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Development of Culturally Responsive Teaching-Based Modules on Plant Structure and Function Material to Improve the Ecoliteracy of Junior High School Students in Jember

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Abstract: This study aims to determine the validity and effectiveness of the Culturally Responsive Teaching-based science module in improving the ecoliteracy of junior high school students in Jember Regency. The subjects in this study were students of class VIII F SMPN 1 Ajung totaling 31 students, with 17 male students and 14 female students. The research model used in this study is the 4-D (Four D) development model which consists of four stages including define, design, develop, and disseminate. The instruments in this study were interview guidelines, validation sheets, and pre-test and post-test sheets for students. The validity data analysis was obtained through a validation questionnaire validated by three expert validators, and the effectiveness data analysis was obtained through the results of the pre-test and post-test given to students at the time before the application of the Culturally Responsive Teaching-based science module and at the time after the application of the Culturally Responsive Teaching-based science module. The validity results of this study obtained an average assessment score from the three expert validators of 94% with very valid criteria so that culturally responsive teaching-based modules can be applied to science learning. The results of the effectiveness of culturally responsive teaching-based modules produce an average N-Gain value at SMPN 1 Ajung of 0.85 with high-value criteria so that students can increase student ecoliteracy. Based on the research results, it is concluded that developing culturally responsive teaching-based modules is valid and effective in improving students' ecoliteracy.

Keywords: culturally responsive teaching, ecoliteracy, learning module.

▪ INTRODUCTION

Jember Regency has an area of 3,293 km2 and 31 sub-districts. Jember has a tropical climate, with temperatures ranging from 23 degrees Celsius to 32 degrees Celsius. According to BPS in 2022, the agricultural area of Jember Regency is 86,358 hectares. Therefore, Jember is one of the national food barns because it is a fertile agricultural area. By strengthening the competitiveness of both natural and human resources, Jember can be prioritized as an agribusiness and agricultural industry investment development area, for example tobacco, and coffee. Tobacco is one of the most economically important non-food crops worldwide. This crop, which grows on small to large tracts of well-drained land in temperate and tropical regions, serves as a source of leaves, which are then cured in various ways, ultimately resulting in more than a billion different plants used in the production of tobacco products (Baranova et al., 2024). The tobacco plant is not only an important crop in traditional agricultural systems, but can also be used as an ideal model plant in the study of biological mechanisms due to its ability to undergo rapid genetic changes, short germination time, and disease susceptibility, because tobacco can be genetically altered easily, has a relatively short genus and tends to be resistant to disease (Zou et al., 2021). Research in tobacco-supplying countries shows that, in addition to economic benefits and market access, one of the main reasons farmers grow tobacco is a strong supply chain (Lencucha et al., 2022).

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Tobacco generates relatively high foreign exchange in Indonesia due to its beacons (Setyoningrum et al., 2021). Different types of tobacco are produced in Jember Regency: Na-Oogst tobacco and Voor-Ogst tobacco. As the largest tobacco producer in Jember Regency, lahbako dance symbolizes this culture. Labako dance is a dance that represents the tobacco processing process in Jember. The choice of movements is inspired by tobacco farmers, so most of the dance movements feature the activities of tobacco farmers, from going to the fields to packing tobacco (Citrifolia et al., 2020).

In addition to tobacco, coffee is also a mainstay product of Jember Regency with the area of coffee plantations reaching 16,882 hectares. From a geographical point of view, Jember Regency is suitable for planting coffee trees because of its stable soil fertility and soil components from the slopes of volcanoes that are mixed, making the soil fertile for regional crops. World agricultural coffee plantations continue to show growth prospects due to the increasing demand for coffee because of its benefits for human health (Kumar et al., 2020). Coffee has a huge impact on the international market due to its sensory and nutritional properties, making it the most consumed beverage worldwide and the product of choice for biofortification (Mateus et al., 2021). There is a tradition that has been passed down from generation to generation in the Jember Regency in the form of coffee-picking dances. This cultural heritage is a representation of the experiences of coffee farmers, and the narrative is delivered through the participation of many women coffee farmers. Although it looks simple, this dancer is a dedicated and diligent coffee farmer and has a tenacious personality. Therefore, to strengthen students' knowledge of the importance of understanding some of these crops as high-value products of Jember Regency. Students can achieve this by using teaching materials to learn about the structure and function of plants.

