



The Development of an Ethnoscience-Based Science Module at Eucalyptus Oil Refining in Buru Regency to Reduce Student Misconceptions

Muhammad Rizal Hardiansyah^{1*}, Rahmiati Darwis¹, Nur Hikmah²

¹ Science Education, FITK, IAIN Ambon, Maluku, Indonesia

² Science Education, FTIK, IAIN Kendari, Sulawesi Tenggara, Indonesia

Received: June 09, 2024

Revised: December 02, 2024

Accepted: February 25, 2025

Published: February 28, 2025

Corresponding Author:

Muhammad Rizal Hardiansyah
rizalscience@iainambon.ac.id

DOI: [10.29303/jppipa.v11i2.6439](https://doi.org/10.29303/jppipa.v11i2.6439)

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



Abstract: This research is based on the limited learning resources that students can use independently. This research aims to develop an ethnoscience-based science module on the process of refining eucalyptus oil to determine the feasibility, practicality, and effectiveness of the module in reducing student misconceptions. The method used was research and development R&D. The research data obtained was analyzed using percentage descriptions. The results of the science module feasibility test showed that the feasibility of the material obtained a score of 88% with very feasible criteria. The feasibility of the media obtained a score of 89% with very feasible criteria. Furthermore, the feasibility of language obtained a score of 80% with appropriate criteria. The practicality of the module was tested through analysis of student responses to the module developed and a practicality score of 87% was obtained with very good criteria. This means that the ethnoscience-based science module developed has very good practicality in terms of a) attractiveness of the module, b) ease of use, c) ease of understanding the contents of the module, d) completeness of the contents of the module, and e) conformity with character values ethnoscience. According to the results of the analysis of learning outcomes tests accompanied by the Certainty of Response Index, it shows that the level of student misconceptions has decreased by 34% accompanied by an increase in the level of student understanding of concepts by 37%, and students who do not understand concepts have decreased by 3%. This shows that the module developed is effective in reducing student misconceptions.

Keywords: Ethnoscience-Based Science Module; Eucalyptus Oil Refining; Misconception

Introduction

Contemporary educational curriculum reform emphasizes the development of comprehensive learning experiences that facilitate students' acquisition of essential competencies required for both current and future challenges. This educational transformation recognizes the fundamental importance of preserving local wisdom while simultaneously addressing contemporary societal demands. The integration of local

cultural elements into pedagogical processes has become increasingly imperative, particularly within science education, where the preservation of traditional knowledge concurrent with the advancement of scientific understanding represents a critical educational objective. Within this pedagogical framework, ethnoscience has emerged as an increasingly significant approach in contemporary science education, offering a methodological bridge between traditional wisdom and modern scientific understanding.

How to Cite:

Hardiansyah, M. R., Darwis, R., & Hikmah, N. (2025). The Development of an Ethnoscience-Based Science Module at Eucalyptus Oil Refining in Buru Regency to Reduce Student Misconceptions. *Jurnal Penelitian Pendidikan IPA*, 11(2), 415–424. <https://doi.org/10.29303/jppipa.v11i2.6439>

Fundamentally, ethnoscience is a learning strategy that integrates culture into the science learning process to make it beneficial for life (Sudarmin & Rahayu, 2015). This concept has undergone significant development in recent years, where researchers have discovered that ethnoscience not only serves as a bridge between indigenous knowledge and modern science but also acts as an effective tool in building strong conceptual understanding. The transformation process of indigenous community knowledge into empirically validated scientific knowledge remains a key characteristic of the ethnoscience approach (Ahmadi et al., 2019).

In the learning context, ethnoscience plays a strategic role in building comprehensive and deep conceptual understanding (Sani, 2021). Recent research reveals that the ethnoscience approach enables students to construct scientific knowledge through concrete experiences rooted in local cultural practices. This finding is reinforced by (Sumarni & Kadarwati, 2020) study, which demonstrates that ethnoscience-based learning facilitates students in developing critical and analytical thinking abilities through the process of exploring traditional knowledge transformed into modern scientific concepts.

Based on the results of a preliminary study through observation activities carried out on students of the Tadris IPA Study Program at IAIN Ambon, it was found that the level of misconceptions in the Integrated Science course was in the medium category (53%). Initial observations were carried out by providing multiple choice questions related to integrated science material accompanied by the CRI (Certainty of Response Index) index which aims to see the level of student misconceptions in integrated science courses. This shows that the problem of misconceptions is still found in integrated science lectures.

As a result of interviews conducted with students, information was obtained that one of the factors causing students to experience misconceptions was the unavailability of adequate learning resources. When given independent or group assignments, students prefer using the internet or online sources. Students use online sources directly without considering which online sources are valid and credible. Thus, there could be information obtained from the internet that is entered by just anyone. The lecturer has recommended books that can be used in the Integrated Science course. Yet, students find it difficult to have these books and these books are not available in the library. Therefore, it is necessary to have adequate, valid, and credible learning resources that can be utilized by students to prevent ongoing misconceptions.

