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Development of Local Potential Booklet Mangrove Mangunharjo Ecosystem to Improve Environmental Literacy

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Abstract

Using local potentials as a source of teaching materials in the biology learning process affects building contextual learning and stimulating learners to learn more about the surrounding environment. Mangrove Mangunharjo ecosystem can be used as a learning resource to improve students' knowledge of the environment. The purpose of this study is to develop a booklet on the local potential of the mangrove Mangunharjo ecosystem Semarang as an effort to improve environmental literacy. Research methods using R&D with the ADDIE model. The booklet was implemented using a quasi-experiment. The results showed that: 1) The mangrove Mangunharjo ecosystem has the potential to serve as a learning resource. 2) The characteristics of the booklet contain specific information about ecosystem materials that utilize the local potential of mangrove Mangunharjo, which is used as a learning resource. 3) The validity of the booklet obtained a result score from material experts of 92.1% with a very valid category and a result score from media experts of 97.2% with a very valid category. 4) The effectiveness of the booklet on students' environmental literacy obtains the result of N-gain analysis is known that the value of N-gain in the experimental class is much higher with the value of N-gain of 0.536 with moderate criteria, while the value of N-gain in the control class of 0.352 with moderate criteria. Based on developing the ecosystem booklet, mangrove Mangunharjo was declared feasible based on validity, readability, practicality, and effectiveness as a learning resource.

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INTRODUCTION

Mangrove forests are one of the plant communities that live on the coast. Almost all of the coast in Indonesia is overgrown by mangrove plants with an area of approximately 3,489,140 ha or about 23% of mangrove forests in the world are in Indonesia (Akbaruddin et al., 2020). The area with mangrove forests in Indonesia is located in Mangunharjo Village, Semarang City, Central Java Province which has an area of 68.13 ha of mangrove forest (Nurhidayati, 2017).

Mangrove ecosystems have high productivity compared to other ecosystems, so they have an essential role as a local coastal potential that has a physical, economic, and ecological role (Handono et al. 2014). Mangrove ecosystems have a unique and distinctive form of forest ecosystems in tidal areas and tolerate the salinity of seawater. These are important factors that support the growth of mangrove forests and various species that live in them (Gufran, 2012; Saru, 2014).

The extent of mangrove forests in Indonesia and its benefits are not balanced by its preservation. This can be seen from the amount of damage to mangrove forests that causes a decrease in the area and reduced utilization of mangrove forests. Mangrove forest Mangunharjo also experiences mangrove forest damage. The destruction of mangroves is caused by the lack of public knowledge about mangroves and their role. Therefore, efforts must increase public understanding and awareness to prevent damage to mangrove forests. One way to avoid it is by applying it to a learning process. Teachers are expected to be able to develop factual learning innovations so that they can build learners' knowledge (Toharudin & Iwan, 2017).

The North American Association for Environmental Education states that if we are to provide the right solutions to environmental problems, every human being must have environmental literacy to understand their environment (NAAEE, 2011). One of the strategies that can foster environmental literacy in students can be done by implementing contextual learning based on local potential (Apriani, 2012). Shamuganathan & Karpudewan (2015) revealed that environmental literacy can foster a person's sense of responsibility to protect the environment. Using nature, especially local potential, as a learning resource becomes meaningful because it relates to the surrounding environment (Wardani et al., 2018; de Brito Miranda et al., 2017; Haske & Wulan, 2015).

Developing teaching materials can contribute to local potential utilized in learning. The purpose of developing teaching materials associated with local potential is to help learners understand the lesson because learners will get real examples in learning materials. According to Toharudin & Iwan (2017), teachers are expected to develop factual learning innovations to build learners 'knowledge and improve learning outcomes. One of the lessons that can be designed to improve environmental knowledge to protect the environment is biology.

The material that can be taught to increase knowledge is the ecosystem. Ecosystem matter is closely related to the environment. According to Kahar (2018), an example that fits the context of students' daily lives is the development of ecosystem materials in the learning process. Therefore, the mangrove Mangunharjo ecosystem can be used as a learning resource for the delivery of information about the condition of the mangrove ecosystem.