Teaching materials are a set of learning materials that assist teachers in carrying out teaching and learning activities (Nurmala & Susanti, 2020). Appropriate teaching materials are essential for the design and effectiveness of the educational process. According to Rahmat & Yahya (2022), the accuracy, difficulty, structure, and meaning of the material must be by the learning outcomes and skills desired by students and teachers. According to Alenezi (2020), teaching materials are categorized into learning elements, which are organized based on specific learning objectives and serve as scaffolding for creating learning-oriented teaching resources that meet specific curriculum requirements. These learning materials aim to strengthen the methodological basis of teaching, improve the efficiency and quality of students' knowledge, develop students' creative abilities, provide methodological support to students in mastering the material, help teachers improve their teaching skills, plan and organize effective self-study work and manage students' knowledge (Tursunovich, 2022).

Teaching materials are divided into two types, the first is printed teaching materials such as books, modules, worksheets, handouts, and booklets; and non-print teaching materials such as tapes, radio, or interactive media. One of the most effective teaching materials is modules (Retnowati et al., 2020). A module is a learning tool that contains material, methods, limits, and evaluation methods designed in an observable and interesting way to achieve the desired results (Arifuddin et al., 2022). According to Purwanto et al (2020), one of the media that students can use as independent learning materials according to the current curriculum is modules, the use of this module is a form of integrating environmental education into science learning and is an innovation in the

field of education. The use of modules is a flexible approach that helps students understand the content of the lesson effectively, either under the guidance of the teacher or working independently. Modules allow students to work independently or in class with a teacher, the result is that modules allow teachers to easily accommodate the different needs of their students without compromising the quality of teaching or saving time (Kiong et al., 2022). Modules include an overview of materials and training and explain how students build their knowledge, and modules play an important role in achieving educational goals by allowing students to adapt to the characteristics of their social environment (Setiyani et al., 2020).

Based on interviews conducted with teachers at school, teachers have not actualized modules related to the presentation of surrounding culture, and students do not know the culture around plants, for example, what plant commodities are in the surrounding environment. Therefore, learning modules can help improve students' ecoliteracy. Ecoliteracy is about understanding the environment, it refers to the knowledge understood about environmental issues (Rida Nurfarida et al., 2022). According to Dwinur et al (2020), the meaning of ecoliteracy is to describe the awareness of the importance of humans in protecting the environment, people who have ecoliterate about the importance of maintaining and caring for the earth which is the natural habitat of living things will behave more environmentally friendly. Ecoliteracy or ecological literacy is needed so that students understand that they need to respect the environment and acquire appropriate skills, these skills are about literacy and providing effective and intelligent solutions to environmental problems that are important for creating a greener environment for life on earth (Wulandari et al., 2024). According to Maulana et al (2021), ecoliteracy is very important to be created in learning because students have a role as agents who create economic information, experiences, attitudes, and behavior in society (agents of change), agents who have awareness of their natural conditions and can apply ecoliteracy in life. This is in line with Afiani et al (2022), that ecoliteracy needs to be applied in the learning process to improve problem-solving skills, make students independent, develop an awareness of the surrounding natural conditions, and enable them to incorporate the knowledge they already have about the environment into their practical needs, without action, environmental knowledge will only become unsustainable knowledge.

Based on some explanations of the definition of ecoliteracy above, it can be concluded that ecoliteracy is the ability to understand the surrounding environment and how to protect the environment around humans. In improving students' ecoliteracy skills, it is necessary to have an unusual approach to presenting an understanding of culture. Culturally Responsive Teaching (CRT) approach is an approach to learning that requires the equal rights of every student to get taught without distinguishing the cultural background of students (Khasanah et al., 2023). According to Abacioglu et al (2020), CRT emphasizes the importance of integrating academic knowledge and skills with students' personal experiences and frames of reference in a collaborative and supportive environment, this will make learning more meaningful and interesting. Through this explanation, teachers need educational materials in the form of Culturally Responsive Teaching (CRT) based modules that can be used to facilitate students in recognizing the culture that surrounds them to advance their ecoliteracy. Based on this description, the researcher here conducts research with the title "Development of Culturally Responsive

Teaching-Based Modules to Improve the Ecoliteracy of Junior High School Students in Jember".