Students interviewed also stated that lecturers rarely linked the scientific concepts being taught

(scientific knowledge) with traditional culture. So far, the integrated science learning carried out by lecturers in the classroom seems to be unrelated to what is encountered and applied at home or outside the classroom. According to students, the knowledge and habits they acquire in society are limited to knowledge that has been passed down through generations, without trying to relate it to the scientific concepts they have studied.

Misconceptions in science learning have become a serious challenge in higher education, particularly in Integrated Science learning. Recent studies have identified that misconceptions often occur when students cannot connect scientific concepts with their daily experiences (Lucariello & Naff, 2020). Learning approaches integrating local context can effectively reduce student misconceptions in science courses. These findings highlight the importance of developing learning strategies that can help students build meaningful connections between scientific concepts and their concrete experiences.

In the context of Integrated Science learning, the use of ethnoscience-based modules becomes increasingly relevant considering the characteristics of courses that integrate various science concepts. Ramandanti & Supardi (2020) reveal that the ethnoscience approach helps students understand the interconnections between science concepts through concrete examples from local cultural practices. This finding is strengthened by (Ardianti & Raida, 2022) research, which demonstrates the effectiveness of ethnoscience approach in improving science conceptual understanding.

Based on the above literature review, the development of ethnoscience-based science modules has great potential to reduce student misconceptions. The integration of traditional knowledge with modern scientific concepts not only helps students build more comprehensive understanding but also facilitates the process of identifying and correcting misconceptions through contextual and meaningful learning. This approach becomes increasingly relevant in the context of Integrated Science learning, which requires an integrated understanding of various science concepts.

The results of investigating aspects of local culture in Maluku, found that the people of Maluku, especially Buru Regency, have utilized scientific concepts in their daily lives and have been doing this for generations, especially in the process of refining eucalyptus oil. The eucalyptus oil refinery boiler on Buru Island has been operating since World War II. Local people depend on managing eucalyptus oil for their livelihood from generation to generation and distilling eucalyptus oil using traditional methods. A distiller does not have special skills in the process of distilling eucalyptus. The knowledge of distilling was obtained from the

experience of helping his parents. According to him, from the past until now, there has been no muscy change in the refining process. Everything is still conducted traditionally. The process of refining eucalyptus oil can be explored with scientific concepts related to the concept of changes in form, separation techniques, density, and pressure of substances. The results of ethnosience studies show that there is potential for ethnosience that can be applied to science learning.

Most previous research has studied about ethnosience-based science module. The Development an ethnosience-based science module can effectively improve students' critital thinking abilities (Fitriani & Setiawan, 2017; Nabil et al., 2021). The Development an ethnosience-based science module can improve students' scientific literacy (Afliansyah, 2022; Dewi et al., 2020; Dian, 2022; Fitria & Wisudawati, 2018). An ethnosience-based science module can instilling a spirit of conservation in students (Rahayu & Sudarmin, 2015). The Development an ethnosience-based science module has improved students' critital thinking abilities, scientific literacy, and a spirit of conservation. However, no research has studied its effect to reduce students' misconceptions.

Based on the description above, the author needs to conduct research related to teaching materials in the form of ethnosience-based science modules. The module characterized by ethnosience aims to reduce the level of student misconceptions about Integrated Science concepts. Therefore, the author intends to conduct development research entitled "Development of an ethnosience-based science module at the eucalyptus oil refinery in Buru Regency to reduce student misconceptions".

Method

The type of research used in this research was research and development known as Research and Development (R&D). It used a quantitative approach to produce ethnosience-based science modules at eucalyptus oil refineries in Buru Regency to reduce student misconceptions. The development model used as the basis for developing ethnosience-based science modules adapts the Borg & Gall model.

According to Borg and Gall, R&D approach in education includes 10 research steps. From the 10 research steps, this research simplified it into 8 development stages to minimize research time and costs incurred in the production process of module teaching materials. The research development steps are potential and problems, information gathering, initial product design, validation, design revision, small group trials, product revision, and final product. The research

development phases are systematically illustrated in Figure 1.

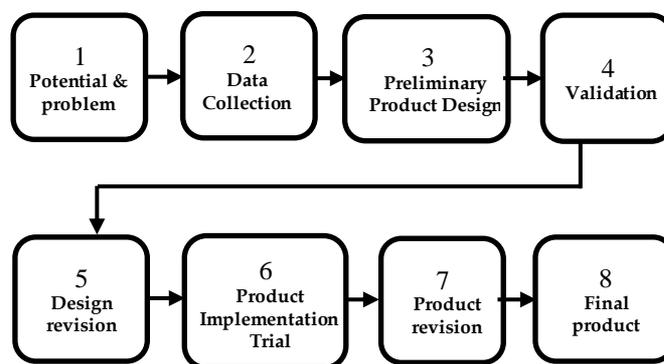


Figure 1. Research and development flow

The population determined by the researcher comprised all active students of the Science Education Study Program at the FITK IAIN Ambon, during the even semester of the 2022/2023 academic year. In the limited trial, a sample of 20 students was selected using random sampling technique, while the large-scale trial involved the entire student population.

