related to students' scientific literacy skills in their surroundings that are close to culture and learning styles because students learn through phenomena that are close to culture and everyday life in their environment (Rizki et al., 2025).

The Nias Islands boast abundant natural resources and diverse flora and fauna, which can be studied in ecology and linked to students' scientific literacy. The Nias people possess ancestral knowledge that needs to be scientifically studied to develop local potential for preserving their natural resources. This potential requires preservation by developing local potential through student learning. This allows students to easily integrate this knowledge into their daily lives. Recent research on Nias local wisdom suggests that the local knowledge of the Nias people can be explored as a source of scientific learning through an ethnoscience approach for students to explore more broadly (Sakti et al., 2024).

The development of a plant ecology textbook based on Nias ethnoscience is crucial because it can provide teaching materials that are more relevant to students' experiences. The textbook not only presents theoretical concepts of plant ecology but also relates them to local phenomena in Nias, such as plant adaptation in the island environment, vegetation patterns, community agricultural systems, the use of local plants, and the relationship between communities and forests and the environment. This way, students can understand that plant ecology is not a science isolated from community life, but rather a science that can be used to interpret, explain, and solve environmental problems in their surroundings (Liu et al., 2021).

In addition, ethnoscience-based books can also strengthen students' cultural identity and foster conservation awareness. Students not only learn abstract scientific concepts but are also encouraged to appreciate local community knowledge as part of scientific learning resources. The integration of local wisdom in science learning has been shown to strengthen conceptual understanding, increase learning engagement, and encourage students' ability to connect scientific knowledge with real life (Bearzatto & Mammino, 2026). Based on the research background above, the purpose of this study is to develop a valid, practical, and effective plant ecology book based on Nias ethnoscience to improve biology students' scientific literacy.

The development of a plant ecology textbook based on Nias ethnoscience is crucial because it can provide teaching materials that are more closely connected to students' experiences. The developed book not only presents theoretical plant ecology concepts but also links them to local Nias phenomena, such as plant adaptation to the island environment, vegetation patterns, community agricultural systems, the use of local plants, and the community's relationship with forests and the environment. In this way, students can understand that plant ecology is not knowledge separate from community life, but rather a science that can be used to read, identify, and solve environmental problems (Jacinda & Surtikanti, 2023).

Furthermore, ethnoscience-based books can strengthen students' cultural identity and foster conservation awareness. Students not only learn scientific concepts in a formative manner but are also encouraged to appreciate local knowledge as part of scientific learning resources. Integrating local wisdom into science learning has been shown to strengthen conceptual understanding, increase learning engagement, and encourage students' ability to connect scientific knowledge to real life. Based on the research background above, the purpose of this study is to develop a valid, practical, and effective plant ecology book based on Nias ethnoscience to enhance biology students' scientific literacy.

METHOD

The type of research used in this study is research and development (R&D) with the aim of this research to develop a plant ecology book based on Nias ethnoscience in improving the scientific literacy of biology students that is valid, practical and effective. According to Sugiyono (2016:197) defines that research and development (R&D) is research used to produce certain products and test the effectiveness of products in the form of Nias cultural ecology books.

The development model for this research uses the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, which is designed to produce valid, practical, and effective learning products. The ADDIE model was chosen because of its high flexibility in various educational contexts, including integration with ethnoscience content. This model allows each development stage to be designed sequentially and iteratively, ensuring that the resulting plant ecology textbook is in accordance with learning needs and is able to accommodate local wisdom (Roswita et al., 2024).

The subjects of this study were students taking the Plant Ecology course, majoring in biology education, at the Faculty of Teacher Training and Education, Nias Raya University. These subjects were selected based on the criteria of course involvement, cultural diversity, and student availability. The number of subjects was determined using a sampling method. Subjects will be grouped into initial and main trial groups to measure the effectiveness of the developed textbook. The object of this study is an ethnoscience-themed textbook developed for the Plant Ecology course. This research includes the Lesson Implementation Plan (RPS), the textbook, and the Student Worksheet.

The research was conducted in the Biology Education Department, Faculty of Teacher Training and Education, Nias Raya University, due to its cultural relevance and the potential for exploring and integrating local wisdom into learning in the South Nias region, located on Jl. Pramuka, Nari-nari, Pasar Teluk Dalam Village, South Nias Regency, North Sumatra Province.