▪ METHOD

Participants

This research was conducted at SMPN 1 Ajung Jember Regency in class VIII F with a total of 31 students. Data collection techniques in this study are divided into validity data collection techniques and effectiveness data collection techniques. The validity data collection technique was done by giving expert validators a product validation questionnaire sheet. Meanwhile, the effective data collection technique was obtained through pre-tests and post-tests given to students.

Research Design and Procedures

The design of this research utilizes Research and Development (R&D) research. Development research or also known as RnD research is a research method to validate and develop products (Ruhansih, 2021). In this research and development, researchers used the 4-D research method for device development. This 4D model was chosen to be developed because it is a recommended model for the development of learning devices. The developed product is tested for feasibility based on product effectiveness and testing. The 4-D development model consists of 4 main stages, namely the first define, second design, third develop and finally disseminate (Rasyono et al., 2020). At the defining stage, researchers analyzed teachers and students for the problems faced by students in science subjects, especially plant structure and function material. At the planning stage, researchers designed a Culturally Responsive Teaching-based science module to overcome the problems students have. At the development stage, researchers validated the teaching module to expert validators and made revisions as suggested by the validators. At the deployment stage, researchers disseminate and adopt the results of the development of Culturally Responsive Teaching-based science modules. The period of research conducted at SMPN 1 Ajung starting from the defining, planning, developing and disseminating stages lasted for one month.

Instruments

The instruments in this study were interview guidelines, validation sheets, and pre-test and post-test sheets for students. The pre-test and post-test sheets each consisted of 6 questions. Each question includes indicators of ecoliteracy adapted from research conducted by Tyas et al (2022) in the form of indicators of basic knowledge of ecological principles, the ability to analyze environmental problems, can provide solutions to environmental problems, have concern for others and the environment, have a responsibility to protect the environment, and a wise attitude in the use of natural resources. Before distributing the pre-test and post-test, the instrument had gone through a validation process carried out by expert validators and received a score of 92.2% with a very valid category that could be implemented in research.

Data Analysis Technique

Data Analysis of Validity

Quantitative data obtained by researchers through validation questionnaires to expert validators were analyzed through formulas converted concerning Table 1 below.

$$\text{Score criteria} = \frac{\text{number of scores obtained}}{\text{total score}} \text{x} 100\%$$

Table 1. Product validity categories

No	Percentage	Validity Category
1	81% ≤ 100%	Very Valid, can be used without improvement
2	61% ≤ 80%	Moderately valid, but needs minor improvements
3	41% ≤ 60%	Less valid, and a major improvement
4	21% ≤ 40%	Invalid, cannot be used
5	0% ≤ 20%	Highly invalid, cannot be used

Effectiveness Data Analysis

The acquisition of effectiveness data in the form of pre-test and post-test that has been obtained by researchers during the learning process. The data was analyzed using the N-Gain score obtained from the formula below.

$$\text{N} - \text{Gain} = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score}}$$

Table 2. N-Gain criteria

No	N-Gain Score	Category
1	0.00 < N – Gain < 0.30	Low
2	0.30 ≤ N – Gain ≤ 0.70	Medium
3	N – Gain > 0.70	High

▪ RESULT AND DISSCUSSION

Research Results Validity

The culturally Responsive Teaching-based science module is designed by combining the existing culture in Jember Regency with the material of class VIII junior high school, namely the structure and function of plants, with the hope that this science module can improve the ecoliteracy of students. The design of the Culturally Responsive Teaching-based science module can be seen through the link https://drive.google.com/file/d/1gbzTAtJu1dNIbO2tIbOX38xPcAIAuSlO/view?usp=sharing or in Table 3 below.