Data collection techniques in this research included expert validation questionnaires, student response questionnaires, and administering the CRI test to measure the level of student misconceptions.

Expert validation questionnaire

This questionnaire was used to measure the feasibility of the ethnosience-based science module being developed. This validation questionnaire consisted of three, namely material validation questionnaire, language validation questionnaire, and media/design validation questionnaire. The quantitative validation questionnaire data can be processed by presenting percentages using a Likert scale as a measurement scale. The Likert scale is an attitude scaling method that uses response distribution as the basis for determining the scale value. This questionnaire consisted of five scales consisting of: (5) Excellent, (4) Good, (3) Fair, (4) Poor, (5) Very Poor. The eligibility criteria can be seen in Table 1.

Table 1. Eligibility Criteria

Evaluation	Criteria
$81 \leq P < 100\%$	Very Decent
$61 \leq P < 81\%$	Decent
$41 \leq P < 61\%$	Quite decent
$21 \leq P < 41\%$	Not Decent
$0 \leq P < 21\%$	Very Not Decent

Student response questionnaire

This questionnaire was used as a practical questionnaire to determine student responses to the ethnoscience-based science module that has been developed. This questionnaire contained student responses regarding ease of use, the practicality of learning time, as well as the attractiveness and benefits of ethnoscience-based science learning modules. The results of this student response questionnaire were given to 20 students. Practicality, criteria can be seen in Table 2.

Table 2. Practicality Criteria

Evaluation	Criteria
$81 \leq P < 100\%$	Very Practical
$61 \leq P < 81\%$	Practical
$41 \leq P < 61\%$	Quite Practical
$21 \leq P < 41\%$	Not Practical
$0 \leq P < 21\%$	Not Very Practical

CRI Test

The CRI test instrument was used as a data collection tool to identify misconceptions. Student misconceptions in Integrated Science learning could be identified by looking at the answers of students who have studied the material. This research used the CRI test instrument to provide a level of certainty in understanding to select concepts, knowledge, and laws that are formed from within oneself to determine answers according to one's understanding of a question. The CRI test instrument in this research used science questions, especially material on changes in form, separation of mixtures, density, and pressure. The test is a multiple choice with 20 questions.

One example of a CRI test item is as follows:

Object A has a density of $1,200 \text{ kg/m}^3$ and object B has a density of 850 kg/m^3 . If both objects are placed in a vessel containing water with a density of $1,000 \text{ kg/m}^3$, what will happen to both objects?

- a. Objects A and B will float on the water surface
- b. Objects A and B will sink in the water
- c. Objects A and B will remain suspended in the water
- d. Object A will float on the water surface and object B will sink in the water
- e. Object B will float on the water surface and object A will sink in the water

Table 3. Certainty of Response Level

Absolutely Certain	Very Confident	Confident	Not Confident	Just Guessing	Completely Guess

The equation for finding the percentage of students answering questions along with their level of confidence is as follows:

$$P = \frac{f}{N} \times 100 \% \tag{1}$$

Information:

f = The frequency the percentage is being searched for

N = The number of frequencies or number of individuals

P = Percentage

The percentage of misconceptions obtained is then grouped based on Table 3.

Table 4. Misconceptions Percentage Assessment Category

Misconceptions	Category
0 % - 33 %	Low
34 % - 67 %	Moderate
68 % -100%	High

Result and Discussion

Ethnoscience-based science learning is conducted by reconstructing original science to translate original science into scientific concepts (Fasasi, 2017). This original science was obtained through interviews and observations of culture and local wisdom at the eucalyptus oil refinery in Buru Regency. As for the results of observations and interviews with respondents, namely eucalyptus farmers, and distillers of eucalyptus oil on Buru Island, precisely in Jamilu Village, the stages in the eucalyptus oil distillation process were obtained, consisting of sorting the leaves in the eucalyptus plantation, storing the leaves in good condition. closed before distilling, preparing a series of distillation kettles, filling the kettle with water and circulating the cooler, putting the leaves into the kettle until they are full, closing the kettle lid tightly, heating the furnace, and separating the water and eucalyptus oil.



