

DEVELOPMENT MACROALGAE DIVERSITY LEAFLET ON EAST COAST PACITAN TO IMPROVE STUDENTS' CONCEPTUAL UNDERSTANDING OF LOCAL BIODIVERSITY

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Abstrak

Penelitian ini bertujuan untuk mengembangkan leaflet keanekaragaman hayati berbasis potensi lokal berupa keanekaragaman makroalga di pesisir timur Pacitan untuk meningkatkan pemahaman konsep keanekaragaman hayati lokal pada siswa. Penelitian ini menggunakan metode Research and Development (R&D) dengan model ADDIE yang dimodifikasi meliputi tahap analisis, desain, dan pengembangan. Penelitian dilaksanakan di MI Muhammadiyah Gawang, Pacitan, Jawa Timur dengan melibatkan 22 siswa kelas IV yang dipilih menggunakan teknik purposive sampling. Pengumpulan data dilakukan melalui angket analisis kebutuhan guru dan siswa, lembar validasi ahli, angket penilaian kepraktisan guru, dan angket respon siswa. Data dianalisis secara kualitatif dan kuantitatif menggunakan analisis persentase. Hasil penelitian menunjukkan bahwa leaflet yang dikembangkan memiliki karakteristik interaktif melalui penyajian gambar kontekstual dan penjelasan ringkas mengenai keanekaragaman makroalga. Hasil validasi validator pertama memperoleh skor 93,35% dan validator kedua sebesar 97,23% dengan kategori sangat baik, yang menunjukkan bahwa leaflet sangat layak digunakan sebagai media pembelajaran. Hasil uji kepraktisan oleh guru memperoleh skor 76,19% dengan kategori praktis, yang berarti leaflet mudah digunakan dalam kegiatan pembelajaran. Selain itu, respon siswa mencapai 91,66% dengan kategori sangat baik, yang menunjukkan bahwa siswa tertarik dan memberikan respon positif terhadap media yang dikembangkan. Temuan penelitian ini menunjukkan bahwa leaflet keanekaragaman makroalga layak dan praktis digunakan sebagai media pembelajaran kontekstual berbasis potensi lokal untuk mendukung pembelajaran keanekaragaman hayati serta meningkatkan kesadaran lingkungan dan pemahaman konsep siswa.

Kata Kunci: keanekaragaman hayati, leaflet, potensi lokal, makroalga, pembelajaran IPA

Abstract

This study aimed to develop a biodiversity leaflet based on the local potential of macroalgae diversity on the east coast of Pacitan to improve students' understanding of local biodiversity concepts. The research employed a Research and Development (R&D) design using a modified ADDIE model consisting of analysis, design, and development stages. The study was conducted at MI Muhammadiyah Gawang, Pacitan, East Java, involving 22 fourth-grade students selected through purposive sampling. Data were collected through teacher and student needs analysis questionnaires, expert validation sheets, teacher practicality assessments, and student response questionnaires. The collected data were analyzed qualitatively and quantitatively using percentage analysis. The results showed that the developed leaflet had interactive characteristics through contextual images and concise explanations related to macroalgae diversity. The first validator assessment obtained a score of 93.35% and the second validator obtained 97.23%, both categorized as very good, indicating that the leaflet was highly feasible as a learning medium. The practicality test conducted by teachers showed a score of 76.19% categorized as practical, meaning that the leaflet was easy to implement in classroom learning. In addition, student responses reached 91.66%



with very good criteria, indicating that students were highly interested in and positively responded to the developed media. These findings suggest that the macroalgae diversity leaflet is feasible and practical as a contextual learning medium that supports biodiversity learning based on local potential and contributes to strengthening students' environmental awareness and conceptual understanding.

Keywords: biodiversity, leaflet, local potential, macroalgae, science learning

INTRODUCTION

Learning is a systematic process consisting of interconnected components such as objectives, teaching materials, methods, media, and evaluation that work together to achieve learning goals (Rosmana, P.S., Ruswan, A., Alifah, A.N., Pratiwi, K., Fitriani, M.G., Huda, N., Ramadhani, S., & Nurnikmah, 2024). Learning media plays an important role in creating meaningful and engaging learning experiences (Kandia et al., 2023), especially in science education, where abstract concepts often require visual and contextual representation to support students' understanding. The use of appropriate learning media can improve students' motivation, attention, and conceptual understanding because media helps students visualize scientific concepts more concretely (Syumiarti, Makki, M., Astria, F.P., 2024). Previous studies reported that attractive and interactive learning media positively influence students' learning engagement and facilitate knowledge retention, particularly for elementary school students who tend to learn through concrete experiences and visual observation (Kori Sundari et al., 2024). In biodiversity learning, students are expected not only to understand theoretical concepts but also to recognize the biodiversity that exists in their surrounding environment (Aminullah et al., 2025). However, learning resources used in schools are still predominantly textbook-oriented and rarely integrate local potential into the learning process. Based on observations and interviews conducted at MI Muhammadiyah Gawang, Pacitan, East Java, teachers mainly relied on printed textbooks with limited availability, resulting in not all students having equal access to learning resources. In addition, teachers had not integrated local biodiversity into science learning, particularly the diversity of macroalgae found along the east coast of Pacitan. As a result, students' understanding of local biodiversity remained limited even though the surrounding environment has considerable ecological potential that can be utilized as contextual learning material.