The research location was conducted using a sampling method, considering that the Biology Education Department, Faculty of Teacher Training and Education, Nias Raya University, was chosen because it aligns with the book's research subjects: students studying plant ecology who are enthusiastic and highly motivated in their learning. The research was conducted in November 2025.

Data Collection Instruments

The data collection instruments used in this study were designed to support the collection of accurate and valid information regarding the validity, practicality, and effectiveness of ethnoscience-related textbooks. The instruments used were as follows:

Textbook Validation Test Instrument

The content validity of the instruments in this study was assessed using the CVR and CVI. The CVR was used to determine the suitability of each instrument item based on expert assessments, while the CVI was used to assess the overall relevance and representativeness of the instrument's content (Larasanty et al., 2021; Fitrianty et al., 2022). The following is the formula for the Content Validity Ratio (CVR) and Content Validity Index (CVI):

$$\text{CVR} = \frac{ne - \frac{N}{2}}{\frac{N}{2}}$$ (Lawshe, 1975)

Description:

CVR = content validity ratio
n = number of panelists who gave a rating of 3 (relevant)
N = number of panelists

An instrument item is declared to meet the content validity requirements if it has a CVR value ≥ CVR table at a significance level of α = 0.05. Furthermore, after the CVR results are obtained, an analysis

is continued using the CVI (content validity index) formula to determine the validation of the entire instrument (Lawshe, 1975).

$$\text{CVI} = \frac{\sum \quad CVR}{k}$$

Description:

CVI = content validity indeks

CVR = number of content validity index

K = number of grains

The validation criteria for the overall content of the instrument in the content validity index (CVI) formula are as follows.

Table 1. CVI Value Categories

Range	**Weight**	
0.00 - 0.33	Not appropriate/invalid	
0.34 - 0.67	Appropriate/Valid	
0.68 - 1.00	Very appropriate/Very Valid	(Lawshe,1975)

The results of the validated instruments in the form of book validation sheets, practicality questionnaires, and student science literacy tests conducted by validators took into account aspects of content suitability, indicator suitability, language clarity, item construction accuracy, and instrument relevance according to the research instrument data.

Table 2. Instrument Validity Results

No.	Type of Instrument	Aspects Assessed	CVI Value	Category
1	Subject matter expert validation sheet	Conformity of content, concepts, and indicators	0,89	Very valid
2	Media/teaching materials expert validation sheet	Appearance, presentation, and readability	0,87	Very valid
3	Language expert validation sheet	Clarity of sentences and accuracy of terms	0,85	Very valid
4	Lecturer practicality questionnaire	Conformity of statements and ease of use	0,88	Very valid
5	Student practicality questionnaire	Clarity of statement and understandability of content	0,86	Very valid
6	Science literacy test	Suitability of questions with scientific literacy indicators	0,90	Very valid

Validation results showed that all instruments achieved CVI values between 0.85 and 0.90, categorizing them as highly valid. These results indicate that each instrument met the analyzed indicators and was valid for use in the research trials.

Instrument Reliability

Reliability testing is conducted to determine whether the instrument can provide consistent results in measuring the variables studied (Basantes, 2023). A reliable instrument will produce reliable data when used under relatively similar conditions. In this study, the reliability of the questionnaire was analyzed using Cronbach's Alpha with the help of the SPSS program. An instrument is considered reliable if the Cronbach's Alpha value is ≥ 0.70. This test is used to determine consistency between questions in measuring the same aspect. The following is the Cronbach's Alpha (α) formula used (Sugiono, 2018):

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum \sigma_i^2}{\sigma_t^2}\right)$$

Interpretation of Alpha Value:

Table 3. Alpha Values

Alpha Value	Reliability Level
≥ 0.90	Very high
0.80 - 0.89	High
0.70 - 0.79	Poor
0.60 - 0.69	Unreliable
< 0.60	No reliability

The minimum threshold often used is ≥ 0.70, which indicates that the instrument is sufficiently reliable in research data. The results of the research reliability instrument test indicate that the instrument is said to be reliable if the Cronbach's Alpha value is ≥ 0.70. This value indicates that the items in the instrument have sufficient consistency to be used in research instruments.