Figure 2. Traditional Eucalyptus Oil Refining Kettle

As a result of observations and interviews with respondents, namely eucalyptus farmers as well as eucalyptus oil refiners in Jamilu Village, several things were used as the focus of the research, namely knowledge regarding:

1. Traditionally distilling eucalyptus oil. It is known that distilling skills mostly come from hereditary knowledge inherited from ancestors. This shows that traditional eucalyptus oil distillation is a culture that has survived from time to time and developed as local wisdom in refining eucalyptus oil on Buru Island which is still carried out by eucalyptus farmers today.
2. Leaf sorting. It is the activity of harvesting eucalyptus leaves from the tree by pulling the leaves from the base of the twig to the tip of the twig. Leaf sorting should be conducted when the weather is sunny and not raining. When it is stored, the leaves are dry. This is because storing the leaves in wet conditions can accelerate the rotting of the leaves after sorting, which will affect the quality of the eucalyptus oil produced.
3. Storing leaves covered before cooking is an activity of storing the main raw materials before entering the cooking process by covering the leaves. This is scientifically interpreted in terms of changes in form that leaves that are kept open can cause the eucalyptus oil content to evaporate due to exposure to sunlight.
4. Filling water into the *kawali* until it approaches the filter. It is the activity of flowing water into the cooking pan by opening the tap that leads to the *kawali* (cooking pan) until the water approaches the filter (does not touch or cross the filter line). This is scientifically interpreted in terms of changes in form that the water in the *kawali*, after being cooked for a while, will boil and then evaporate, where the water vapor will carry the eucalyptus oil vapor along with it to the cooler. Filling the kettle with water must not touch or pass through the filter boundaries so that the leaves in the kettle are not submerged to maximize the steaming process.
5. Tightly closing the lid of the kettle is an activity of putting a lid on the *sambo* (steamer) and sealing it by plugging the gap in the lid using eucalyptus tree bark. This is interpreted scientifically in terms of steam pressure, namely that the kettle is closed very tightly so that the steam produced can then exit in one direction through the condenser (cooler). The lid of the kettle is closed completely to avoid the release of water vapor containing oil which can reduce the yield of eucalyptus oil produced.
6. Furnace heating. It is lighting a fire in a clay oven using firewood as a sign of the start of the distillation process. This is interpreted scientifically in terms of mixture separation techniques (distillation), namely separating the contents of eucalyptus leaves by heating water and leaves and then collecting and condensing the vapor to obtain liquid form. Separating this mixture takes advantage of the boiling point difference, which involves heating the mixture until the substance with the lower boiling point evaporates and separates from the mixture.
7. Separating water and eucalyptus oil is an activity to drain the water in the distillation reservoir until the bottom water layer runs out. This is interpreted scientifically in terms of density, where the resulting distillate (distillate) is separated between oil and water by utilizing the principle of difference in density. The density of water is greater than the density of oil, so the water layer is at the bottom and will be removed first.

After knowing the traditional processes that occur in refining eucalyptus oil, the following describes the terms for the tools used in this traditional process.

1. Kettle is a whole series of tools for distilling traditional eucalyptus oil;
2. *Kawali*, is a tool for storing water made of aluminum metal which is in the lower position. *Kawali* is also known as a cooking pan.
3. *Sambo* is a tool for holding leaves made of wood in a position above *kawali*. *Sambo* is equipped with a cover which is also made of wood and a gap plug made of eucalyptus tree bark.
4. The furnace is a cooking stove made of clay.
5. The cooler is a condenser whose function is to change steam into liquid by lowering the temperature of the steam. The water in the condenser is always circulating so that the cooling process occurs continuously.

The scientific explanation found in the eucalyptus oil refinery of the Buru Island community can be used as a learning resource in the form of an integrated science lecture module. The results of the findings in original science which have been interpreted in scientific terms in refining eucalyptus oil have various functions and meanings for farmers. Thus, the local wisdom of refining eucalyptus oil is still implemented in everyday life as time goes by.

This research aims to produce a science module based on the ethnoscience of eucalyptus oil refining in Buru Regency for Integrated Science lectures. This development research was carried out using the method of Borg and Gall. Nieveen, (1999) stated that in research on the development of learning modules, 3 quality criteria are required, namely feasibility, practicality, and effectiveness (Rochmad, 2012).

The feasibility test in this research consisted of the appropriateness of the material, media, and language. Each feasibility assessment was carried out by one

expert from material, media, and language experts. Based on the diagram in the results of the previous data analysis, it can be concluded that the science module based on ethnoscience of the eucalyptus oil refining process has the criteria to be suitable for use because it has been validated with 3 experts.

Feasibility of Ethnoscience-Based Science Modules

The researchers tested the feasibility through validation from material experts, media experts, and language experts.

a. Material Expert Assessment

The material expert assessment was carried out by a science material expert to assess the feasibility of an ethnoscience-based science module in the process of refining eucalyptus oil. The aspects assessed by material experts are content appropriateness, linguistic appropriateness, presentation aspects, and independent learning aspects. This material expert validation was carried out to obtain assessments from science material experts to assess ethnoscience-based science modules.

