

The Development of an Ethnoscience-Based Mangrove Module in Improving Student's Critical Thinking Abilities and Concern for the Environment at SMA IT Daarul Hikmah Bontang

Sri Roma Yuliarta^{1*}, Muhammad Amir Masruhim¹, Aloysius Hardoko¹, Krishna Purnawan Candra², Sukartiningih³, Taufan Purwokusumaning Daru⁴, Elsje Theodore Massawet¹, Masitah¹, Yusak Hudyono¹

¹ Faculty of Teacher Training, University of Mulawarman, Samarinda, Indonesia.

² Faculty of Environmental Science, University of Mulawarman, Samarinda, Indonesia.

³ Faculty of Forestry, University of Mulawarman, Samarinda, Indonesia.

⁴ Faculty of Agriculture, University of Mulawarman, Samarinda, Indonesia.

Received: April 20, 2024

Revised: May 30, 2024

Accepted: July 25, 2024

Published: July 31, 2024

Corresponding Author:

Sri Roma Yuliarta

sriyuliarta47@guru.smp.belajar.id

DOI: [10.29303/jppipa.v10i7.7456](https://doi.org/10.29303/jppipa.v10i7.7456)

© 2024 The Authors. This open access article is distributed under a (CC-BY License)



Abstract: A module is an educational material or learning tool that includes teaching materials, methods, and assessments that are developed in a systematic and structured manner to achieve expected competency goals. The aim of this study is to develop a valid, practical and effective mangrove module based on ethnoscience on biodiversity. The type of research is R&D which refers to the ADDIE method developed by Mayfield. Data collection techniques consist of expert verification, observations, tests, questionnaires, and interviews. The results of the study show that, this module was developed based on the manual previously used by SMA IT Daarul Hikmah Bontang students to learn biology. The module validity result for the module is 99%, which is in the very valid category. The material validity result of the module was in the very reasonable category at 84.69%. The linguistic validity result of the module was 73.6% in the valid category. The results of the student survey regarding the practicality of the module were 88.65%, which fell into the very practical category. The effectiveness module in improving student's critical thinking ability and environmental awareness have n-gain values are 0.55 and 0.44. It can be concluded that the development of the ethnoscience-based mangrove module in the intermediate category has been effectively used to improve the critical thinking skills of the students of SMA IT Daarul Hikmah Bontang.

Keywords: Critical thinking; Ethnoscience; Mangrove module

Introduction

Mangrove ecosystems in East Kalimantan have an area of 883,379 ha. While in Bontang, the mangrove ecosystem area reaches 1,069.44 ha (Yonvitner et al., 2019). Bontang City, as a coastal area because it is directly adjacent to the Makassar Strait to the east, is a suitable habitat for the existence of mangrove ecosystems. Mangroves are one of the most important

natural resources for the community. Mangrove area empowerment has two main roles in Bontang City. First, mangroves are a source of income for some coastal communities. Mangrove fruit parts can be a processed syrup product that can be consumed and become a souvenir characteristic of the city of Bontang. Bontang city culture, which is directly related to mangroves, is contextual material that can be a source of knowledge for students if it is related to biodiversity material. The

How to Cite:

Yuliarta, S. R., Masruhim, M. A., Hardoko, A., Candra, K. P., Sukartiningih, Daru, T. P., ... Hudyono, Y. (2024). The Development of an Ethnoscience-Based Mangrove Module in Improving Student's Critical Thinking Abilities and Concern for the Environment at SMA IT Daarul Hikmah Bontang. *Jurnal Penelitian Pendidikan IPA*, 10(7), 3739–3750. <https://doi.org/10.29303/jppipa.v10i7.7456>

handbook used by students so far is a book from the Ministry of Culture, Research, and Technology of the Republic of Indonesia in 2021, which is distributed in printed form. Meanwhile, the biodiversity material in the book is still very general; even in some discussions, there are still explanations about ecosystems that have never been encountered directly by students. This can hamper students' ability to think critically to identify problems and even find solutions in group discussions. In addition, in the discussion activities of students, there is no differentiation of content so that the discussion material of one group with another group is the same. Awareness Research on ecosystem modules based on regional potential has previously been carried out in the Lamongan area of East Java using the ADDIE method (Melawati et al., 2022), but there is no module that discusses environmental changes by the community to the mangrove ecosystem and its relationship with ethnosience in the city of Bontang. Researchers want to develop ethnosience-based mangrove modules with similar methods so that they can be used by students to support the learning process in class. The problem that exists in SMA IT Daarul Hikmah Bontang is the lack of students' ability to analyze a problem to find a solution. Researchers also saw the low learning outcomes of students in the 2022–2023 school year on this material, with an average score above the KKM of 46.28%, in line with the lack of understanding of students' concern for the environment by 35.71%. The purpose of this research is to develop modules, identify module validation scores, identify module practicality, and identify effectiveness in improving critical thinking skills and students' concern for the environment.

Modules are teaching materials or learning tools that include material, methods, and evaluations that are made systematically and structured in an effort to achieve the expected competency objectives (Chatri et al., 2023; Funa et al., 2021; Pakaya et al., 2023). Modules are specifically and clearly designed based on the speed of understanding of each student, thus encouraging students to learn according to their abilities. In learning, the teacher is only a facilitator (Culajara et al., 2022; Dejene, 2019; Sunaryo et al., 2020).

The application of ethnosience learning is not only in accordance with the times and the rules of the education curriculum currently adopted by the Indonesian nation but also aims to instill an attitude of love for culture and its people and increase students' knowledge and understanding of the culture and potential possessed by their region (Pratama et al., 2023). This is useful for overcoming the difficulties of students in absorbing abstract lessons by providing learning experiences that involve students in a complex manner according to the real world (contextual) and as a special alternative as a step towards realizing the formation of

nationalism character through strengthening the value of local wisdom with the implementation of ethnosience (Winarto et al., 2023).

