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Development of Ethnoscience E-Module Integrating Sedekah Laut to Enhance Biodiversity Learning

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Abstract

This research aims to determine the characteristics of Google Sites learning media integrated with Islamic values on Static Electricity material and its impact on the improvement of religious characters and critical thinking skills. The research method used is R&D with the ADDIE type. The research results show that the Google Sites learning media integrated with Islamic values on Static Electricity material is very valid for use. The validation scores from media and material experts were 4.38 and 4.42, respectively, with very valid criteria. The results of the data analysis show the N-Gain test results for 1 religious characters indicator with a high criterion and 7 religious character indicators with a medium criterion. The results of the N-Gain test for critical thinking skills showed 3 indicators with high criteria and 2 indicators with medium criteria. The results of the t-test for religious characters and critical thinking skills show a significant difference between the pretest and posttest scores. Based on the research results, the Google Sites learning media integrated with Islamic values on Static Electricity material is valid, usable, and can enhance the religious characters and critical thinking skills of the students.

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INTRODUCTION

Science education serves as a medium for students to explore their natural surroundings and consider further opportunities for applying scientific concepts in daily life. Listyawati (2012) states that the science learning process, which integrates concepts from physics, chemistry, and biology, can enhance students' competencies in understanding their environment. Jayadi et al. (2021) argue that science education can be developed by leveraging the uniqueness and strengths of a region, including its local (traditional) culture.

Rahayu & Sudarmin (2015) define ethnoscience as a learning activity that transforms the indigenous science of local communities into formal scientific knowledge. According to research by Widiana & Rosy (2021), a wise teacher should be able to incorporate local cultural values into the science learning process. However, the reality in schools shows that science education often pays little attention to local culture, and most teachers still rely heavily on textbooks or worksheets (LKS). This approach tends to be ineffective and inefficient, especially if it is not supported by learning resources that can enhance students' scientific literacy, critical thinking, and creativity, one such resource being e-modules (Sudjana & Rivai, 2007).

The use of less-than-ideal learning resources causes difficulties for students, particularly in the topic of biodiversity in senior high schools (SMA/MA). Students often struggle to connect the concept of biodiversity with local cultural practices, such as the "sedekah laut" (sea offering) tradition. According to research by Utami et al. (2020), based on observational data, around 76.5% of students were unaware of ethnoscience-based learning. This finding has motivated the continuous development of ethnoscience-based education.

Learning through e-modules can improve learning outcomes, as the comparison of students' performance shows a better increase in those who use e-learning modules compared to those who do not (Rosyidah et al., 2013). Current teaching materials are not yet effective in fostering environmental awareness and critical thinking skills. The effectiveness of learning materials requires reinforcement through consistent practice and habituation. Utilizing local culture as a learning resource is one effective way to help students understand the meaning of lesson content by linking it to everyday life (Syamzani, 2017).

This study aims to identify the types of biodiversity present in the offerings used in the "sedekah laut" tradition and in the students' surrounding environment. It also aims to analyze the validity, practicality, and effectiveness of an ethnoscience-based e-module rooted in local wisdom (sedekah laut) in improving students' scientific literacy and critical thinking on the topic of biodiversity.

METHOD

This study employs the Research and Development (R&D) method using the 4-D model, which consists of four stages: the Define stage, which involves literature analysis, curriculum analysis, and field analysis; the Design stage, which involves designing the e-module; the Develop stage, which involves producing the learning materials; and the Disseminate stage, which involves conducting small- and large-scale trials at MAN 2 Pati. The research was conducted at MAN 2 Pati, with the research subjects being Grade X students. The small-scale trial involved 30 students from class X1, while the control group consisted of 30 students from class X2. The research procedure began with identifying potential problems, collecting data, designing the product, validating it with experts, conducting the first revision, conducting a small-scale trial, and finally implementing the product.

Data collection techniques in this study included interviews, documentation, questionnaires, and tests. The interview method was used for the initial observations, the documentation method was used to gather data to obtain a general overview of the school being studied, the questionnaire method was used to assess the feasibility of the ethnoscience-based e-module integrating the local wisdom of the sedekah laut tradition, and the test method was used to measure improvements in students' scientific literacy and critical thinking skills on the topic of biodiversity.

RESULT AND DISCUSSION

This study aims to identify the types of biodiversity in the contents of the sedekah laut offerings and in the environment around the students, analyze the validity, practicality, and effectiveness of the ethnoscience-based e-module based on the local wisdom of sedekah laut to improve scientific literacy and critical thinking in biodiversity material.

Based on the results of the study, there are 15 different species in the contents of the sedekah laut offerings, while the identification results of

plants in the school environment show that almost all plants are vascular plants (Tracheophyta). The identification results of 11 plants are: Persea americana maluma, Pachira aquatica, Peperomia species, Lophomyrtus bullata, and Podocarpus nakaii, Agave americana margiata and Agave attenuate, Sansevieria trifasciata, Philodendron and Philodendron memelong. Both the contents of the offerings and the plants in the school environment have biodiversity.