Table 3 above is the design of the Culturally Responsive Teaching-based science module produced by researchers through the incorporation of regional culture and also learning materials in the classroom. Culturally Responsive Teaching-based science module has five categories which are divided into 1) Integrating culture in material content that connects learning materials with culture in the surrounding environment, 2) Construction of knowledge that lies in the knowledge of the material and culture in the teaching materials, 3) Not prejudiced in differences that are contained in classroom learning, 4) Social justice that is contained in classroom learning so that students do not discriminate between others, and 5) Academic development obtained through material and local cultural elements that are packaged in teaching materials (Alhanachi et al., 2021). The application of this approach highlights various techniques related to the

Table 3. Design of science module based on culturally responsive teaching

a. Module frontpage

b. Cultural display of jember regency

c. Display of material content

d. Student evaluation

integration of student characteristics culture and background. The integration of Culturally Responsive Teaching into science learning developed in this study occurs through the integration of natural phenomena and traditions that exist in the students' environment, associated with scientific theories obtained from students' learning experiences. Culturally Responsive Teaching is also a learning approach where the teacher positions himself as a facilitator in charge of eliminating gaps that arise in the classroom due to differences in background, traditions, ethnicity, and other differences from each student. The development of Culturally Responsive Teaching-based science modules has passed the validation stage which has been assessed by three expert validators. The results of the validation of the Culturally Responsive Teaching-based science module are as follows.

The validity of the Culturally Responsive Teaching-based science module was evaluated based on content validity and construct validity. Evaluation of content validity

Table 4. Validation results

Content Validity		**Criteria**
Content eligibility	93%	Very Valid
Presentation feasibility	93%	Very Valid
Language feasibility	95%	Very Valid
Construct Validity	95%	Very Valid
Average	**94%**	Very Valid

is divided into content suitability, presentation suitability, and language suitability. The suitability of the content gets a result of 93% with a valid category, the suitability of the presentation gets a result of 93% with very valid criteria, and the suitability of the language gets an average of 95% with very valid criteria. As for construct validity, the result is 95% with a very valid category. The results of the validation of science modules based on culturally responsive education reached an overall average score of 94% with a very valid category. From the results obtained, the development of this learning module can be used as teaching material for any subject, especially science. If the development of this module is transferred to other scientific fields, the basic science education level must be changed to the general basic education level. Its characteristics are strongly influenced by the type of science contained in each subject. Because of the different characteristics of each subject, the way students learn in each subject is also different. In science subjects, there are three characteristics that must be present: scientific rules and theories are openly disclosed to formulate hypotheses; the relationship between observed facts is such that the facts can be established to make predictions before conclusions can be made; and scientific significance (Retnowati et al., 2020). Based on the validation results, expert validators declared the Culturally Responsive Teaching-based science module valid. This is in line with research conducted by O'Leary et al (2020) that Culturally Responsive Teaching-based modules are included in the valid category with an average of 86%.

Effectiveness Research Results

The results of the study were obtained through the N-Gain value obtained through the pre-test and post-test that had been tested on students. The pre-test was given to students before the implementation of the Culturally Responsive Teaching-based science module and the post-test was given after the implementation of the Culturally Responsive Teaching-based science module to determine the increase in student ecoliteracy. The results of the pre-test and post-test obtained the N-Gain value as follows.

Table 5. N-Gain analysis results

No.	**Ecoliteracy Indikator**	**Average Value**		**N-gain**	**Criteria**
		Pre-test	**Post-test**		
1.	Have basic knowledge of ecological principles.	1.30	2.87	0.92	High
2.	Have the ability to analyze environmental problems.	1.13	2.77	0.88	High
3.	Can provide solutions to environmental problems.	0.55	2.58	0.83	High

4.	Have concern for fellow humans and the environment.	0.81	2.61	0.92	High
5.	Responsible for protecting the environment.	0.94	2.55	0.78	High
6.	Wise use of natural resources.	1.23	2.74	0.85	High
	Average	1.00	2.69	0.85	High

Based on Table 5, the average N-Gain result at SMPN 1 Ajung resulted in a value of 0.85. The data analysis was generated through pre-test and post-test scores during learning activities using Culturally Responsive Teaching-based science modules to improve student ecoliteracy on plant structure and function material. The results of the analysis on the first indicator obtained an N-Gain value of 0.92 with high criteria. The results of the analysis on the second indicator obtained an N-Gain of 0.88 with high criteria. In the third indicator, the N-Gain result is 0.83 with high criteria. The results of the analysis of the fourth indicator resulted in an N-Gain value of 0.92 with high criteria. The results of the analysis on the fifth indicator obtained an N-Gain value of 0.78 with high-value criteria. The analysis of the sixth indicator or the final indicator resulted in an N-Gain value of 0.85 with high-value criteria. The acquisition of the six indicators shows that the average N-Gain has high criteria.