Knowledge of local biodiversity is important because it can strengthen students' environmental awareness, conservation attitudes, and understanding of scientific concepts through direct interaction with their environment. Integrating local potential into science learning also supports contextual and meaningful learning (Az Zahra et al., 2024). Furthermore, utilizing local biodiversity as a learning resource can help students develop deeper scientific understanding and improve environmental literacy (Shavira, A. P., Nurmiawati, M., & Santoso, 2021). One form of local biodiversity that has educational potential in Pacitan is macroalgae diversity. Macroalgae are marine organisms that can be easily observed in coastal ecosystems and can serve as authentic examples in biodiversity learning. However, information about macroalgae diversity in Pacitan has not been optimally introduced in elementary school learning materials.

To address these problems, innovative learning media that are practical, contextual, and attractive for elementary school students are needed. One alternative medium is a leaflet. Leaflets are concise printed learning media containing visual illustrations and brief explanations that can facilitate independent learning. The use of leaflets is considered suitable for elementary school students because they provide colorful visualizations, simple language, and practical formats that are easy to carry and use (Mahmudah, D., & Kurniasari, 2024). Previous studies have shown that leaflet-based learning media can increase students' learning interest, motivation, and conceptual understanding because students are more actively involved in the learning process through visual and contextual information (Setiawan, 2020). In addition, visual learning media are more effective in helping students understand biodiversity concepts compared to text-dominated learning resources because images and contextual illustrations make learning more concrete and meaningful (Nur'ani, A.L., Sholihah, R.N., Riandi, & Widodo, 2022).

Therefore, this study aims to develop a biodiversity leaflet based on the local potential of macroalgae diversity on the east coast of Pacitan. The developed leaflet is expected to become an alternative learning medium that is feasible, practical, and capable of improving students' understanding of local biodiversity concepts while fostering awareness of environmental conservation.

METHOD

This research and development (R&D) refers to the Analysis, Design, Development, Implementation and Evaluation (ADDIE) approach, but only up to development stage due limited research time (Branch, 2010). This research was conducted at MI Muhammadiyah Gawang, Pacitan, East Java. The sampling technique used was purposive sampling. The



sample taken was class IV with 22 students. The selection of this sample was part of trial to get feedback on leaflet that was developed.

Qualitative data obtained at analysis stage include observation data, interviews, questionnaires, and document studies. While quantitative data was obtained at development stage, include questionnaire data from validators and practitioners. In addition, quantitative data was also carried out at development stage on expert validation data (content and media), teacher assessment questionnaires, and student response questionnaires. The questionnaires used were expert validation, teacher assessments, and student responses which were compiled using a Likert scale (Suryaningsih et al., 2022) as in table 1. Scores obtained from the questionnaire were measured using percentage score formula adapted from (Dewi & Handayani, 2021).

Table 1. Likert Scale

Options	Score
Strongly Agree	4
Agree	3
Disagree	2
Strongly Disagree	1

$$score\ percentage = \frac{\sum obtainedscore}{\sum maximumscore} \times 100$$

The percentage score results are used to categorize validity, practicality and feedback criteria for leaflet. Validity criteria can be seen in table 2 which consists of 5 criteria (Kolbiyah et al., 2020). These feasibility test criteria serve as guidelines in assessing feasibility of leaflet developed by researchers.

Table 2. Validity Criteria

Percentage Interval (%)	Criteria	Decision
80 – 100	Very Good	Not Revisied/Good
66 – 79	Good	Not Revisied/Good
56 – 67	Enough	Revisied/Not Good
40 – 55	Not Enough	Revisied/Not Good
0 – 39	Not Very Enough	Revisied/Not Good

Practicality criteria as guideline for assessing the practicality of developed leaflet (table 3) while student responses (table 4) consist of criteria that describe students' perspectives on product (Pasaribu et al., 2023).