Material expert validation was carried out by filling out an assessment questionnaire consisting of 4 aspects with 15 indicators and 15 statements. At the validation stage, material experts provided assessments and suggestions regarding the development of ethnoscience-based science module products developed by researchers.

Table 5. Material Feasibility Result

Aspect	Score	Percentage	Criteria
Content	23	92	very feasible
Language suitability	24	96	very feasible
Presentation	11	73	Feasible
Learn to be independent	9	90	very feasible
Average	16.75	88	very feasible

Based on the feasibility aspect of the material, this module was declared valid by the validator and received a score from material experts of 88% with very feasible criteria. This is following the Ministry of National Education (2008) which stated that the teaching materials developed must follow the applicable curriculum and valid criteria for the material in this module showing that the materials in this module are well structured and suitable for use (Mirza et al., 2019). This module is packaged with a complete and sequential presentation (starting from the cover, foreword, table of contents, CPMK and objectives, usage guide for lecturers and students, learning activities, sample questions, practice questions, evaluation, and ending with a bibliography).

b. Media Expert Assessment

Media expert assessments are carried out by filling out an assessment questionnaire consisting of 3 aspects with 13 indicators and 13 statements. Media experts provide assessments and suggestions regarding the development of ethnoscience-based science module products developed by researchers.



Figure 3. Cover Design (Front Cover and Back Cover)

Validation results were obtained from media experts for the development of ethnoscience-based science modules with assessment results from the module size aspect of 90%, the cover design aspect of 85%, and the module content design aspect of 91%. The average result obtained from all aspects was 89% with very feasible criteria.

The feasibility aspect of this development module was declared valid by media experts who received a score of 89%. The media presentation in the module contains a pleasant atmosphere, uses attractive pictures and graphics, and displays the stages in the skill of distilling eucalyptus oil traditionally. Thus, it can encourage students to explore information that follows the purpose of making the module. The modules presented must use attractive images and graphics. Sudjana & Ahmad, (2013) stated that the images displayed must depict the concept or message of the content of the material to be conveyed. Thus, it can facilitate the achievement of learning objectives. Images can also attract attention, clarify ideas presented, and illustrate or decorate facts that might be quickly forgotten or ignored (Sadiman et al., 2011). Hence, pictures can motivate students to learn and remember lecture material, so that students can avoid misconceptions.

c. Linguist Assessment

The linguist assessment was carried out by a linguist to assess the feasibility of the ethnoscience-based science module on the process of refining eucalyptus oil. The aspects assessed by this linguist are

straightforwardness, communicativeness, language rules, dialogical and interactive, suitability to the level of development of students, consistency and integration of thought flow, as well as the use of terms and symbols or icons.

Linguist validation is conducted by filling out an assessment questionnaire consisting of 7 aspects with 14 indicators and 14 statements. At the validation stage, linguists provide assessments and suggestions regarding the development of ethnosience-based science module products developed by researchers. Data that has been validated by linguists is presented in Table 6.

Table 6. Linguist Eligibility Test Results

Aspect	Percentage	Criteria
Straightforwardness	80%	Very Decent
Communicative	100%	Decent
Language Rules	60%	Quite Decent
Dialogic and Interactive	80%	Decent
Suitability to the level of students' development	90%	Very Decent
Sequence and integration of thought flow	80%	Decent
Terms and symbols or icons	67%	Decent
Average	80%	Decent

Based on the validation results from language experts as in Table 4, it can be seen that the average percentage obtained was 80% and achieved adequate criteria. In other words, the linguist gave a decent value in terms of language to the science module based on the ethnosience of the eucalyptus oil refining process and also added a little input and suggestions to the researcher.

The language feasibility aspect obtained a score of 80% with appropriate criteria. This follows Prastowo's (2013) statement that the sentences used in the module must be simple, clear, and broad so that students can easily learn them. This module has been validated by language experts and has been revised based on criticism and suggestions from validators. Thus, the preparation of this module follows the linguistic rules of Enhanced Spelling. This module has been created using simple language, sentences that are clear, concise, and communicative, and the sentences are not complicated (straightforward).

Practicality of Ethnosience-Based Science Modules

The practicality test of the module was carried out on 20 prospective science teacher students from the Tadris IPA IAIN Ambon study program. This assessment was carried out by filling out a questionnaire provided by the researcher. This assessment was carried out after the research process ended, precisely after they took the post-test. Students responded to the

ethnosience-based science module that had been developed. This questionnaire was distributed to obtain grades or responses or input on the ethnosience-based science module by students.