Teaching materials that are contextual and can help explain the subject matter related to ecosystem materials are equipped with concise, systematic explanations and images as fundamental illustrations that facilitate students' understanding of a concept or fact, which are booklets. Based on the research results, Melati et al. (2020) state that the booklet based on local wisdom is quite interesting, adding insight and knowledge because the booklet is equipped with illustrations of authentic images in the surrounding environment. According to Setyaningsih (2019), the study's results showed that local potential-based booklets received a positive response, indicating that booklet media can make learners understand more.

Local potential is a means of learning biology, which can be used as a learning resource packaged as learning media (Widowati, 2013). This can be associated with a learning process involving local potential to hone students' awareness of the environment, improve literacy and education, and bring creativity to preserve and develop local potential in their area (Ilma, 2018). According to research conducted by Huda et al. (2018), teaching

materials with local content of Bengkulu coastal can improve significant changes for the better in responding to environmental problems.

Teaching materials that are contextual and can help explain the subject matter related to ecosystem materials are equipped with concise, systematic explanations and images as actual illustrations that facilitate students' understanding of a concept or fact, which are booklets.

Based on the problems described above, providing teaching materials to overcome environmental issues is essential by integrating local potential into booklets to help teachers improve students' environmental literacy.

METHODS

The study was conducted at SMA Negeri 8 Semarang. The subjects in this study are class X students in 2023/2024 who will take material about ecosystems with an independent curriculum. A small-scale trial was conducted with ten students in Class XI. Large-scale trials were conducted using the supplied product booklets. This research is included in the category of R&D development research, and it uses the ADDIE (Analyze, Design, Develop, Implement, Evaluate) approach developed by Branch (2009). This approach is suitable for producing products and seeing their effectiveness (Sugiyono, 2010). The stages of the research procedure using the ADDIE approach are in Figure 1.

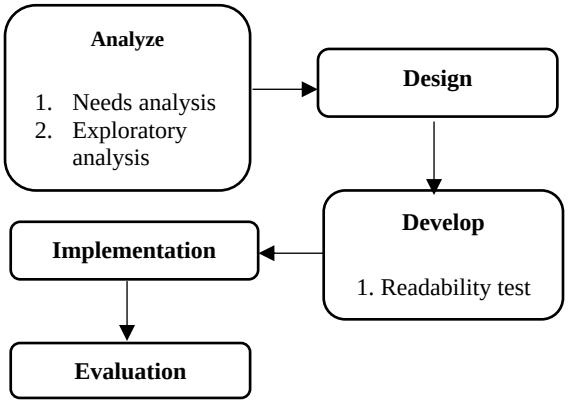

Figure 1. ADDIE Model Development (Branch, 2009)

The analysis stage involves gathering information and analyzing learning needs. The study aims to thoroughly understand the target audience, learning objectives, learning context, and possible obstacles. Exploration analysis of the potential of the mangrove ecosystem Mangunharjo to get quality learning. Quality learning is determined by teachers' teaching techniques (Boleng et al., 2017). Teachers are obliged to pay attention to the needs of each student in learning activities (Averos et al., 2019).

At the design stage, the aim is to design a booklet consisting of a front cover, preface, booklet characteristics, table of contents, instructions for use, material maps, introduction, content, glossary, and author biography.

Development stage, the booklet material products developed by researchers will be carried out through a series of tests, including testing the validity of media experts and validation testing of material experts with qualified and competent validators. Improvements will be made based on suggestions from validators. Valid product results can then be continued for small-scale trials or product readability tests to determine the practicality of booklets when used in learning.

Implementation phase According to Premana et al. (2013), learners can use teaching materials and implement procedures that have been created. The local potential booklet test was conducted using a quasi-experimental method and a non-equivalent control-group design. This method uses one experimental class and one control class. The experimental class used a booklet based on the local potential of the mangrove Mangunharjo Semarang ecosystem, while the control class used a booklet commonly used in schools. This design aims to retrieve students' environmental literacy data through pretest and posttest activities.