Ethnosience-based learning that does not separate cultural science and local wisdom from society can also be used as a learning approach to develop science learning modules (M. P. Sari et al., 2024; Wardani et al., 2023). With ethnosience, students do not view science as a foreign culture that they learn, but are seen as part of the existing culture and local wisdom (Hikmawati et al., 2021; Khoiri et al., 2018; Khusniati et al., 2023).

Mangrove plants can be an alternative source of income for coastal communities. In Bontang City, there are several farmer groups that cultivate mangrove plants to be used as basic ingredients in syrup making. The fruit of Pedada (*Sonneratia alba*), which has a sour and sweet taste, is used as the main ingredient in making syrup. This has become one of the typical products of Bontang City that can improve the economy of coastal communities.

In addition, the local culture and wisdom that exist in the city of Bontang is the Bontang Kuala Sea Party. The Bontang Kuala Sea Party is usually routinely held in the middle of November to December for one week. Of course, there are various arrays of events organized to enliven the event, such as traditional rituals, traditional dance performances, the introduction of typical Bontang cuisine, and various kinds of competitions. The traditional rituals carried out include the following: a) The day before the peak event, the first ritual performed is the ritual of entertaining or feeding corals. The meaning of the ritual is as a form of notification to the guardian spirit of the waters of Bontang Kuala village that a sea party tradition will be carried out. b) Mencerah Buluh (Menjamu Kampung). It is a notification to the guardian spirits of the villages in the north, west, east, and south that a Sea Party tradition will be held. These areas will be marked with the blood of native chickens and put out offerings, usually done a day or two before the event takes place. c) Bebalai. Has the meaning of treating sick people for the previous residents of Bontang. The purpose of the ritual is to be given health and avoid disease.

The 21st century, which is the century of globalization, requires humans to have skills, one of which is thinking skills, to survive and compete in global competition. Critical thinking itself is one of the high-level thinking competencies and is very important in moral formation, social adjustment, and the structuring of science. In many countries, critical thinking skills have become one of the competencies of educational objectives. The ability to think critically should be developed from an early age through learning, especially science.

The ability to think critically will make it easier for a person to analyze problems in his life and make it a source of energy for personal needs and in helping society (Facione, 2013).

Method

This type of research is called development research (R&D). Research that is applied to produce a product and test the effectiveness of the product. This research uses the ADDIE method developed by Mayfield (2011). The activity steps are detailed as follows: 1) Analysis Stage: Analyzing field needs related to problems in learning biology. This needs analysis, which is the initial stage in development research. At this stage, mapping the needs of students to improve critical thinking skills is carried out. 2) Design Stage: making pretest-posttest questions and LKPDs that are compiled based on a knowledge grid. The questions designed can stimulate students' critical reasoning skills. 3) Development Stage: Create and develop a paragraph outline based on data obtained from observations and interviews with the community. Modules are compiled in Word by paying attention to writing rules based on good and correct Indonesian spelling. 4) Implementation Stage: Before using this ethnoscience-based mangrove module, students first undergo a *pre-test*, the results of which will be compared after studying the module. 5) Evaluation Stage: After making improvements to the module, the next step is to obtain data from test results and fill out questionnaires.

The instruments used in this study are: 1) a validation sheet; 2) a questionnaire; 3) an interview; and 4) a question instrument. The data needed in this study were collected in five ways, namely: 1) interviews with the community around the Mangrove area that has been determined; 2) observations made by the observer; 3) validation of research instruments and learning devices by validators; 4) giving tests to students; and 5) asking for written answers or filling out questionnaires for students.

Data analysis techniques using: 1) observation research data analysis technique; 2) mangrove module feasibility data from experts, teachers, and students will be analyzed descriptively and quantitatively to determine the percentage of scores obtained from student questionnaire results. 3) Module Validation Data Analysis Technique: Data on the validation of the Mangrove module in improving learning outcomes and environmental care attitudes will be analyzed by determining the comparison of assessment results from experts and teachers with very valid, valid, less valid, and invalid criteria (Riefani, 2019). 4) Module Practicality Data Analysis Technique: Data on

practicality regarding the use of modules with very practical, practical, less practical, and impractical criteria (Istiningrum, 2017). 4) Data on the effectiveness of the ethnoscience-based mangrove module in improving critical thinking skills and environmental care attitudes will be analyzed with a t-test using SPSS VS 25. Then, to see how much the research results increase, the N-Gain test is carried out with the N-gain score category, namely high, medium, and low (Hake, 2002).

Result and Discussion

The module used as a biology handbook for students at SMA IT Daarul Hikmah Bontang uses references from the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia in 2021. This research is adapted to the material on biodiversity. To enrich the content of the developed module, direct observations were made at the mangrove forest, which is part of Kutai National Park, and direct interviews were conducted with communities in several areas to obtain information related to ethnicity, culture, and the direct and indirect benefits of mangroves for their daily lives.

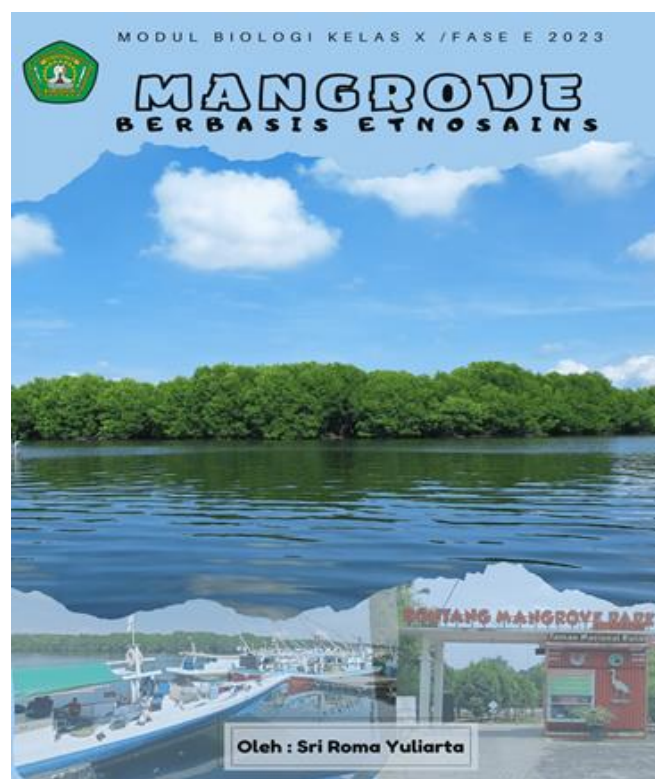


Figure 1. The developed module

Material Content

In the handbook that has been used by students at SMA IT Daarul Hikmah Bontang, biodiversity material has a global explanation regarding biodiversity that is