Data Analysis Techniques

a. Product Content Validity Analysis

Textbook validation testing evaluates the feasibility of textbooks developed through expert input. Validation testing ensures that textbooks containing ethnoscience are feasible in terms of didactic, technical, construction, and linguistic aspects. Content validity is obtained from expert assessments based on analyzed items. The quantitative method used in assessing content validity is the Aiken's V test (Aryanto, 2018).

$$V = \frac{\sum \quad s}{n\,(c-1)}$$

(Aryanto, 2018)

Description:

V	=	Aiken's V validity coefficient
s	=	the score given by the expert minus the lowest value on the scale
c	=	number of categories in the scale
n	=	jnumber of experts (validators)

The results of the V index calculation can be categorized based on the index, with details of the index conversion guidelines as seen in Table 3.4 below.

Table 2.4 Index V Conversion Guidelines

Index	Category (validity)
≤ 0,4	Less valid
0,4 < 0,8	Quite valid
≥ 0,8	Very valid

Product Practicality Analysis

Practicality analysis aims to measure the extent to which a plant ecology textbook containing ethnoscience can be easily understood and effectively used in the learning process by lecturers and students. Practicality was assessed through a limited trial in the form of a questionnaire of lecturer and student responses.

The test analyzed included ease, clarity, and understandability of the content of each ethnoscience element relevant to the local context. The collected data were analyzed using descriptive statistical analysis techniques with the following formula.

$$NK \frac{\Sigma x}{SMI} x100\%$$

(Riduwan, 2007)

Description:

NK = Practical value of the product

Σx = Total score given by observer

SMI = The maximum score that can be given by an observer.

To determine the level of practicality of a book, use the benchmark assessment (PAP) as presented in Table 5 below.

Table 5. PAP Conversion Guidelines Product Practicality

No	Percentage range of scores (%)	Category
1	81 – 100	Very practical
2	61 – 80	Practical
3	41 – 60	Quite practical
4	21 – 40	Low practical
5	0 – 20	Not practical

(Riduwan, 2007)

If the product is deemed worthy, it will receive a minimum score of 80%, categorized as good. If the score falls short of this criterion, the product will need to be revised based on input and suggestions from the validators.

This study aimed to test the product's practicality by measuring the extent to which the ethnoscience-based plant ecology textbook is easily understood and effectively implemented in the learning process by both lecturers and students.

b. Product Effectiveness Analysis

The effectiveness analysis of a plant ecology book containing ethnoscience measures the effect on students' scientific literacy skills. This test was conducted to determine whether the use of the book can have a significant impact on student literacy or not. The book's effectiveness was tested through a quasi-experimental design with a pretest-posttest control group design approach, in which there were two groups. Dantes, (2017, namely:

1) Normality Test

A normality test was conducted to measure whether the data on students' scientific literacy improvement was normally distributed (Sugiono, 2018). This test is important before using parametric statistical analysis, which assumes that the data is normally distributed. In this study, a normality test was conducted on the N-Gain scores of the creative thinking ability of the experimental and control groups using the Kolmogorov–Smirnov (K–S) test, with a significance level (α) of 0.05. The data were processed using IBM SPSS Statistic 25 software.

2) Homogeneity Test

The homogeneity test aims to measure whether the data on student science literacy improvement from both groups (experimental and control) have equal variances. This test is an important prerequisite for using parametric statistical analysis, such as the independent sample t-test. In this study, the

homogeneity test was conducted using Levene's Test for Equality of Variances using IBM SPSS Statistics 25 software. If the significance value (Sig.) in the Levene's test is >0.05, then the data from both groups are considered to have homogeneous variances (not significantly different), allowing for further parametric analysis (Pallant, 2020).

3) Hypothesis Testing

Hypothesis testing was conducted to determine whether there was a significant difference between the experimental and control groups in students' creative thinking skills after using the ethnoscience-themed textbook.

The testing was conducted on the N-Gain values of creative thinking skills obtained from the pretest and posttest results for both groups. Because the data met the assumptions of normality and homogeneity of variance, the testing was conducted using an Independent Sample t-Test with the following hypothesis criteria using IBM SPSS Statistics 25 software (Pallant, 2020):

H_0 (Null Hypothesis): There is no significant improvement between the experimental and control groups in students' scientific literacy.