Figure 4. Testing Ethnosience-Based Science Module

The results of the student response data received a score of 87%, which means the science module is very practical to implement in the field. Of the 16 assessment aspects measured, 2 aspects received the maximum score, namely the 2nd assessment item which stated the practicality aspect in terms of simple size, not burdensome. Thus, it is practical to carry around the 14th assessment item which stated the material aspect in the delivery module about ethnosience in Maluku, namely the eucalyptus oil refinery on Buru Island. Based on the results of student responses, it can be concluded that students gave very good grades for this ethnosience-based science module.

The practical aspect of the ethnosience-based science module was measured using a student response questionnaire. This questionnaire was given to students after learning using the ethnosience module. The results of the student response data received a score of 87%, which means that this ethnosience module is very practical to implement in the field. This lecture module is very practical to apply in learning. Students can study easily anywhere and anytime because this ethnosience module is very practical to carry. Students can easily get to know the culture that exists in the people of Buru Island, namely the tradition of refining eucalyptus oil because in the module it is explained in the form of pictures and its relationship to scientific concepts.

Effectiveness of Ethnosience-Based Science Modules in Reducing Student Misconceptions

To determine the effectiveness of the module developed by researchers in reducing student misconceptions. This was conducted by giving pretest

and post-test questions to students. The pretest questions given before learning using this module were given 20 items related to the material in the integrated science course, namely changes in form, separation of mixtures, density, and vapor pressure. Meanwhile, the post-test is given after students learn to use the module that has been developed. The test questions given are accompanied by a CRI index to measure the level of student misconceptions in answering the questions given.

To make it clearer, the changes in learning outcomes that occur after applying the developed module can be seen in Figure 4.

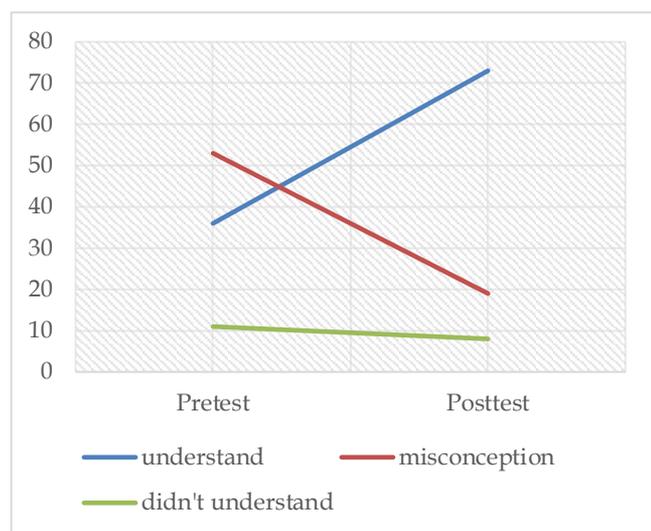


Figure 5. Comparison graph of student pretest and post-test scores

Based on Figure 4. There were visible changes in student learning outcomes that improved after studying using ethnosience-based science modules. The level of students' understanding of science concepts increased by 37%, the level of student misconceptions decreased by 34%, and students who did not understand the concepts decreased by 3%. The application of an ethnosience-based science module in the eucalyptus oil refining process in Buru Regency contributes to helping students obtain good learning outcomes in integrated science lectures. Thus, this module is effective in reducing student misconceptions.

The results of inferential statistical analysis confirmed that both sample groups met the assumptions of normality and homogeneity. Based on the fulfillment of these assumptions, the analysis proceeded using parametric t-test statistics. The analysis revealed a significance value of $0.031 < \alpha = 0.05$, indicating the rejection of H_0 and acceptance of H_1 . These findings demonstrate that the use of ethnosience-based science modules significantly improved students' conceptual

understanding, accompanied by a reduction in students' misconception levels.

The development of a science module based on the ethnosience of eucalyptus oil refining can be categorized as successful because it can be seen that during lectures students were very interested in the teaching materials that were different from before. In this ethnosience module and based on student learning outcomes using the CRI test, the level of student misconceptions decreased.

Misconception is a wrong understanding of a concept and cannot be accepted by experts in the field (Yuliati, 2017). Misconceptions in education have a dangerous impact because they can lead to a wrong understanding of a concept (Dewi & Wulandari, 2021). The problem of misconceptions among prospective science teacher students is very important because misconceptions among prospective teachers will have a significant impact on their competence as teachers which will later influence students' science abilities at school (Darwis & Hardiansyah, 2022). One effort that can be made to reduce misconceptions is to use valid and credible teaching materials, such as in this ethnosience module.

The success of the ethnosience-based module in reducing misconceptions can be attributed to several key factors that distinguish it from traditional teaching materials. First, the integration of local cultural practices (in this case, eucalyptus oil refining) provides students with concrete, familiar contexts through which to understand abstract scientific concepts.