Each environmental system has different biodiversity (Saito, 2023). Biodiversity is indicated by the various variations in shape, size, color, and traits of living organisms (Qudrat, 2025). Biodiversity is caused by two factors: genetic factors and environmental factors (Zhao, et al., 2021). There is an interaction between genetic factors and environmental factors in influencing the traits of living beings. Biodiversity is a component of natural ecosystem composition that plays a very important role ecologically, socially, economically, and culturally (Siboro, 2019). Understanding biodiversity needs to be emphasized to students in schools considering the importance of studying biodiversity, one of which is to maintain biodiversity around by efforts of preservation, so it needs to be part of the scientific studies that must be understood by students in senior high schools (SMA) (Tsaniyah & Fadly, 2024). In reality, there are still students who find it difficult to understand the concept of biodiversity, so there is a need to improve students' understanding of biodiversity, how to identify it, and calculate its index (Anjarwati et al., 2025).

The validity of the e-module is based on the assessment of material expert validators. The results of material expert validation can be seen in Table 1.

Table 1. Validation Results of E-module by Material Experts

No	Aspects	Score	%	Criteria
1	Content suitability	38	79%	Worthy
2	Presentation Eligibility	36	91%	Very worthy
3	Language Eligibility	36	75%	Worthy
4	Scientific	23	82%	Very worthy
	Average	133	89%	Very worthy

The material expert validators have 4 assessment aspects consisting of content, presentation feasibility, language feasibility, and scientific aspects. After revision/improvement, the recapitulation results of the e-module assessment by material expert validators obtained an average score of 89% with the criteria of very feasible/valid to be used in school learning.

The assessment by media expert validators consists of 3 aspects: graphic feasibility, e-module components, and language feasibility. Graphic feasibility is used to determine the suitability of the e-module format with ISO standards, e-module components to describe the content/material and reveal the object's characteristics, and language feasibility to determine content suitability.

Based on the assessment results by media expert validators consisting of 3 aspects, namely text design and message, image design, and e-module organization, the e-module received a score of 86% with the criteria of very valid/feasible. The results of the media expert validator assessment can be seen in Table 2.

Table 2. Validation Results of Media Expert Instruments

No	Aspects	Score	%	Criteria
1	Text message design	20	83%	Worthy
2	Image and video message design	25	89%	Very worthy
3	Organizing E-modules	10	83%	Worthy
	Average	55	86%	Worthy

The practicality assessment of the e-module was tested on a small scale with 30 students and the biology subject teacher. Aspects of teacher and student responses include language, sentence structure, image presentation, and e-module practicality. When combined, the average score of teacher and student readability and practicality responses was 85% with very good criteria. Based on these results, it can be concluded that the e-module meets the indicators listed as the basis for assessment because it has feasible or good criteria.

Table 3. Results of Practicality Assessment of Ethnoscience-Based E-module

Aspects	%	Criteria
readability	96%	Very worthy
Practicality of E-modules	75%	Worthy
Average	85%	Worthy

Practicality aspects include the use of easily understood language, sentence structure, con-

sistent sentence usage, image presentation, as well as font shape and size. The practicality aspects of the e-module include ease of access because it is digital, communicative, and ethnoscience-based.

The effectiveness test aims to determine students' level of understanding and mastery of concepts. The effectiveness of the e-module is obtained from test results using 2 classes, namely control and experimental classes. Testing was conducted using a non-quasi experimental control group design with class X MIPA 1 as the experimental class and class X MIPA 2 as the control class. The effectiveness test of the ethnoscience-based e-module developed can be measured using learning outcomes by conducting pre- and post-tests. There was a significant difference in pre-test and post-test scores based on statistical tests and proven by the N-gain test.

The average learning outcomes in the control class had a pre-test score of 63.5 and a post-test score of 79.7, while the experimental class had an average pre-test score of 61 and an average post-test score of 90, as shown in Figure 1. Data analysis results indicate an increase in average post-test scores in both control and experimental classes. The increase in the experimental class is higher than in the control class. These results indicate that the use of the e-module as a learning resource can improve learning outcomes.

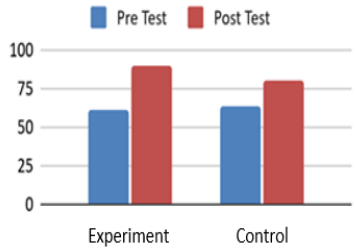

Figure 1. Comparison of Pre-test and Post-test

The cognitive aspect of learning outcomes was measured using 20 multiple-choice test questions consisting of pre-test and post-test questions. At the beginning of the learning activity, both control and experimental classes were given pre-test questions. Then different treatments were applied in the experimental class, which was given the e-module previously installed by students during the small-scale trial. The control class was not given the e-module. The post-test results were used to determine the effect of using the e-module during the learning process (Sriyanti et al., 2025). Data analysis results show an increase in average post-test scores in both control and experimental classes. The increase in the experimental class was higher than the control class due to the use of the ethnoscience-based e-module. The comparison shows that the N-gain value for pre-test was 0.43 and post-test was 7.2, as shown in Figure 2.