H_1 (Alternative Hypothesis): There is a significant improvement between the experimental and control groups in students' scientific literacy.

d. *N-Gain Score*

This study measures the level of improvement in students' scientific literacy skills after treatment using textbooks containing ethnoscience, compared to conventional learning with the following formula (Hake, 2020).

$$(g) = \frac{(posttest\ score - pretest\ score)}{(maximum\ score - pretest\ score)}$$

Next, the Normality Gain (g) value obtained is translated according to the criteria for obtaining Normality Gain (g) as presented in Table 2.6 below.

Tabel 2.6
Kriteria perolehan Normalitas Gain (g)

Interpretation Gain Score	Interpretation Gain Score
$g \geq 0{,}7$	High
$0{,}3 < g < 0{,}7$	Medium
$g \leq 0{,}3$	Low

RESULTS

A. Research and Development Results

This research resulted in a plant ecology textbook based on Nias ethnoscience to improve the scientific literacy of biology students. The research and development was designed based on the needs of students teaching plant ecology courses, integrating plant ecology concepts with local wisdom and knowledge of the Nias community. The developed textbook contains plant ecology teaching materials based on phenomena found in the local Nias community. The results of this research include the validity of the teaching materials, their practicality, and their effectiveness in improving students' scientific literacy.

1. Textbook Validity Results

Validation of the textbook examines the appropriateness of the content, presentation process, technical construction, and language, as well as its relevance to the developed ethnoscience elements. The validation process involves experts including material experts, language experts, media experts, and ethnoscience experts.

The content validity test for this product uses the Aiken's V formula. This formula is used to assess the experts' assessments of each aspect of the indicators tested in the textbook. The validity test criteria refer to an index value of ≤ 0.4, which is considered less valid; $0.4 < V < 0.8$ is considered moderately valid; and $V \geq 0.8$ is considered highly valid. The results of the validation test for the Nias ethnoscience-based plant ecology textbook can be seen in Table 3.1.

Table 3.1 Results of Textbook Validation by Experts

No.	Assessment Indicator	Aiken's V Score	Category
1	Content/Material Suitability	4.10	Very Valid
2	Presentation Suitability	4.15	Very Valid
3	Language Suitability	4.13	Very Valid
4	Construction Suitability	4.20	Very Valid
5	Technical/Design Suitability	4.10	Very Valid
6	Suitability with Nias Ethnology	4.21	Very Valid
7	uitability with Scientific Literacy	4.20	Very Valid
	Average	**4,15**	**Very Valid**

Table 3.1 above shows that the Nias ethnoscience-based plant ecology textbook achieved an average Aiken's V score of 4.15, categorizing it as highly valid. This study indicates that the textbook developed by the researchers is highly valid and can be used in plant ecology teaching for biology education and biology science students.

The content suitability indicator, with a score of 4.10, indicates that the book is suitable for teaching materials based on the basic concepts of plant ecology. The developed textbook covers topics such as plant adaptation, population, community, vegetation, ecosystem, productivity, succession, and plant conservation. Furthermore, the teaching materials are linked to local Nias cultural phenomena, allowing students to study the ecology textbook based on the traditions and culture they learn in their daily lives in the Nias archipelago.

The material presentation indicator, with a score of 1.5, categorizes it as highly valid. These indicators demonstrate that the book's development process is systematic, beginning with an introduction to the material, conceptual descriptions, examples of Nias ethnoscience, scientific literacy activities, a summary, and evaluation. The book's development process is easily utilized by students in their learning.

The language aspect indicator received a score of 3.15, which is considered highly valid. The results of this study indicate that the language used in the book is relatively clear and specific, in keeping with the Nias culture it is compiled from, is highly communicative, and relevant to the students' level of development. The sentence structure is easy to understand without compromising the established scientific principles.

The Nias ethnoscience aspect indicator received a score of 4.21, which is considered highly valid. The results of this study indicate that the local culture and scientific knowledge of the Nias people in this book are highly relevant to the concept of plant ecology. The application of ethnoscience in the book strongly characterizes the uniqueness of the developed product, enabling students to integrate Nias cultural knowledge with contemporary science. From the results of the feasibility of this product, it was stated that the plant ecology textbook based on Nias ethnoscience was worthy of being continued to the practicality test stage.

2. Practicality Test Results of Textbooks Containing Ethnoscience

The Practicality Test of the textbook aims to measure the level of user-friendliness of the book for both students and lecturers teaching plant ecology courses. The following table summarizes the practicality test assessments by lecturers.