Table 3. Practically Criteria

Percentage (%)	Criteria
0 – 20	Impractical
21 – 40	Not Practical
41 – 60	Quite Practical
61 – 80	Practical
81 – 100	Very Practical

Table 4. Criteria For Student Feedback

Percentage (%)	Criteria
81 – 100	Very Good
61 – 80	Good
41 – 60	Good Enough
21 – 40	Not Good
0 – 20	Very Bad

RESULT AND DISCUSSIONS

Analysis

The analysis consists stages of curriculum analysis, topic analysis, needs analysis and determination of learning objectives. Curriculum used is independent curriculum (in Indonesian “kurikulum merdeka”). Research was conducted on topic of recognizing biodiversity by recognizing macroalgae biodiversity. Topic analysis in learning development leaflets aims to ensure that concepts and topics presented are in accordance with learning outcomes in curriculum. Topic



of biodiversity is part of dimensions Pancasila student profile. Purpose this topic integration is to enrich knowledge of local biodiversity in Pacitan. Needs analysis conducted consists of two, there are teacher needs analysis conducted using structured interview method with 1 respondent, and student needs analysis to ensure content presented is relevant and easily accessible and can encourage active involvement and student desire to learn. Teacher needs analysis shows that teachers have known concept of biodiversity but have not fully understood local biodiversity, especially macroalgae diversity in Pacitan and have not taught concept or integrated it into learning. In addition, learning resources used in topic of biodiversity are still oriented towards textbooks. The results of teacher needs analysis state that teachers have never used leaflets as learning media and have never integrated local biodiversity into learning.

Based on results of student needs analysis questionnaire distributed to students, 40.8% did not know about local biodiversity, 75.2% of students did not know about macroalgae diversity in Pacitan, and 90% of students were interested in learning more about macroalgae diversity in Pacitan. Furthermore, 92.8% of students needed leaflets that could be used to study the topic of macroalgae diversity in Pacitan, and 90% of students agreed to try learning using leaflets. Determining learning objectives is an important stage or action in learning process. Learning objectives serve to provide direction for activities in learning process and help students achieve learning outcomes.

Design

Topic used in the leaflet is biodiversity by integrating macroalgae diversity which is local potential into biodiversity learning. Based on needs analysis conducted, students stated that they strongly agree to utilize local potential as learning resource (Imtihana & Febriani, 2023), so it is necessary to develop learning media that can integrate local potential into learning. Selection of media in the form of learning leaflets has an important role in determining the effectiveness and strength of topic that will be conveyed to students. By packaging learning resources based on local potential into the form of learning media, it is hoped students can improve their conceptual understanding of biodiversity, especially local biodiversity in their own area.

Result analysis of teacher needs related to integration of local potential into learning show that teachers have not fully integrated local regional potential into learning and are still limited to using printed books as learning resources. In addition, teachers find it difficult to integrate local regional potential into learning and still confused about how to package it into an interesting learning media for students. Therefore, solution is needed to overcome this problem, by developing more effective and interactive learning leaflets.



Figure 1. Outer Page Of Leaflet



Figure 2. Inside Page Of Leaflet



Development of leaflets is adjusted to curriculum Learning Outcomes and learning objectives that have been formulated which are then compiled into leaflets. The content contained in leaflet includes contextual images, information about macroalgae diversity presented concisely and in practical size.

Development

Development stage of biodiversity topic leaflet was carried out by integrating local potential-based diversity, macroalgae diversity in Pacitan, consisting of several stages, there are expert validation and product trials. Expert validation is stage of leaflet development that aims to assess that developed leaflet has met eligibility criteria. Expert validation in this study consists of topic expert validation, media expert validation and learning expert validation.

Table 5. Leaflet Assessment Results From The 1st Media Validator

Aspect	Obtained Score	Maximum Score	Percentage	Criteria
Topic or content	30	32	93,75	Very Good
Self-instruction	42	44	95,45	Very Good
Self-contained	4	4	100	Very Good
Stand alone	3	4	75	Good
Adaptive	4	4	100	Very Good
Usher friendly	4	4	100	Very Good
Media	25	28	89,28	Very Good
Average percentage			93,35	
Validity criteria				Very Good

Based on table 5, it can be seen that assessment of leaflet from the 1st media validator shows an average percentage of leaflet developed of 93.35 with very good criteria.

Table 6. Leaflet Assessment Results From The 2nd Media Validator

Aspect	Obtained Score	Maximum Score	Percentage	Criteria
Topic or content	31	32	96,87	Very Good
Self-instruction	40	44	90,90	Very Good
Self-contained	4	4	100	Very Good
Stand alone	4	4	100	Very Good
Adaptive	4	4	100	Very Good
Usher friendly	4	4	100	Very Good
Media	26	28	92,85	Very Good
Average percentage			97,23	
Validity criteria				Very Good

Based on table 6, it can be seen that assessment of leaflet from the 2nd media validator shows an average percentage of leaflet developed of 97.23 with very good criteria.