located in all ecosystems. There are even some materials that have never been seen or imagined by students, namely the Sabana ecosystem. The novelty of the module developed by the researcher is that it describes a contextual ecosystem, a characteristic of Bontang City, which is a coastal area, namely the mangrove forest. In fact, students can also see the mangrove ecosystem directly by conducting field trip activities at a predetermined location.

Differentiated Content on Critical Thinking LKPDs

In the handbook used by students, it already contains learning activities at the end of the meeting that stimulate students' critical thinking in groups. It's just that there is no content-differentiated learning in these activities. This can be seen from the same instructions given to all groups of learners. While the novelty developed by researchers in the module is the existence of different instructions for each group in the form of analyzing problems related to the preservation of the mangrove area with role-playing activities. So, the hope is that students can see the other side of community participation from various aspects that can preserve natural resources, especially coastal areas.

Use of TPACK (Technological Pedagogical Content Knowledge)

The handbook used so far by students has included a searchable material *link* regarding biodiversity material. But so far, books are given in printed form, so students cannot access them directly with existing devices. The novelty of this developed module changes the required *link* into the form of a *QR Code (Quick Response Code)*.

Discussion of Benefits of Material

In the handbook used by students, it is only explained about the benefits of ecosystem balance from the ecological side. But the renewal of the module not only explains the benefits of the ecological side but also the economic side.

Module Feasibility

The validation sheet instrument is adjusted based on the provisions of the feasibility of learning instruments referring to the provisions of book assessment according to BNSP (National Professional Certificate Agency) and arranged based on the description of the indicators that have been developed.

Table 1. Module Feasibility Test Results

Validation by Module Expert		
Measured Aspect	Percentage	Criteria
Technique	95%	Very valid
Content Appropriateness to Child Development	100%	Very valid
Scientific Substance	100%	Very valid
Insight to Advance and Develop	100%	Very valid
Diversity of Social Values	100%	Very valid
Validation by Material Expert		
Measured Aspect	Percentage	Criteria
Technique	81%	Very valid
Material	100%	Very valid
Learning	83%	Very valid
Graphic	97%	Very valid
Validation by Language Expert		
Measured Aspect	Percentage	Criteria
Readability	71%	Valid
Conformity with Good and Correct Indonesian Language Rules	75%	Valid
Language Logic	75%	Valid

Module's Validation

Based on the analysis conducted on the module validation instrument on the technical aspect with indicators of the suitability of the truth of facts and concepts and clearly does not refer to the refraction of concepts, deviations, and misconceptions, a percentage of 95% was categorized as very valid. Then the module has been in accordance with the formulation of competence on the subject of biodiversity. The developed module is organized systematically and

coherently with the acquisition of factual concepts obtained empirically. The module can provide understanding to students with no refraction of concepts.

In the indicator of the suitability of media content for child development, a percentage of 100% was categorized as very valid. So the module as teaching material is easy for students to understand when used in learning. Teaching materials in the form of pocket books are very helpful in the learning process so that they can

replace the role of the teacher in supporting individual learning (Choir et al., 2021; Ester et al., 2022; Hasan et al., 2020).

The preparation of the module is packaged in a light manner so that it can be easily accessed by students according to their thinking abilities. In the scientific substance indicator, the percentage of 100% is categorized as very valid. So the module has a novelty in lifting the ethnoscience of Bontang City, which is adapted to biology learning material, namely biodiversity. Learning with ethnoscience not only prioritizes academic ability to think rationally and brilliantly but can also strengthen the character of students with the surrounding culture (Sarwi et al., 2021; Septiani et al., 2020; Wati et al., 2021; Zidny et al., 2022).

On the indicator of insight to progress and develop, a percentage of 100% is categorized as very valid. Then the module is in accordance with the curriculum used. The curriculum set by the government runs in harmony with the learning activities delivered by the teacher (Septiani et al., 2020). In the indicator of the diversity of social values, the percentage of 100% is categorized as very valid. Ethnoscience-based learning can make students sensitive to the surrounding environment so that they can study and examine natural phenomena scientifically. So the module has contained learning activities for students to prioritize existing character values. Students are not only qualified in terms of knowledge and skills, but the cultivation of good character attitudes also needs to be familiarized with and fostered from an early age. Overall, the average module validation assessment in the content aspect is 99%, including very valid criteria.

Material's Validation

Based on the analysis conducted on the module validation instrument on the presentation aspect, the technique indicator obtained a percentage of 81%, categorized as very valid. So the module has been arranged sequentially and systematically. There are instructions for use as a signpost for learning activities on each component of the module as a whole. Learning instructions are a component that must be present in teaching materials.