In the evaluation stage analyze the results of the evaluation of environmental literacy. Data analysis techniques are performed by converting qualitative data into quantitative.

RESULTS AND DISCUSSION

Local Potential of Mangrove Ecosystem Mangunharjo Semarang

Based on the results of research conducted to explore the local potential of the mangrove Mangunharjo Semarang ecosystem by exploring

Station 1 and the utilization zone. Local potential found in mangrove Mangunharjo there are 8 species of mangrove plants. Mangunharjo mangrove species diversity there are 5 major mangrove species, 1 minor mangrove, and 2 associated mangroves. The results of identifying fauna found in mangrove Mangunharjo identified as many as 9 species of birds, 2 species of fish, 9 species of Mollusca, 3 species of crustacea and 1 species of reptile.

Table 1. Results of Exploration of The Local Potential of Mangrove Ecosystem Mangunharjo

No.	Taxa	Total	Species
1.	Mangrove plants	8 Species	*Avicennia alba*
			Avicennia marina
			Rhizopora apiculata
			Rhizopora mucronate
			Rhizopora stylosa
			Xylocarpus granatum
			Ipomoea press-capree
			Wedelia biflora
2.	Bird	9 Species	*Actitis hypoleucos*
			Egretta garzetta
			Numenius phaeopus
			Todirhamphus Chloris
			Ardea sumatrana
			Ardea alba
			Ardeola speciosa
			Pycononotus aurigaste
			Lonchura punctulate
3.	Mollusca	9 Species	*Perna viridis*
			Babylonia spirata
			Cherithidea obtuse
			Cassidula aurisfelia
			Clibnarus sp
			Cassidula nucleus
			Cheritidea alata
			Onchidium griseum
			Telescopium
4.	Crustacea	3 Species	*Portunua pelagicus*
			Litopenaeus vannamei
			Sesarma sp
5.	Reptile	1 Species	*Varanus Salvator*
6.	Fish	2 Species	*Johnius trachycephalus*
			Boleophthalmus boddarti

This area is an example of an environment that has the potential to serve as a source for the development of local booklets in biology subjects on ecosystem materials. Utilization of local potential as a learning resource has significant benefits. According to Arifin (2019), utilizing local potential as a learning resource can encourage students to participate more and be concerned for the environment. The many local potentials in the school environment can be used as a learning resource packaged in the form of learning media (Situmorang, 2016).

Characteristics of the Local Potential Booklet Mangrove Mangunharjo Ecosystem

A booklet on the mangrove Mangunharjo Semarang ecosystem's local potential was created with the Canva application's help with A5 booklet size (14 x 21 cm). Characteristics of local potential booklet mangrove Mangunharjo ecosystem developed following the needs of students as a

learning resource on ecosystem materials. This booklet consists of several parts as follows: 1) Cover; 2) Preface; 3) Table of contents; 4) User guide; 5) Material map; 6) Bioinfo; 7) Attitude column; 8) Content of the material; 9) Glossary; and 10) Bibliography.

A booklet on the local potential of the Mangunharjo mangrove ecosystem is a learning resource designed to support the learning process on ecosystem material. According to Khotimah (2016), booklets should be used to improve understanding of a material or subject. The booklet on the Local Potential of the Mangunharjo Mangrove Ecosystem can be illustrated in Figure 2.

Figure 2. Display of local potential booklet mangrove ecosystem Mangunharjo

The characteristics of the booklet that was developed contain specific information about ecosystem materials that utilize the local potential of mangrove Mangunharjo, which is used as a learning resource. This booklet was developed based on exploring mangrove Mangunharjo's local potential. The characteristics of this booklet are different from other teaching materials that can be seen in terms of material. The contents of the local potential booklet material were developed based on research through direct data collection contained in mangrove Magunharjo. This exploration aims to obtain data on the local potential mangrove Mangunharjo used in ecosystem materials.