Table 3.2 Practicality Test of Textbooks by Lecturers

No.	Assessment Indicator	Percentage (%	Category
1	Ease of use of the book	81,2	Very practical
2	Clarity of instructions for use	77,4	practical
3	Understandability of the material	84,3	Very practical
4	Relevance to learning	82,4	Very practical
5	Relevance to scientific literacy activities	88,5	Very practical
6	Relevance to Nias ethnoscience	85,6	Very practical
	Average	**83,2**	**Very practical**

Table 3.2 shows that the textbook's practicality rating by lecturers indicates that it achieved an average of 83.2%, categorizing it as highly valid. The research findings indicate that the Nias ethnoscience-based plant ecology textbook is highly practical and easy to use by lecturers during learning activities.

Lecturers teaching plant ecology courses responded that the textbook was very easy to use because the textbooks they had previously studied did not focus on Nias cultural nuances, but rather were general in nature and did not relate to phenomena around the students. Furthermore, the developed textbook, which focuses on Nias ethnoscience, helps students think more critically and creatively and improves biology literacy in their home areas.

3. Practicality Test of Textbooks by Students

Based on the results of a practicality test of student textbooks, this study measures the level of usability of the textbooks for both students and lecturers teaching plant ecology courses. The following table shows the assessment of the practicality test by biology students:

Table 3.3 Practicality Test by Students

No.	Aspects Assessed	Percentage (%	Category
1	Attractive book layout	81,4	Very practical
2	Easy-to-understand language	83,2	Very practical
3	Easy-to-learn material	82,2	Very practical
4	Examples of Nias ethnoscience are easy to understand	81,10	Very practical
5	Activities help understand the material	82,4	Very practical
6	Books help improve scientific literacy	84,6	Very practical
	Average	**82,5**	**Very practical**

The practicality test results in Table 3.3, the results of the student practicality questionnaire, showed that the textbook, with an average percentage of 82.5%, was in the very practical category, indicating that the textbook was very practical for biology students to use during the learning process.

Students perceived the textbook as well-designed and provided responses in the form of examples that align with the culture of their environment. The textbook encouraged students to think realistically, and the examples presented were more accessible and engaging.

4. Textbook Effectiveness Test Results

To measure the effectiveness of the textbook, a study was conducted to determine the improvement in students' scientific literacy after using the Nias Ethnoscience-Based Plant Ecology textbook. To test

effectiveness, a pretest and posttest were used to assess student literacy improvement. The data were analyzed in the form of students' scientific literacy scores before and after the lesson. Effectiveness analysis was conducted through normality tests, homogeneity tests, hypothesis tests, and N-Gain calculations.

1) Results of the Student

Science Literacy Pretest and Posttest The following presents the results of the pretest and posttest for students' scientific literacy in the experimental and control groups, as shown in Table 3.4.

Table 3.4 Description of Students' Science Literacy Values

Class	Number of Students	Average Pretest	Average Posttest	Difference
Experimental	23	75,30	87,44	12,14
Control	21	70,50	71,30	0,8

Table 3.4 shows that the average pretest score for the experimental class was 70.3, with an average posttest score of 0.8. The results of this study indicate an increase in students' scientific literacy after using the Nias Ethnoscience-Based Plant Ecology textbook. Meanwhile, the control class had an average pretest score of 70.50 and a posttest score of 71.30. While this significant increase occurred in the control group, the increase was lower than in the experimental group. Based on this difference in improvement, it is clear that the use of the Nias Ethnoscience-based textbook had a significant impact on students' scientific literacy. Students in the experimental class experienced a more contextual learning experience because the Plant Ecology material was directly linked to local Nias experiences and the ecological wisdom of the Nias people.

2) Normality Test Results

Based on the results of the normality test with the aim of determining whether the data on increasing student scientific literacy is normally distributed or not. The results tested are N-Gain data from the experimental group and the control group. The results of the normality test were carried out using the Kolmogorov-Smirnov test using the SPSS data program. Based on the results of the normality test, the provisions were obtained where If the significance value > 0.05, then the data is normally distributed and if the significance value ≤ 0.05, then the data is not normally distributed. The results of the normality test can be seen in the following table.