The material indicator obtained a percentage of 100%, which is categorized as very valid. Then the module illustration can be clearly understood and is in accordance with the ethnoscience raised. Learners can understand directly what the benefits of mangrove areas are for the community. Local wisdom-based learning activities, especially in science lessons, can facilitate the understanding of students. On learning indicators obtained, a percentage of 83% was categorized as very valid. So the module has been able to accommodate the needs of students to be actively involved. In addition,

the module has prepared LKPD activities to stimulate students' critical thinking skills in the classroom. The module is also equipped with an understanding test along with an answer key to make it easier for students to correct the results of the exercises performed. Evaluation activities in the form of exercise questions equipped with supporting information, such as discussion of exercise questions, are also important components that must be present in teaching materials (Choirina et al., 2023; Hadiyanti, 2021; Marisa et al., 2020).

In the graphic aspect, the module size indicator obtained a percentage of 100%, which was categorized as very valid. Modules used as teaching materials in the classroom are 210x297 mm (Gunawan, 2022). In the skin design indicator, a percentage of 75% is categorized as valid. While the design of the content obtained a percentage of 81.25%. Good module content is supported by a consistent content layout between modules.

In the aspect of paper quality and print quality, both obtained a percentage of 75% categorized as valid. So the module as printed media can be used for large-scale needs at school. Overall, the average module validation assessment on the material aspect obtained an average percentage of 84.69%, including very valid criteria.

Language's Validation

Based on the analysis conducted on the module validation instrument on the linguistic aspect of the readability indicator, a percentage of 71% was categorized as valid. So the module can be reached and information can be absorbed by readers, including the research target, which is class X high school students. In the indicator of conformity with good and correct Indonesian language rules, a percentage of 75% is categorized as valid. So the module is in accordance with PUEBI (General Guidelines for Indonesian Spelling), so the language order used in the module is good, correct, and appropriate for use.

In the language logic indicator, a percentage of 75% is categorized as valid. So the sentence structure used in the module is not biased or does not refer to double meanings. This shows that the module can be interpreted easily when students learn. The preparation of language in teaching materials is an important component to describe instructions for use, explain theory, and provide exercise questions. Overall, the average module validation assessment in the language aspect was 73.6%, including valid criteria.

Based on the results of the review of the interpretation of the questionnaire that has been filled out by the expert team, it can be concluded that the pocket book has met the eligibility requirements in terms

of modules (content), material (presentation and graphics), and language. So the module is suitable for field testing so that it is ready to be utilized as a learning resource on the subject of biodiversity. Depdiknas (2022) explains that product development or learning tools before being tested in the field must meet the eligibility criteria set by experts in terms of content, presentation, grammar, and language.

Module Practicality

The results of the practicality test were obtained from the students' questionnaire responses to the experimental class to determine the level of practicality and ease of use of the ethnosience-based mangrove module.

Table 2. Module Practicality Test Results

Aspect	Practicality	Description
Flexibility in Use	89.70%	Very Practical
Time Efficiency	88.48%	Very Practical
Learner Attraction	89.39%	Very Practical
Easy to Enterpret	87.27%	Very Practical

In the material of Biodiversity in Biology lessons at SMA IT Daarul Hikmah Bontang, the reference source of teaching materials used so far is still based on government package books, with a broad discussion of material that is less contextual. It can be seen that the flexibility indicator in use obtained a percentage of 89.70%, categorized as very practical. So the module is easy to apply to learning. In addition, the arrangement of words, sentences, and language is easy to understand. Language in teaching materials must be communicative. It is intended that readers easily capture messages or information according to their level of absorption, and the scope of discussion is also expected to be focused and measurable (Riza et al., 2020; Shofiyani' et al., 2020; Wahyuningsi, 2019).

In the time efficiency indicator, the percentage of 88.48% is categorized as very practical. So the module can be a guide that can be used as an alternative for students to manage learning activities independently. The learning process can also be anywhere and anytime. The learning process of individual learners means that these learners can adjust the learning speed to their personal abilities. Learners who are left behind can read and reopen the content of the material that has been delivered.

In the indicator of learner attractiveness, the percentage of 89.39% is categorized as very practical. So the module can attract the attention of students interested in studying biology. In addition to increasing the literacy skills of students, the developed module is also interesting because it involves TPACK, where students can use gadget devices to explore activities

with LKPD in the module. Septiani et al. (2020) also said that teaching materials that attract students' attention to learning are those that contain colorful, varied images, a balanced layout, and module design that matches the content and typeface.

In the indicator easy to interpret, a percentage of 87.27% was categorized as very practical. So the module can direct students to learn actively. The achievement of learner activeness is influenced by various factors, including teacher innovation in making media or teaching materials and packaging learning thematically. Research by Sari et al. (2020) shows that the ethnosience-based module has been practical for use as teaching material. Setiawati et al. (2013) state that modules that score very well can be used for trials. For ethnosience-based modules to facilitate learning, the guide must essentially provide clarity precisely and understandably so that it is easily understood by users (N. P. Sari et al., 2020). Overall, the average assessment of the practicality of the module on the four indicators developed was 88.65%, including very practical criteria. The developed module can be easily used in learning activities as a substitute for package books.

Module Effectiveness on Critical Thinking

Based on the table 3, all pretest and posttest values in both the experimental and control classes sig. ≥ 0.05 (shapiro-Wilk test). This indicates that the data is normally distributed and will be continued in the next analysis. Based on the table 4, the homogeneity test value is > 0.05 . This indicates that the data is homogeneous and can be continued with parametric tests using the *paired sample T test*. Based on the table 5, the t-test results and *N-Gain* score are: The significance of the t test is 0.000 and *N-Gain Score* = 0.56.

The t test result of 0.000 ≤ 0.05 so H_0 is rejected or H_1 accepts. This shows that there is a significant average difference between the control class and the experimental class. Based on the *N-Gain* category, the *N-Gain score of 0.56* $0. \geq 0.3$ indicates that learning using ethnosience-based mangrove modules is effective in improving critical thinking skills at SMA IT Daarul Hikmah Bontang.

Biodiversity material associated with the ethnosience of Bontang City is very suitable to be taught in the classroom. Contextual learning can encourage students to build their knowledge and connect it with the reality or phenomenon that students experience directly in their daily lives. The more concrete the way a learner learns, the more experience they get (Baharsyah, 2020).