The indicators of student ecoliteracy that received the first N-Gain increase were indicators 1 and 4, namely having basic knowledge of ecological principles and having concern for fellow humans and the environment. The highest criterion obtained from this indicator is because students have understood the material presented by researchers regarding the structure and function of plants and the use of local wisdom-based teaching materials, teachers can instill ecoliteracy in students in the learning process. According to Tursunovich (2022), ecology is described as a state inspired by the environment and reflected in the actions and deeds of each individual, therefore, ecological awareness refers to a state in which a person understands the fundamental interactions of living things in the environment. The indicator of students' ecoliteracy that gets the second N-Gain increase is indicator 2, which can analyze environmental problems. The high criteria on this indicator is because when analyzing a problem, students can find different answers and opinions needed to implement interesting ideas to develop solutions to the problem. According to Rokhmah & Fauziah (2021), environmental literacy needs to be improved because high school students do not yet have the necessary skills to identify, analyze, and apply solutions to environmental problems. Therefore, through the science module based on culturally responsive education, we help students understand the environment, and this second indicator increases the level of students' ecoliteracy. The indicator of students' ecoliteracy that got the third N-Gain increase was in indicator 6 wise in using natural resources, in this indicator students gained an increase after the researcher taught how important it is to be wise in using natural resources with the help of module teaching materials. The indicator of student ecoliteracy that received the fourth N-Gain increase was indicator 3 can provide solutions to environmental problems. High criteria in this indicator indicate that students can provide solutions to environmental problems that occur based on what they have learned through Culturally Responsive Teaching-based science module learning. While the indicator of student ecoliteracy that gets the last N-Gain increase is indicator 5 responsible for protecting the environment. The role of

teachers is needed to improve students' understanding of the environment, one of which is using Culturally Responsive Teaching-based teaching materials. Hermino et al (2020) noted another benefit of local wisdom-based learning is that cultural influences greatly shape students' attitudes toward science, one form of student attitudes towards science is environmental literacy.

These results state that learning media plays an important role in the implementation of the learning process. The use of interesting learning media can encourage students to absorb the content presented (Setyo et al., 2023). The use of modules with a Culturally Responsive Teaching approach makes students better understand the cultural diversity that exists in the surrounding environment. The Culturally Responsive Teaching approach is an approach that recognizes and embraces cultural diversity in the classroom, integrates cultural diversity into the school curriculum, and creates meaningful relationships with community culture (Biazus & Mahtari, 2022). According to research conducted by Gunawan et al (2020) said that ecoliteracy is the ability to deeply understand environmental and sustainability issues and act effectively to protect and preserve the environment so that through an approach using Culturally Responsive Teaching can help students improve ecoliteracy. The results of the development of Culturally Responsive Teaching-based science modules to increase student ecoliteracy show the results of the N-Gain analysis through the pre-test and post-test scores that students can increase student ecoliteracy. This is in line with research conducted by Malapad & Quimbo (2021) that Culturally Responsive Teaching-based learning is effective in increasing students' learning understanding of the environment. So, it can be concluded that the existence of a Culturally Responsive Teaching-based science module improve students' ecoliteracy.

▪ CONCLUSION

Based on the results and discussion, it is concluded that the Culturally Responsive Teaching-based science module on plant structure and function material is proven to be valid and effective in increasing student ecoliteracy at SMPN 1 Ajung. The validity of the Culturally Responsive Teaching-based science module is reviewed from the validation assessment with an average of 94% very valid criteria. The effectiveness of the Culturally Responsive Teaching-based science module obtained an average N-Gain at SMPN 1 Ajung of 0.85 with high-value criteria so that students can improve their ecoliteracy.

The impact of the research that has been conducted on the school that the researcher has chosen as the place to carry out the research is the interest of students in learning about the various cultures that are in the environment where students live so that previously students did not understand what cultures existed in their area with the Culturally Responsive Teaching-based module helps students understand the importance of protecting and preserving the surrounding environment. This study has limitations, namely carried out in one school in the Jember Regency area due to the difficulty of researchers in the distance traveled and so on.

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