The ethnosience-based science module on eucalyptus oil refining is effective in reducing student misconceptions. The level of student misconceptions decreased by 34%, the level of students' understanding of science concepts increased by 37%, and students who did not understand the concepts decreased by 3%. This is in line with research conducted by Safrida et al. (2017) which stated that learning using modules and animation can reduce misconceptions and improve learning outcomes on circulatory system material at SMAN 5 Banda Aceh City. The modules used are equipped with interesting and more colorful pictures so that they attract students' interest in reading.

The broader implications of these findings for educational practice are significant and multifaceted. First, this study provides a replicable model for developing culturally responsive science education materials. The success of the eucalyptus oil refining context suggests that other local cultural practices can similarly be integrated into science education to enhance learning outcomes. This approach could be particularly valuable in diverse cultural contexts where traditional teaching methods may not effectively engage students or address their unique learning needs.

Second, the methodology used in this study can be adapted to develop similar modules for other science concepts or disciplines. The combination of CRI assessment, ethnoscience integration, and systematic module development provides a framework that educators can apply across various educational contexts. This scalability is particularly important given the growing recognition of the need for culturally responsive teaching materials in science education.

This study addresses a critical gap in science education by demonstrating how traditional knowledge systems can be effectively integrated with modern scientific concepts. This integration not only reduces misconceptions but also helps preserve valuable cultural knowledge while making science more accessible and relevant to students from diverse backgrounds.

Future research could explore the long-term retention of correct scientific concepts when learned through ethnoscience-based approaches, as well as the potential application of this methodology to other subjects and cultural contexts. Additionally, investigating the impact of such modules on student motivation and interest in science could provide valuable insights for educational practice.

Conclusion

Based on the results of data analysis and discussion of the development of an ethnoscience-based science module on the eucalyptus oil refining process that has been described, it can be concluded that: (1) The feasibility of this module was tested by 3 experts consisting of material experts, media experts, and language experts. The feasibility of the material obtained a score of 88% with very feasible criteria from material experts. The media feasibility score was 89% with very feasible criteria from media experts. Then the language feasibility score was 80% with appropriate criteria; (2) The practicality of the module was tested through analysis of student responses to the module developed and a practicality score of 87% was obtained with very good criteria. This means that the ethnoscience-based science module developed has very good practicality in terms of a) attractiveness of the module, b) ease of use, c) ease of understanding the contents of the module, d) completeness of the contents of the module, and e) conformity with character values ethnoscience; (3) The module developed is effective in reducing student misconceptions. The level of student misconceptions decreased by 34% accompanied by an increase in the level of student understanding of concepts by 37%, and students who did not understand the concept decreased by 3%.

Acknowledgments

I would like to acknowledge LPPM IAIN Ambon for the full research funding that has been provided and I would like to thank my students for the participation during this research.

Author Contributions

All authors have made significant contributions to completing this manuscript.

Funding

This research received no external funding

Conflicts of Interest

The authors declare no conflict of interest

References

- Afliansyah, E. (2022). *Pengembangan Modul Pembelajaran IPA Berbasis Etnosains Materi Zat Aditif Dan Adiktif Untuk Melatih Literasi Sains Siswa SMP*. UIN Fatmawati Sukarno Bengkulu.
- Ahmadi, Y., Astuti, B., Linuwih Jurusan Fisika, S., & Matematika dan Ilmu Pengetahuan Alam, F. (2019). Bahan Ajar IPA Berbasis Etnosains Tema Pemanasan Global untuk Peserta Didik SMP Kelas VII. *Unnes Physics Education Journal*, 8(1), 54-59. <https://doi.org/10.15294/upej.v8i1.29512>
- Ardianti, S. D., & Raida, S. A. (2022). The Effect of Project Based Learning with Ethnoscience Approach on Science Conceptual Understanding. *Journal of Innovation in Educational and Cultural Research*, 3(2), 207-214. <https://doi.org/10.46843/jiecr.v4i1.382>
- Darwis, R., & Hardiansyah, M. R. (2022). Analisis Miskonsepsi Calon Guru IPA Terpadu pada Materi Pamanasan Global Menggunakan Certainty of Response Index. *Jurnal Pendidikan MIPA*, 12(4), 1023-1032. <https://doi.org/10.37630/jpm.v12i4.732>
- Dewi, E. P., & Wulandari, F. (2021). Identification of Misconceptions in Science Learning During the Covid-19 Pandemic Using the CRI (Certainty of Response Index) Method for Primary school Students. *Jurnal Penelitian Pendidikan IPA*, 7(Special Issue). <https://doi.org/10.29303/jppipa.v7iSpecialIssue.876>
- Dian, E. (2022). *Pengembangan Modul Pembelajaran Ipa Berbasis Etnosains Pada Materi Gerak Untuk Meningkatkan Literasi Sains Pada Siswa Kelas IV SD*. Universitas Muhammadiyah Mataram.
- Fasasi, R. A. (2017). Effects of Ethnoscience Instruction, School Location, and Parental Educational Status on Learners' Attitude towards Science. *International Journal of Science Education*, 39(5), 548-