In participating in classroom learning for biodiversity material, students are interested and curious about the content in the developed module. This ethnosience-based mangrove module has added

insight for students regarding the different characteristics of each mangrove area in Bontang City. The distribution of tribes and cultures also varies in each mangrove area. Therefore, the usefulness of mangroves in ethnoscience is seen in the development of this module.

Learning biodiversity coupled with collaborative activities is very suitable for the conditions of students at SMA IT Daarul Hikmah Bontang. Especially for students who have a history of lazy reading, conducting open discussions with peers can maximize learning. The developed module also has diverse discussion content

so that students can see problems from various perspectives. Of course, the material content has been arranged based on critical thinking indicators.

However, during implementation in the field, researchers found several obstacles, namely that there were some students who felt they understood the teacher's explanation well enough, so they did not really read the module properly. In addition, another obstacle is the ability of students' absorption, which varies, so not all students can understand the material well. So the teacher needs to help provide additional explanations while showing the material in the module.

Table 3. Normality Test Results from Critical Thinking

Class	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	statistic	df	Sig.	statistic	df	Sig.
Pre-test experiment	.167	32	.023	.960	32	.276
Pre-test Control	.109	32	.200*	.969	32	.479
Post-test experiment	.142	32	0.99	.953	32	.176
Post-test Control	.082	32	.200*	.970	32	.493

*This is a lower bound of the true significance

a. Lilliefors significance correction

Table 4. Homogeneity Test Results from Critical Thinking

	Levene Statistic	df1	Df2	Sig.
Based on mean	2.296	1	63	.135
Based on median	2.329	1	63	.132
Based on median and with adjusted df	2.329	1	53.964	.133
Based on trimmed mean	2.291	1	63	.135

Table 5. t- Test Analysis Result

		Paired Samples Test							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pretest experiment- Posttest experiment	-28.969	13.146	2.324	-33.708	-24.229	-12.466	31	.000
Pair 2	Pretest Control- Posttest Control	-13.696	19.223	3.398	-20.587	-6.726	-4.019	31	.000

Table 6. N-Gain Score Test Result

Class	Descriptives	Statistic	Std. Error	
Experiment	Mean	.56	.028	
	95% Confidence Interval of the Difference mean	Lower Bound	.50	
		Upper Bound	.62	
		5% trimmed Mean	.57	
	Median	.58		
	Variance	.025		
	Std. Deviation	.158		
	Minimum	0		
	Maximum	1		
	Range	1		
	Interquartile Range	0		
Skewness	-.897	.414		
kurtosis	.564	.809		
Control	Mean	.19		
	95% Confidence Interval of the Difference mean	Lower Bound	.05	
		Upper Bound	.34	
	5% trimmed Mean	.23		

Class	Descriptives	Statistic	Std. Error
	Median	.27	
	Variance	.165	
	Std. Deviation	.406	
	Minimum	-1	
	Maximum	1	
	Range	2	
	Interquartile Range	0	
	Skewness	-1.560	.414
	kurtosis	3.097	.809

Module Effectiveness on Environmental Awareness

An attitude of environmental care is a sense possessed by each individual to be able to improve and manage the environment in an appropriate and useful manner so that it can be enjoyed sustainably and not damaged, namely by playing a role in maintaining and preserving it so that it can be used for children and grandchildren later (Sunderlin et al., 1997).

In the activities at the beginning of learning, through observation, the control class and experimental

class had a low attitude toward environmental care, as seen in the condition of the class, which was not clean, and there was a lot of garbage in the desk drawer and the corner of the class. One of the indicators developed in the questionnaire is the habit of maintaining cleanliness and sustainability in the school environment. The emphasis on honesty in filling out the questionnaire is mentioned repeatedly so that the data obtained is accurate.

Table 7. Normality Test Results from Environmental Awareness

	Class	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		statistic	df	Sig.	statistic	df	Sig.
Environmental Awareness	Experiment	.138	32	.123	.947	32	.118
	Control	.161	32	.035	.946	32	.114

a. Lillieforts significance correction

Table 8. Homogeneity Test Results from Environmental Awareness

	Levene Statistic	df1	Df2	Sig.
Environmental Awareness	Based on mean	2.296	1	.135
	Based on median	2.329	1	.132
	Based on median and with adjusted df	2.329	1	53.964
	Based on trimmed mean	2.291	1	.135

Table 9. t-Test Analysis Result

		Independence Samples Test								
		Levene's Test for Equality of Variances		t	df	Sig. (2-tailed)	t-test for Equality of Means		95% Confidence Interval of the Difference	
		F	Sig.				Mean Difference	Std. error Difference	Lower	Upper
Environmental Awareness	Equal variances assumed	2.296	135	-3.828	63	.000	-15.56723	4.06693	-23.69434	-7.44013
	Equal variances not assumed			-3.849	57.084	.000	-15.56723	4.04466	-23.66627	-7.46820

Table 10. N-Gain Score Test Result

Class	Descriptives	Statistic	Std. Error	
Experiment	Mean	.4427	.01500	
	95% Confidence Interval of the Difference mean	Lower Bound	.4121	
		Upper Bound	.4733	
	5% trimmed Mean	.4422		
	Median	.4428		
	Variance	.007		
	Std. Deviation	.08488		
	Minimum	.30		
	Maximum	.59		

Class	Descriptives	Statistic	Std. Error
	Range	.30	
	Interquartile Range	.13	
	Skewness	.264	.414
	kurtosis	-1.013	.809
Control	Mean	.1102	.01020
	95% Confidence Interval of the Difference mean		
	Lower Bound	.0894	
	Upper Bound	.1310	
	5% trimmed Mean	.1102	
	Median	.1144	
	Variance	.003	
	Std. Deviation	.05768	
	Minimum	.00	
	Maximum	.21	
	Range	.21	
	Interquartile Range	.10	
	Skewness	.148	.414
	kurtosis	-.993	.809