Table 7. Student Response Results

Questions	Obtained Score	Maximum Score	Percentage (%)	Criteria
Clarity of images and content to understand learning objectives	135	140	96,42	Very Good
Leaflet's content interesting and easy to understand	127	140	90,71	Very Good
Leaflet are easy to carry and use any time	131	140	93,28	Very Good
Attractive appearance	125	140	89,28	Very Good
Readability of type and size font	126	140	90	Very Good
Communicative language	125	140	89,28	Very Good
The concept of matter is close to everyday life	130	140	92,85	Very Good
Leaflet can provide information about diversity of macroalgae	135	140	96,42	Very Good
Reliable reference content	120	140	85,71	Very Good



The presentation of leaflet encourages involvement students active	130	140	92,85	Very Good
Leaflet color attractive and proportional to the content	136	140	97,14	Very Good
Content presented contextually	123	140	87,85	Very Good
Leaflet content easy to understand	126	140	90	Very Good
Information about macroalgae is presented clearly	131	140	93,57	Very Good
Leaflet present systematic information	125	140	89,28	Very Good
Average percentage	91,66			
Validity criteria	Very Good			

Based on table 7, it can be seen that results of students' responses to leaflet showed percentage of 91.66 with very good validity criteria.

Table 8. Practicality Test Results

Aspect	Obtained Score	Maximum Score	Percentage	Criteria
Content	22	28	78,57	Practical
Language	9	12	75	Practical
Format/ Display	6	8	75	Practical
Average percentage	76,19			
Validity criteria	Practical			

Based on table 8, it can be seen that results of practicality test show an average percentage leaflet developed of 76.19 with validity criteria, practical with usable information and minimal revisions.

Characteristics Macroalgae Diversity Leaflet to Increase Knowledge of Local Biodiversity

The developed leaflet is an alternative learning media that allows students to interact actively and increase long-term information retention. In addition, it can also create positive and enjoyable learning experience for students (Kori Sundari et al., 2024). Research conducted by (Setiawan, 2020) shows that leaflets are interactive learning media that can increase students' interest in material being studied. This is because students can read, observe pictures and interact with information presented in leaflet. Students can process information in leaflet according to their own pace and learning style. This can help students develop independent learning skills and be responsible for their learning process. With the visualization in leaflet can help students understand material more clearly and strengthen students' conceptual understanding (Kori Sundari et al., 2024).

The development of this leaflet highlights local potential of region and integrates it into learning. Local potential used is macroalgae and its integrated in learning of science for grade IV on biodiversity topic. Integration of this local potential is expected to increase students' knowledge and understanding local natural resources (Imtihana, E.R., 2020) (Wicaksono et al., 2025) in this case, diversity of macroalgae so students can develop conservation attitude in context of sustainable development.

Leaflet media is one of alternative learning media that can be used for elementary school students' learning (Mahmudah, D., & Kurniasari, 2024). This is because elementary school students like fun learning activities. Characteristics of elementary school students' learning process are that they tend to learn concretely by utilizing their surroundings, integrative and hierarchical (Rohim, A., & Wardhani, 2024). Through interaction with real and factual situations regarding learning objects, students' learning experiences will become more meaningful. (Mahmudah, D., & Kurniasari, 2024) visual messages in the form of images are easier to understand than text. Therefore, learning about biodiversity will be more effective if using visual media (Nur'aeni, A.L., Sholihah, R.N., Riandi, & Widodo, 2022) (Norma et al., 2025), especially for elementary school students.

Although research about use of leaflet media to improve students' understanding at elementary school level has many benefits, there are several limitations that need to be considered. First, this study may have limitations in generalizing its results because it may only be conducted in certain schools or areas. Second, this study may also be limited in measuring the long-term impact of using learning media on students' learning interests (Rahmawati et al., 2020). To overcome these limitations, several recommendations can be put forward. First, further research can be conducted with a wider scope. Second, longitudinal research can be conducted to understand the long-term impact of using leaflet learning media on students' learning interests and academic achievement. These recommendations can help optimize the implementation of leaflet media and increase its effectiveness in improving students' understanding.



CLOSING

Conclusion

Results of the study indicate that leaflets developed by integrating local potential of Pacitan can be alternative learning media for biodiversity topics. Results of expert validation show that the developed product is very good with score above 90%. Results of the practicality test also show that leaflet is valid and practical so that it can be used in learning.

Suggestion

Future studies are recommended to examine the effectiveness of the macroalgae biodiversity leaflet in improving students' learning outcomes, conceptual understanding, and environmental literacy through experimental research involving control and experimental groups. In addition, the development of learning media can be expanded by integrating digital technology such as e-leaflets or application-based interactive media to create more engaging and accessible learning experiences. Further research is also suggested to involve different educational levels and wider geographical areas to determine the effectiveness and generalizability of local potential-based learning media in science education.

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