The booklet on the local potential of the Mangunharjo mangrove ecosystem also includes images, which are the results of research based on field research. The presentation of the images in the booklet is tailored to the local potential of the mangrove Mangunharjo ecosystem. Therefore, this booklet is more interesting for students to use and study. Apart from that, the booklet is also equipped with a Bioinfo feature and an Attitude feature. The Bioinfo feature contains information and facts to increase students' insight and literacy regarding the mangrove ecosystem. Attitude features aim to describe the attitude that students should have towards the environment.

Booklets are designed to be contextual means by utilizing the surrounding environment as a learning resource for the mangrove ecosystem of Mangunharjo. According to Ibrohim (2015), several studies using local potentials have been recommended to support the achievement of learning objectives.

The Validity of Local Potential Booklet Mangrove Mangunharjo Ecosystem

Material experts and media experts validated the validity of the booklet to determine the level of validity of the local potential booklet mangrove Mangunharjo ecosystem.

Table 2. Material Expert Validation Results

Aspect	Percentage (%)	Category
Fill eligibility	90.0	Very Valid
Eligibility for presentation	93.2	Very Valid
Contextual assessment	94.6	Very Valid
Average	92.6	Very Valid

Based on the results of the booklet assessment recapitulation by material experts, an average score of 92.6% was obtained with the criteria very valid. The booklet on the local potential of the Mangunharjo mangrove ecosystem has completeness, breadth and depth of content/material in the booklet which is tailored to the learning objectives to be achieved.

Table 3. Media Expert Validation Results

Aspect	Percentage (%)	Category
Graphical Components	97.8	Very Valid
Booklet Component	95.8	Very Valid
Language Component	100	Very Valid
Average	97.8	Very Valid

The results of the media validity recapitulation show that the booklet mangrove Mangunharjo's local potential in the category of very valid with a percentage value of 97.2% can be used in the learning process. Assessment of the validity aspects of the booklet by media experts and teachers include a component of 97.8% graphics, a booklet component with a percentage of 95.8%, and a language component with a percentage of 100%.

Table 4. The result of the readability booklet

Respon	Aspect	Score (%)	Category
Teacher	Content	100	Very Good
	Language	100	Very Good
	Booklet view	100	Very Good
		100	Very Good
Students	Content	91.0	Very Good
	Language	82.5	Very Good
	Booklet view	90.0	Very Good
		87.83	Very Good
	Average	93.91	Very Good

Booklet readability test on a limited scale trial aims to determine the level of readability or the ability of the booklet to be understood by teachers and learners as prospective users of the booklet. The results of the booklet readability test by teachers and students showed that the local potential booklet mangrove Mangunharjo ecosystem gets a percentage value of 100% by teachers and 89.2% by students, with both categories being outstanding.

The booklet readability test received a positive response from students due to the use of booklets on ecosystem materials using a contextual approach by integrating the local potential of the mangrove Mangunharjo ecosystem. Environmental conditions can also provide real stimulation and inspiration for learning (Mirrahimi et al., 2011). Using the surrounding environment as a learning resource can facilitate students' relating their experiences to obtain new information (Irwandi, 2019; Zukmadini, 2018).

Conclusions drawn from the booklet readability test conducted by students and teachers indicate that students can use it well and understand its contents well.

The Effectiveness of Local Potential Booklet Mangrove Mangunharjo Ecosystem

The booklets developed were declared very valid and, then implemented in the learning process on ecosystem materials for class X in SMA Negeri 8 Kota Semarang. The implementation phase was carried out to test the effectiveness of booklets in improving students' environmental literacy by providing environmental literacy test questions. The measurement of students' environmental literacy is assessed from the knowledge and competence component, according to the North American Association for Environmental Education (2011).