Table 3.5 Results of the N-Gain Normality Test for Science Literacy

Class	Kolmogorov-Smirnov Classification Sig.	Description
Eksperimen	1,15	Normally Distributed
Kontrol	1,00	Normally Distributed

Based on Table 3.5, the significance value in the experimental group is 1.15 > 0.05, which can be stated as normally distributed, while the significance value in the control class is 1.00 > 0.05, which is also normally distributed. From the data above, considering that the significance value of both groups is greater than 0.05, thus the analysis of the N-Gain data on student science literacy can be concluded as normally distributed and can be continued with parametric statistical tests.

3) Data from the Homogeneity Test

The results of the homogeneity test were used to measure whether the data on the improvement in student scientific literacy in the experimental and control groups showed the same differences. The homogeneity test was conducted using SPSS. The criteria for homogeneity testing are that if the significance value is >0.05, the data have homogeneous variance. If the significance value is <0.05, the data have non-homogeneous variance. The results of the homogeneity test are presented in the following table.

Table 3.7 Results of the N-Gain Homogeneity Test of Scientific Literacy

Date	Levene Statistic	Sig.	Description
N-Gain Literasi Sains	1,075	0,05	Homogen

Based on Table 3.7, the significance value of the homogeneity test was 1.075. It can be concluded that the significance value is greater than 0.05, thus the N-Gain data on student scientific literacy from the experimental and control groups are homogeneous. From the results of this study, it was found that the data can be continued with parametric testing using the Independent Sample t-Test.

4) Hypothesis Test Results

Based on the research results, the hypothesis test can be conducted to determine whether there is a difference in the improvement of students' scientific literacy between the experimental and control groups. The test results using the N-Gain value for students' scientific literacy are shown in Table 3.8, as follows.

Table 3.8 Results of the Independent Sample t-Test N-Gain Science Literacy

Date	t	Df	Sig. (2-tailed)	Criteria
N-Gain Literasi Sains	7,842	42	0,000	Sig. < 0,05

From the research results above in table 3.9, the 2-tailed Sig. value was obtained at 0.000. Seeing the significance value of 0.000 < 0.05, then H_0 is rejected and H_1 is accepted. From these data, there is a significant difference between the increase in student scientific literacy in the experimental class and the control class.

Based on the research findings above, the use of the Nias Ethnoscience-Based Plant Ecology textbook was highly effective in improving the scientific literacy of biology students. This is supported by an increase in the average grade of the experimental class from 75.30 to 87.44, while the control class only increased from 70.50 to 71.30.

5) Results of the N-Gain Calculation of Scientific Literacy

Based on the N-Gain calculation, the aim was to determine the increase in students' scientific literacy after the learning process. The N-Gain data was analyzed using the difference between the posttest and pretest scores to be achieved, as shown in Table 3.9.

Table 3.9 Analysis of N-Gain Values of Students' Scientific Literacy

Class	N	Average Pretest	Average Posttest	Difference	N-Gain	Percentage N-Gain (%)	Category
Experimental	23	75,30	87,44	12,14	0,49	49%	Medium
Control	21	70,50	71,30	0,80	0,03	3%	Low

From the research results above, in the experimental class, the N-Gain value was obtained at 0.49 or 49% and was in the moderate category. The results of this study stated that the use of the Nias Ethnoscience-Based Plant Ecology Book product could improve the scientific literacy of Biology students and was in accordance with the Nias local culture book that had been in accordance with scientific studies. In the control class, the N-Gain value was obtained at 0.03 or and was in the low category. With the two classes above, it can be interpreted that there was a fairly small increase in student scientific literacy in the control class when compared to the experimental class that had implemented ethnoscience-based learning.

DISCUSSION

The research results indicate that the development of the Nias Ethnoscience-Based Plant Ecology Textbook achieved the highest quality based on validity, practicality, and effectiveness. The well-designed textbook applies scientific principles of plant ecology and is highly relevant to the richness of Nias cultural knowledge. This application serves as a theoretically grounded plant ecology textbook, yet scientifically grounded due to the concrete realities of student learning in the Nias Islands. According to (Annajmi et al., 2026), learning implemented with a local cultural context is highly relevant to direct student learning without theoretical fieldwork, resulting in a more meaningful learning process.