564.
<https://doi.org/10.1080/09500693.2017.1296599>
- Fitria, M., & Wisudawati, A. W. (2018). The development of ethnoscience-based chemical enrichment book as a science literacy. *International Journal of Chemistry Education Research*, 2(1), 50–59. <https://doi.org/10.20885/ijcer.vol2.iss1.art8>
- Fitriani, N. I., & Setiawan, B. (2017). Efektivitas Modul IPA Berbasis Etnosains Terhadap Peningkatan Keterampilan Berpikir Kritis Siswa. *Jurnal Penelitian Pendidikan IPA*, 2(2), 71–76. <https://doi.org/10.1080/09500693.2017.1296599>
- Lucariello, J., & Naff, D. (2020). How Do I Get My Students Over Their Alternative Conceptions (Misconceptions) for Learning. *American Psychological Association*. <https://doi.org/https://www.apa.org/education/k12/misconceptions>
- Mirza, G. A., Ristono, & Handayani, D. (2019). Pengembangan Lembar Kegiatan Peserta Didik Bernuansa Emotional Spritual Quotient tentang Materi Sel, Jaringan, Organ dan Organisme untuk Peserta Didik Kelas VII SMP/MTs. *Bioeducation Journal*, 3, 27–36.
- Nabil, M., Juliyanto, E., & Rahayu, R. (2021). Pengembangan Modul IPA Berbasis Etnosains Pengolahan Kopi Untuk Meningkatkan Kemampuan Berpikir Kritis. *Indonesian Journal of Natural Science Education*, 4(2), 457–467. <https://doi.org/10.31002/nse.v4i2.1957>
- Nieveen, N. (1999). *Design Approaches and Tools in Educational and Training*. Kluwer Academic Publisher.
- Prastowo, A. (2013). *Panduan Kreatif Membuat Bahan Ajar Inovatif*. DIVA Press.
- Rahayu, W., & Sudarmin. (2015). Pengembangan Modul IPA Terpadu Berbasis Etnosains Tema Energi Dalam Kehidupan Untuk Menanamkan Jiwa Konservasi Siswa. *Unnes Science Education Journal*, 4(2), 920–926. <https://doi.org/10.15294/USEJ.V4I2.7943>
- Ramandanti, S. K., & Supardi, K. I. (2020). Pengaruh Model Problem Based Learning Terintegrasi Etnosains Terhadap Pemahaman Konsep Materi Redoks Siswa MA Negeri Blora. *Chemistry in Education*, 9(1), 1–6.
- Rochmad, R. (2012). Desain Model Pengembangan Perangkat Pembelajaran Matematika. *Kreano: Jurnal Matematika Kreatif - Inovatif*, 3(1), 59–72. <https://doi.org/10.15294/kreano.v3i1.2613>
- Sadiman, R., Haryono, & Rahardjito. (2011). *Media Pendidikan: Pengertian Pengembangan dan Pemanfaatannya*. Raja Grafindo Persada.
- Safrida, Dewi, C. R., & Abdullah. (2017). Penggunaan Modul dan Media Animasi Dalam Mengurangi Miskonsepsi Siswa Pada Materi Sistem Peredaran Darah di Sman 5 Kota Banda Aceh. *Jurnal Pencerahan*, 11(1), 39–45. <https://doi.org/10.13170/jp.11.1.8115>
- Sani, D. M. (2021). Penerapan Pendekatan Pembelajaran Berbasis Etnosains yang Bersumber pada Kearifan Lokal Untuk Meningkatkan Ketrampilan Proses Sains Peserta Didik Kelas X MIPA 4 SMA Negeri 3 Boyolali. *Jurnal Sains Edukatika Indonesia*, 3(1), 22–26. <https://doi.org/https://jurnal.uns.ac.id/jsei/article/view/67912>
- Sudarmin, S., & Rahayu, W. E. (2015). Development of Ethnoscience Approach in The Module Theme Substance Additives to Improve the Cognitive Learning Outcome and Student's entrepreneurship. *Journal of Physics: Conference Series*, 824(1), 012024. <https://doi.org/10.1088/1742-6596/824/1/012024>
- Sudjana, N., & Ahmad, R. (2013). *Media Pembelajaran*. Sinar Baru Algesindo.
- Sumarni, W., & Kadarwati, S. (2020). Ethno-Stem Project-Based Learning: Its Impact to Critical and Creative Thinking Skills. *Jurnal Pendidikan IPA Indonesia*, 9(1), 11–21. <https://doi.org/10.15294/jpii.v9i1.21754>
- Yuliati, Y. (2017). Miskonsepsi Siswa pada Pembelajaran IPA serta Remediasinya. *Jurnal Bio Education*, 2(2), 50–58. <https://doi.org/10.31949/be.v2i2.1197>