In the module developed, there is a correlation between human concern for mangrove conditions and In interviews conducted by researchers in the Tanjung Limau Mangrove Area, there are differences in the number of mangrove populations in the area due to the large amount of land clearing for housing and the use of mangrove wood as a fish snare tool, or what is called a splint. So that there is a decrease in the mangrove population due to a lack of community concern around the area. With the reduction of mangroves, the habitat of the endemic fauna that inhabits mangroves is threatened. The number of long-tailed monkeys (*Macaca fascicularis*) and macaques (*Macaca nemestrina*) that enter people's homes to get food. And the decline in the yield of crabs, shrimp, and shellfish sold in the market is affecting the income of the local community. It can be concluded that an uncaring attitude towards the condition of mangroves can affect the balance of the ecosystem not only from the ecological side but also from the economic side. Qodriyanti et al. (2022), states that students who have prior knowledge will more easily accept and master the new knowledge they gain during learning. This knowledge will be the initial knowledge for students as a provision for how they determine their attitude towards decisions made in the future related to environmental sustainability.

Meanwhile, another indicator developed in the questionnaire of students' concern for the environment that is correlated with the development of this ethnosience-based mangrove module is planning and carrying out various activities to prevent environmental damage. There are differences in the questionnaire-filling process. At the beginning of learning, students often ask questions related to the meaning of this indicator and worry if they are wrong in giving a response. Meanwhile, after the learners received the material based on the module that had been developed,

it was seen that they confidently filled in the questionnaire response.

Based on table 7, all pretest and posttest scores in both experimental and control classes sig. ≥ 0.05 (shapiro-Wilk test). This indicates that the data is normally distributed and will be continued in the next analysis. Based on table 8, the homogeneity test value is ≥ 0.05 . This indicates that the data is homogeneous and can be continued with parametric tests using the *paired sample T test*. Based on tables 9 and 10, the results of the t test and *N-Gain score* are: The significance of the t test is 0.000. *N-Gain Score* = 0.44. The t test result of 0.000 ≤ 0.05 so H_0 is rejected or H_1 accepts. This shows that there is a significant average difference between the control class and the experimental class. Based on the *N-Gain* category in Table 3.4, the *N-Gain score* of 0.44 ≥ 0.3 indicates that learning using the ethnosience-based mangrove module is effectively used with a moderate category in improving the critical thinking skills of high school students Daarul Hikmah Bontang.

Learning activities designed in this ethnosience-based mangrove module have a correlation to global environmental preservation. This means that before they do conservation, which is far ahead and widespread, the learning process is always emphasized to protect the surrounding environment, especially the classroom and dormitory environment. This is expressed in discussion activities about environmental problems, especially mangroves, which are different for each group, and the instructions given to find solutions to existing problems.

Knowledge about environmental conservation among students will be useful in the future, so that humans can be aware of their activities that can affect the preservation of the environment on this earth. To be able to consider the activities carried out in preserving the environment, three aspects of self-awareness are needed, namely emotions, self-assessment, and

students' self-confidence (Widayanti et al., 2019). In group discussions, there are presentation activities in front of the class that end with responses from other groups. This can train critical thinking skills and increase the confidence of students at SMA IT Daarul Hikmah Bontang.

Conclusion

Based on the results of the research and discussion that have been described, it can be concluded as follows: An ethnoscience-based mangrove module has been developed based on the results of observations and interviews with the community around the mangrove area and has proven to be able to improve critical thinking skills and students' concern for the environment at SMA IT Daarul Hikmah Bontang. The results of the validity of the module in terms of the module amounted to 99%, with a very valid category. The results of module validity in terms of material amounted to 84.69%, with a very valid category. The results of the validity of the module in terms of language amounted to 73.6% in the valid category. Then the module was feasible to use as teaching material on the subject of biodiversity. The results of the student response questionnaire on the practicality of the module amounted to 88.65%, with a very practical category. Then the module is classified as very practical in its use so that it is easy to use by students. The results of the effectiveness of the module for critical thinking skills are moderate. While the results of the effectiveness of the module for students' concerns are also medium, so the module has a positive and effective influence on improving critical thinking skills and students' concern for the environment.

Acknowledgements

Thanks to Allah SWT for the abundance of grace. Prayers and support from family, Asy Syaamil leaders and fellow teachers who supported this research and all lecturers of the faculty of biology education, Mulawarman University, Samarinda, East Kalimantan.

Author Contributions

All authors contributed to writing this article.

Funding

No external funding.

Conflicts of Interest

No conflict interest.