Table 5. Result score N-Gain

Class	*Pretest*	*Posttest*	*N-gain*	Category
Experiment	42.66	76.22	0.536	Medium
Control	47.55	66.55	0.352	Medium

Based on the results of N-gain analysis, it is known that the value of N-gain in the experimental class is much higher with the value of N-gain of 0.536 with medium criteria, while the value of N-gain in the control Class of 0.352 with medium criteria. This shows that learning by using the local potential booklet mangrove Mangunharjo ecosystem in the experimental class is better at improving the ability of environmental literacy on the components of knowledge and competence of learners compared to conventional teaching materials used by teachers. This aligns with research conducted by Nasution (2016), which showed increased environmental literacy after using the environment as a learning resource. Learning about local potentials can improve student learning outcomes (Sriyati et al., 2022). Another study conducted by Rahayungsih et al. (2017) stated that local knowledge is one of the main factors in preserving the environment.

Environmental literacy is the ability possessed by a person to address environmental problems appropriately. Someone who has environmental literacy skills will have a good impact on the surrounding environment. This impact can be seen in changes in a person's behavior when addressing environmental problems. Environmental issues can impact learners' emotional behavior (Kraiter, 2017; Stellmacher et al., 2020). Environmental problems

can be overcome by educating the community, especially students, to remain sustainable and awake (Kusumaningrum, 2018; O'Flaherty et al., 2018).

The results of the N-gain Test increased environmental literacy in each component of knowledge and competence in the experimental class and control class were also carried out. The results of the N-gain test on each component can be seen in Figure 2.

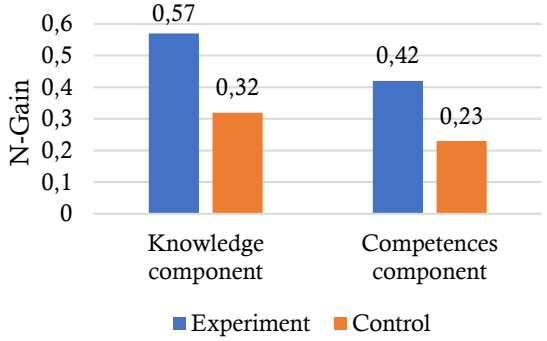

Figure 2. Graph of the N-gain test result for each component

The results of the analysis of the increase in N-gain on the knowledge component in the experimental class of 0.57 with a moderate category, while in the control Class of 0.32 with a moderate category. In the competency component, the experimental class obtained an N-gain value of 0.42 with the medium category while in the control class, 0.23 with the low category. Based on these results, there is a strong correlation between environmental understanding and behavior (Zsóka, 2013)

Improving environmental literacy in the experimental class is supported by the Bioinfo feature. Bioinfo in the booklet allows learners to obtain additional information and knowledge as well as actions that learners should take in the environment. Environmental literacy fosters learners' direct involvement in environmental action (López-Alcarria et al., 2021).

The learning material presented in the booklet contains ecosystem material based on the local potential of the mangrove Mangunharjo ecosystem which is contextual so that the knowledge gained by students after using the booklet is not only limited to theory but can be direct, applicable and more meaningful in everyday life. Meaningful learning activities that utilize the environment as a learning resource will make it easier for learners to gain new knowledge and insights into the environment related to ecosystem materials. This is in line with (Andarias et al., 2022; Saltan *et al.*, 2017) which state that the use of the environment as a learning resource in acquiring new knowledge can be done by bringing learning resources from the environment into the classroom. School becomes a place to foster environmental literacy through learning that uses the environment (Stone, 2017).

CONCLUSION

Mangrove ecosystem Mangunharjo Semarang has a lot of potential to be used as a source of learning on school ecosystem materials. The results of the booklet validity test in terms of material conducted by expert lecturers and teachers deserve to be tested with an outstanding category. The results of the booklet implementation showed that the booklet significantly affects the literacy of the learners' environment by obtaining an N-gain value of 0.53 in the experimental class. In contrast, the control class had an N-gain value of 0.35. A booklet on the local potential of the Mangunharjo mangrove ecosystem is effective in increasing students' environmental literacy.

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