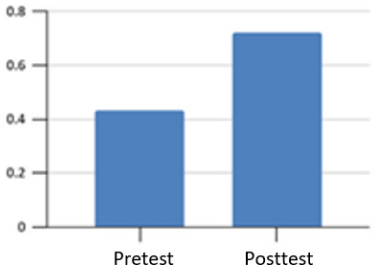

Figure 2. Comparison of N-Gain Pre- and Post-Test Scores

Student assessments on the psychomotor aspect refer to the results of students' worksheet assignments directly. Psychomotor assessment includes skills in observing plants found in the e-module and the surrounding environment, and presentations. The results of the psychomotor assessment can be seen in Figure 3. The average psychomotor scores during class discussions in the control and experimental classes for each indicator were 3.6 and 3.3 respectively, which fall under the very good category, as shown in Figure 3.

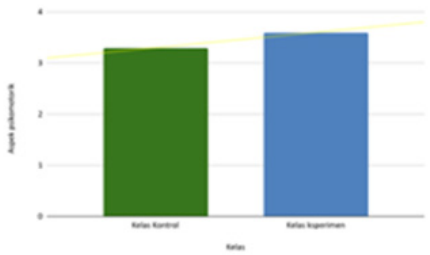

Figure 3. Comparison of Psychomotor Scores

Based on the research results, the development of the ethnoscience-based e-module grounded in local wisdom of sedekah laut effectively improves scientific literacy and critical thinking attitudes in biodiversity material. This study is supported by Yulia & Suttrisno (2024), whose research on the application of student worksheets containing ethnoscience material can improve scientific literacy.

The development process of the e-module to be feasible/valid for use as a learning resource in biodiversity material in schools must be validated first by material experts and media experts. This aligns with Akbar (2013), who stated that validation is conducted to produce learning materials based on development theory and to ensure

their validity for use in the learning process.

Media expert validation of the e-module received a percentage score of 92% with the criteria of very valid to be used as a learning resource. Media expert assessments are based on the e-module cover design, design representing the e-module content, clarity, communicativeness, term usage, and graphics of the e-module developed as a learning media (Pitorini et al., 2024; Elistiana et al., 2024). This aligns with Arikunto (2013), who stated that if the learning media feasibility score is above 80%, it qualifies as very valid and does not require revision, thus the e-module is valid for use in the learning process (Kismiati, 2020; Sujarwo et al., 2024).

Based on the local context, the developed e-module integrates the cultural value of sea alms as a gateway to understanding the concept of biodiversity (Sari et al., 2024). The sea alms tradition, rich with symbols of living creatures, both plants and animals, serves as an authentic medium for introducing biodiversity to students in a more contextual way (Mubarok et al., 2025). This approach not only demonstrates the variety of species in everyday life but also connects scientific knowledge with local wisdom, making learning more meaningful (Anzalina et al., 2024). Thus, this ethnoscience-based e-module serves a dual purpose: it serves to enhance students' understanding of the scientific concept of biodiversity while simultaneously instilling the values of cultural and environmental preservation in students (Hasibuan & Sani., 2023; Inavingtyas et al., 2024).

Based on the research results, the development of an ethnoscience-based e-module with the local wisdom of sea alms has proven valid, practical, and effective in improving students' scientific literacy and critical thinking skills in biodiversity material. Validation by material and media experts showed the criteria were very suitable for use, while the practicality test with teachers and students received a positive response with a high average score. The effectiveness test through a comparison of learning outcomes between the control and experimental classes showed a significant increase in the class that used the e-module. This is in line with the research of Nurhayati & Setiawan (2022) which proved that student worksheets containing ethnoscience can improve scientific literacy, and is supported by the opinion of Amrilizia et al (2022) that validation of the development of learning tools is an important step to ensure the feasibility of their use in the learning process. Thus, the results of this study strengthen previous findings while providing new contributions to the development of contextual learning resources based on local wisdom for biology learning in secondary schools (Wafatolo et al., 2025).

CONCLUSION

Based on the content validity, the E-module can enhance students' scientific literacy and critical thinking skills in biodiversity material. It was rated as highly valid by subject matter experts with a score of 82% and by media experts with a score of 92%. In terms of effectiveness, the E-module was found to improve students' scientific literacy and critical thinking skills on biodiversity material. (1) The result of the t-test for cognitive learning outcomes showed a significance value of 0.000 (< 0.05), indicating a significant difference in learning outcomes between the experimental class and the control class. (2) The N-gain of cognitive learning outcomes in the experimental class was 0.72, which was higher than that of the control class (0.43). (3) The average psychomotor score in the experimental class was 3.60, categorized as very good and higher than that of the control class (3.3), which was also categorized as very good. In terms of practicality, the E-module can enhance students' scientific literacy and critical thinking skills in biodiversity material. The practicality value, based on responses from biology teachers and students through a small-scale trial, was 92% and 93%, respectively, with a final average of 93%, indicating that the E-module meets the criteria of being very good.

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