References

- Baharsyah, M. (2020). Learning About Landslide Disaster Mitigation Based on a Role-Playing Method Assisted by teh Education Pocket Book. *Review of International Geographical Education Online*, 4(10), 618–638. <https://doi.org/10.33403/rigeo.767474>
- Chatri, M., Zalni, T. Y., Zalni, I., & Fajrina, S. (2023). Development of Discovery Learning Based E-Modules on Animalia and Ecosystem Materials for Class X High School Students. *Jurnal Penelitian Pendidikan IPA*, 9(11), 9729–9737. <https://doi.org/10.29303/jppipa.v9i11.4789>
- Choir, J. A., & Fitri, A. Z. (2021). The Development Of English For Beginner Through Pocketbook Media To Improve Student Learning Primary Results. *Al-Bidayah: Jurnal Pendidikan Dasar Islam*, 12(2), 221–236. Retrieved from <https://ejournal.uin-suka.ac.id/tarbiyah/albidayah/article/view/9178>
- Choirina, A. N., Bintartik, L., & Utama, C. (2023). Pengembangan Booklet Materi Hubungan Antar Makhhluk Hidup dalam Ekosistem dengan Penguatan Karakter Mandiri Siswa Sekolah Dasar. *Jurnal Pemikiran Dan Pengembangan Sekolah Dasar (JP2SD)*, 11(2), 209–227. <https://doi.org/10.22219/jp2sd.v11i2.27613>
- Culajara, C. J., Culajara, J. P. M., Portos, O., & Villapando, M. K. (2022). Digitalization of Modules and Learning Tasks for Flexible, Convenient, And Safe Learning Experience of Students. *International Journal of Social Learning (IJSLS)*, 2(3), 350–365. <https://doi.org/10.47134/ijsl.v2i3.172>
- Dejene, W. (2019). The practice of modularized curriculum in higher education institution: Active learning and continuous assessment in focus. *Cogent Education*, 6(1), Research Articl. <https://doi.org/10.1080/2331186X.2019.1611052>
- Ester, E., Dharma, S., & Ruslan, D. (2022). Effectiveness of Thematic Teaching Materials Based on Local Wisdom To Improve the Learning Outcomes of Elementary School Students. *Jurnal Ilmiah Teunuleh*, 3(1), 51–60. <https://doi.org/10.51612/teunuleh.v3i1.98>
- Facione. (2013). *Critical Thinking: What It Is and Why It Counts*. Insight Asesment
- Funa, A. A., & Talaue, F. T. (2021). Constructivist Learning Amid the COVID-19 Pandemic: Investigating Students' Perceptions of Biology Self-Learning Modules. *International Journal of Learning, Teaching and Educational Research*, 20(3), 250–264. <https://doi.org/10.26803/ijlter.20.3.15>
- Gunawan, R. (2022). *Modul Pelatihan Pengembangan Bahan Ajar /Modul Pembelajaran*. Feniks Muda Sejahtera.
- Hadiyanti, A. H. D. (2021). Pengembangan Modul Pembelajaran IPA Digital Berbasis Flipbook Untuk Pembelajaran Daring di Sekolah Dasar. *Jurnal*

- Elementaria Edukasia*, 4(2), 284–291. <https://doi.org/10.31949/jee.v4i2.3344>
- Hake, R. R. (2002). Relationship of individual student normalized learning gains in mechanics with gender, high-school physics, and pretest scores on Mathematics and Spatial Visualization. *Physics Education Research Conference*, 8(August 2002), 1–14. Retrieved from https://scholar.google.com/citations?view_op=view_citation&hl=en&user=10EI2q8AAAAJ&citation_for_view=10EI2q8AAAAJ:IjCSPb-OGe4C
- Hasan, M., Supatminingsih, T., Mustari, M., Ahmad, M., Rijal, S., & Ma'ruf, M. I. (2020). The development of pocketbook learning media based on mind mapping in introductory economics course. *Universal Journal of Educational Research*, 8(12B), 8274–8281. <https://doi.org/10.13189/ujer.2020.082632>
- Hikmawati, Suastra, I. W., & Pujani, N. M. (2021). Local wisdom in Lombok island with the potential of ethnoscience for the development of learning models in junior high school. *Journal of Physics: Conference Series*, 1816(1), 012105. <https://doi.org/10.1088/1742-6596/1816/1/012105>
- Istiningrum, A. A. (2017). Peningkatan Self-Regulated Learning Skills Mahasiswa Pada Mata Kuliah Akuntansi Pengantar Melalui Problem-Based Learning. *Jurnal Cakrawala Pendidikan*, 36(1), 171–182. <https://doi.org/10.21831/cp.v36i1.11080>
- Khoiri, A., & Sunarno, W. (2018). Pendekatan Etnosains Dalam Tinjauan Fisafat. *SPEKTRA: Jurnal Kajian Pendidikan Sains*, 4(2), 145. <https://doi.org/10.32699/spektra.v4i2.55>
- Khusniati, M., Heriyanti, A. P., Aryani, N. P., Fariz, T. R., & Harjunowibowo, D. (2023). Indigenous science constructs based on Troso woven fabric local wisdom: a study in ethnoscience and ethnoecology. *Journal of Turkish Science Education*, 20(3), 549–566. <https://doi.org/10.36681/tused.2023.031>
- Marisa, U., Yulianti, & Hakim, A. R. (2020). Pengembangan E-Modul Berbasis Karakter Peduli Lingkungan di Masa Pandemi Covid-19. In *Seminar Nasional PGSD UNIKAMA*. Retrieved from <https://conference.unikama.ac.id/artikel/index.php/pgsd/article/view/514>
- Mayfield, M. (2011). Creating training and development programs: Using the ADDIE method. *Development and Learning in Organisations*, 25(3), 19–22. <https://doi.org/10.1108/14777281111125363>
- Melawati, D., & Istianah, F. (2022). Pengembangan Modul Berbasis Etnosains pada Pembelajaran IPA Materi Ekosistem Kelas V Sekolah Dasar. *Jpgsd*, 10(4), 709–722. Retrieved from <https://ejournal.unesa.ac.id/index.php/jurnal-penelitian-pgsd/article/view/46244>
- Pakaya, S. Y. C., Dama, L., Hamidun, M. S., Nusantari, E., Baderan, D. W. K., & Katili, A. S. (2023). Development of Problem-Based Learning Modules on Environmental Pollution Materials to Improve Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, 9(10), 7803–7809. <https://doi.org/10.29303/jppipa.v9i10.4323>
- Pratama, D. H., & Jumadi, J. (2023). Analysis the Implementation of Ethnoscience Approach in Learning Science. *Jurnal Penelitian Pendidikan IPA*, 9(4), 1615–1620. <https://doi.org/10.29303/jppipa.v9i4.2721>
- Qodriyanti, A., Yarza, H. N., Irdalisa, I., Elvianasti, M., & Ritonga, R. F. (2022). Analisis Sikap Peduli Lingkungan Siswa di Salah Satu MAN pada Materi Pelestarian Lingkungan. *Jurnal Eksakta Pendidikan (Jep)*, 6(1), 111–116. <https://doi.org/10.24036/jep/vol6-iss1/643>
- Riefani, M. (2019). Validitas dan Kepraktisan Panduan Lapangan “Keragaman Burung” di Kawasan Pantai Desa Sungai Bakau. *Jurnal Vidya Karya*, 34(2), 193–204. <https://doi.org/10.20527/jvk.v34i2.7578>
- Riza, M., Firmansyah, R. A., Zammi, M., & Djuniadi, D. (2020). Pengembangan modul kimia berbasis kearifan lokal Kota Semarang pada materi larutan asam dan basa. *Jurnal Pendidikan IPA Veteran*, 4(1), 25–38. Retrieved from <https://ejournal.ivet.ac.id/index.php/jipva/article/view/1025>
- Sari, M. P., Muttaqin, A., Putri, R. E., & Oktavia, R. (2024). Integrating Ethnoscience on Critical-Thinking Oriented Web-Based E-Module of Secondary School Science. *Jurnal Penelitian Pendidikan IPA*, 10(1), 371–384. <https://doi.org/10.29303/jppipa.v10i1.5928>
- Sari, N. P., Suhirman, S., & Walid, A. (2020). Pengembangan Modul Pembelajaran IPA Berbasis Etnosains Materi Interaksi Makhluk Hidup dengan Lingkungannya untuk Menanamkan Jiwa Konservasi Siswa Kelas VII SMP. *Bio-Edu: Jurnal Pendidikan Biologi*, 5(2), 63–74. <https://doi.org/10.32938/jbe.v5i2.554>
- Sarwi, S., Nisa, G., & Subali, B. (2021). An analysis of critical thinking skill and interpersonal intelligence in the development of ethnoscience-based teaching material salt production. *Journal of Physics: Conference Series*, 1918(5), 052060. <https://doi.org/10.1088/1742-6596/1918/5/052060>
- Septiani, D. R., Agung, S., Sapinatul Bahriah, E., Kimia, P. P., Tarbiyah, I., & Keguruan, D. (2020). Buku Pengayaan Kearifan Lokal: Jakarta dalam Kimia.