1. Discussion of Textbook Validity

Based on the validity test conducted by experts, the Nias ethnoscience-based plant ecology textbook obtained an average validity score of 4.15, categorized as very valid. The feasibility test was assessed by experts in material, language, media, and ethnoscience, covering aspects such as content, presentation, language, construction, technical/design, suitability for Nias ethnoscience, and relevance to scientific literacy. Validity testing in development research is crucial for a product's suitability for use as teaching material for developing appropriate knowledge for students (Miguel et al., 2026). Based on the content validation aspect, it was found that the textbook aligns with the basic principles of plant ecology, such as plant adaptation, population, community, vegetation, ecosystem, productivity, succession, and plant conservation. The developed textbook is then linked to events in the Nias community. Several other aspects that have been tested for feasibility also fall into the same categories and can be used by biology students.

2. Discussion of Textbook Practicality

The results of the practicality test revealed that the plant ecology textbook containing Nias ethnoscience was rated very practical by lecturers and students. Based on the assessment of biology education lecturers, the textbook received a percentage score of 83.2%, falling into the very practical category. The measured aspects included ease of use, clarity of instructions, integration of material, relevance to learning, relevance to scientific literacy activities, and relevance to Nias ethnoscience. The above research results indicate that the textbook is very easy for lecturers to use in the learning process. Based on the results of the practicality test, students obtained a score of 82.5%, categorizing it as very practical. The student assessments indicated that the developed textbook significantly facilitated student time management and was relevant to local culture. The practicality of the development was easily interpreted in the student learning process (Mansour et al., 2025).

3. Developing an Effectiveness Test for Ethnoscience-Based Textbooks

The effectiveness of the textbooks was analyzed in terms of improving students' scientific literacy using pretests and posttests in both the experimental and control classes. In the experimental class, the average pretest score was 75.30, with an increase of 87.44 from the posttest, with a difference of 12.14. Furthermore, the control class achieved an average pretest score of 70.50 and a posttest score of 71.30, with a difference of only 0.80. This difference indicates that the development of a Nias ethnoscience-based plant ecology textbook significantly improved students' scientific literacy compared to conventional learning. Meanwhile, the experimental class had a significant impact on students' scientific literacy skills. This was due to the application of the ethnoscience-based plant ecology textbook, which provided a more meaningful learning experience due to its cultural relevance (Bachri et al., 2024).

The N-Gain data analysis for the experimental class revealed an N-Gain value of 0.49, categorized as moderate. Meanwhile, the control class obtained an N-Gain value of 0.03, categorized as low. These data indicate a significant improvement in the experimental class compared to the control class. Therefore, it can be concluded that the ethnoscience-based plant ecology textbook on Nias is more effective in the learning process of biology students in the Nias Islands. This is consistent with (Bearzatto & Mammino, 2026) that the effectiveness of learning can influence student interest, motivation, creativity, and learning outcomes, and support student scientific literacy with a local integration nuance.

4. Discussion of Normality, Homogeneity, and Hypothesis Tests

Before testing the hypothesis and N-gain data, a normality test was conducted to determine whether the research data were normally distributed. In the experimental class, a significance value of 1.15 > 0.05 was obtained, indicating a normal distribution. Meanwhile, in the control class, a significance value of 1.00 > 0.05 was obtained, indicating a normal distribution. Therefore, the data met the requirements for parametric statistical testing.

Analysis of the homogeneity test results revealed that the N-Gain data on student scientific literacy had a homogeneous variance. Based on the Levene Statistic value of 1.075, the significance value met the homogeneity criteria. Because the data were normally distributed and homogeneous, the hypothesis testing could be continued using an Independent Sample t-Test.

The results of the Independent Sample t-Test showed a 2-tailed sig. value of 0.000 < 0.05. Therefore, H_0 is rejected and H_1 is accepted, meaning there is a significant difference between the increase in students' scientific literacy in the experimental class and the control class. These results indicate that the significant value in increasing Biology students' scientific literacy is very significant because the data from the hypothesis results can be accepted and have a clear effect on increasing students' scientific literacy.

CONCLUSION

The conclusion of this study is that the developed Nias ethnoscience-based plant ecology textbook is highly valid based on the results of expert validator assessments. Judging from the practicality of the Nias ethnoscience plant ecology textbook for both lecturers and students, it can be concluded that it is very practical. Meanwhile, the effectiveness value of the Nias ethnoscience-based plant ecology textbook based on the results of the pretest, posttest, hypothesis testing, and N-Gain can improve the scientific literacy of biology students. The Nias ethnoscience content in the textbook helps students understand the material from the plant ecology textbook in a more contextual, meaningful, and close to the phenomena that exist in the Nias community.

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