- Jipva: Jurnal Pendidikan Ipa Veteran*, 4(2), 2020. Retrieved from <http://e-journal.ivet.ac.id/index.php/jipva>
- Setiawati, R., Fatmaryanti, S. D., & Ngazizah, N. (2013). Pengembangan Modul Berbasis Inkuiri Terbimbing untuk Mengoptimalkan Sikap Ilmiah Peserta Didik pada Pokok Bahasan Listrik Dinamis di SMA N 8 Purworejo Kelas X Tahun Pelajaran 2012/2013. *Jurnal Radiasi*. <https://jurnal.umpwr.ac.id/index.php/radiasi/article/view/468>
- Shofiyani', A., & Rahmawati, R. D. (2020). Pengembangan Bahan Ajar Berbasis Model Komunikatif Untuk Meningkatkan Keterampilan Berbicara Bahasa Arab. *Jurnal Education and Development*, 8(4), 238–238. Retrieved from <https://journal.ipts.ac.id/index.php/ED/article/view/2147>
- Sunaryo, S., Kushermawati, A., & Delina, M. (2020). E-modules on problem based learning to improve students' higher order thinking skills (hots). *International Journal of Innovation, Creativity and Change*, 11(1), 444–457. Retrieved from https://ijicc.net/images/vol11iss1/11132_Sunaryo_2020_E_R.pdf
- Sunderlin, W. D., Aju, I., & Resosudarmo, P. (1997). *Center For International Forestry Research Laju dan Penyebab Deforestasi di Indonesia: Penelaahan Kerancuan dan Penyelesaiannya*. Retrieved from https://www.cifor-icraf.org/publications/pdf_files/OccPapers/OP-09I.pdf
- Wahyuningsi, E. (2019). Pendekatan Komunikatif Dalam Pembelajaran. *Lingua Franca: Jurnal Bahasa, Sastra, Dan Pengajarannya*, 03(02), 1–13. <https://doi.org/10.30651/lf.v3i2.3102>
- Wardani, K. S. K., Astria, F. P., & Nurwahidah, N. (2023). Development of Ethnoscience-Based Science Education Module Using a Case Based Learning Model. *Jurnal Penelitian Pendidikan IPA*, 9(SpecialIssue), 473–478. <https://doi.org/10.29303/jppipa.v9iSpecialIssue.6123>
- Wati, E., Yuberti, Saregar, A., Fasa, M. I., & Aziz, A. (2021). Literature Research: Ethnoscience in Science Learning. *Journal of Physics: Conference Series*, 1796(1), 012087. <https://doi.org/10.1088/1742-6596/1796/1/012087>
- Widayanti, W., Safitri, J., & Yuserina, F. (2019). Relation between self-awareness and altruistic Behaviors on the volunteers of guru sekumpul memorial service. *Jurnal Kognisia*, 2(2), 134–139. <https://doi.org/10.20527/jk.v2i2.1677>
- Winarto, W., Kristyaningrum, D. H., Pamungkas, A., & Wulandari, P. (2023). Ethnosains of The Javanese Community “The Body Funeral Process” as A Resource of Basic Science Learning. *Jurnal Penelitian Pendidikan IPA*, 9(10), 8601–8609. <https://doi.org/10.29303/jppipa.v9i10.4959>
- Yonvitner, Wahyudin, Y., Mujiyo, & Trihandoyo, A. (2019). Biomasa Mangrove dan Biota Asosiasi di Kawasan Pesisir Kota Bontang. *Jurnal Biologi Indonesia*, 15(1), 123–130. <https://doi.org/10.47349/jbi/15012019/123>
- Zidny, R., & Eilks, I. (2022). Learning about pesticide use adapted from ethnoscience as a contribution to green and sustainable chemistry education. *Education Sciences*, 12(4), 227. <https://doi.org/10.3390/educsci12040227>