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Development of Biology Teaching Materials Based on Karawang Local Potential to Improve Environmental Literacy and Problem-Solving Skills of Junior High School Students

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Abstract: This study aims to develop biology teaching materials based on the local potential of rice farming in Karawang district to enhance students' environmental literacy and problem-solving skills. This study employed a research and development model using the ADDIE framework. The research was conducted in a junior high school in Karawang with a total sample of 70 students, consisting of 35 students in the experimental class and 35 students in the control class. The instruments used in this study included teaching materials based on local agricultural potential in Karawang, environmental literacy tests, and problem-solving assessments. T-test validation analysis and N-gain calculation were used to evaluate the effectiveness of the teaching materials. The results showed that the average environmental literacy score of the experimental class was higher than that of the control class, and the problem-solving ability results also indicated that the average score of the experimental class was higher than that of the control class. These findings suggest that the developed local potential-based teaching materials can effectively improve the environmental literacy and problem-solving skills of junior high school students.

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Introduction

The ability to recognize, understand, interpret, produce, convey and use knowledge in various situations is called literacy (OECD, 2015). Entering the 21st century, students' concern for the environment is very important for life, so that students are able to understand and feel the responsibility to preserve the environment. Miftahudin et al (2023) stated that environmental education is very important and must be given early to children so that they understand and do not damage the environment. Very complex problems and issues of environmental change and ecosystem imbalance are things that must be addressed immediately.

Efforts made by the government to encourage awareness of the environment aim to develop students' understanding and concern for environmental issues that occur in the environment (Mustofa & Sueb, 2023). The role of education is very important for preventing environmental problems and helping the environment to be maintained. Environmental literacy is the basis for seeing the influence of the environment on education in an effort to understand students to protect nature and balance the ecosystem.

Education in Indonesia has a very important function to empower human potential to inherit, develop, build culture and a better future civilization. Education serves to preserve positive cultural values, on the other hand it also serves to create changes towards a better and innovative life. The teaching and learning process is a communication process between the two elements, namely teachers and students so that there is constructive interaction

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between the two so that learning objectives can be achieved that can overcome these problems by using local excellence-based learning, which can be utilized as a learning medium in the classroom in science subjects.

Learning that is oriented towards environmental care attitudes is one alternative to restore all awareness of environmental care through formal channels. Building awareness of the environment is closely related to building culture or character itself. This means that it takes a long time to make a culture of environmental love into the character of a nation (Muslich, 2011). One of the learning outcomes associated with environmental awareness is changing students' attitudes to be more positive towards the environment (Kose et al., 2011).

Students' environmental care attitude can be influenced by several factors, including the intention to know and learn about environmental problems, with the teacher factor as an educator who can inform and realize that understanding the environment must be the basis of the attitude to be able to solve environmental problems (Nasution, 2016). By maintaining the traditions and natural balance that exist today, of course, good and relevant thinking skills are needed. This pattern of thought is important to instill in the next generation of society, namely students in schools (Suryabrata, 2006).

Kusumaninrum (2018) states that environmental literacy is a conscious attitude in maintaining and preserving the environment. Environmental literacy is an awareness and skills that are needed for knowledge about the environment in everyday life. Improving environmental literacy skills in learning is a collaborative process between teachers and students. The learning resources used must support students in learning. Environmental literacy will also make someone to interpret the understanding of environmental conditions.

Environmental literacy according to Hidayah & Hayat (2022) is the ability of individuals to respond to understanding of environmental conditions that aim to maintain and preserve the environment. NAAEE 2011 Environmental literacy skills have components, namely *knowledge, attitude*, *cognitive* competence/skills, and environmentally responsible *behavior*. In addition to environmental literacy skills, students' problem solving skills must also be improved. Problem solving is needed to stimulate students in situations that occur in the real environment. According to Scholz (1997) problem solving is an ability needed by students in studying real-life problems, especially in environmental issues. Problem solving skills must be integrated in the learning materials at school. One strategy that can be done to improve students' problem solving skills is to integrate contextual-based biology learning. Learning must involve students actively and use the environment as a learning resource.

Kusumaningrum (2022) stated that efforts to improve environmental literacy skills and problem solving by using environment-based learning. Learning resources are an important instrument in helping students gain knowledge in learning. One solution that can be done to improve environmental literacy skills and students' problem solving ability is by learning based on local potential. The local potential used in this study is the potential of rice farming in Karawang Regency. Karawang Regency has a very large rice field, half of the area in Karawang Regency is a rice field. Even though the times are all technological, but an area that still has a large enough rice field, sometimes still carry out traditions related to agriculture.

Local potential-based learning that is oriented towards increasing environmental care attitudes needs to be supported by the availability of appropriate teaching materials. Teaching materials can also be a reference in maintaining and preserving the environment (Sundari et al., 2022). The use of general teaching materials causes the local context not to be conveyed in the learning process. By identifying local potential in each region, then integrating it in

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learning either as media or learning resources, it will make it easier for students to understand the concepts they learn, because it is close to their daily environment (Nurhidayati & Khaeruman, 2017), The purpose of this study was to produce teaching materials based on local agricultural potential in Karawang on the material of interaction of living things and environmental changes to improve students' environmental literacy and problem solving skills.

Research Method

This research was conducted at SMPN 1 Tirtamulya, this research uses the ADDIE model research and development method. The ADDIE model consists of five stages, namely analysis (*analyze*), design (*design*), development (*develop*), implementation (*implement*) and evaluation (evaluate). The stages carried out at each stage of ADDIE can be seen in Figure 1.

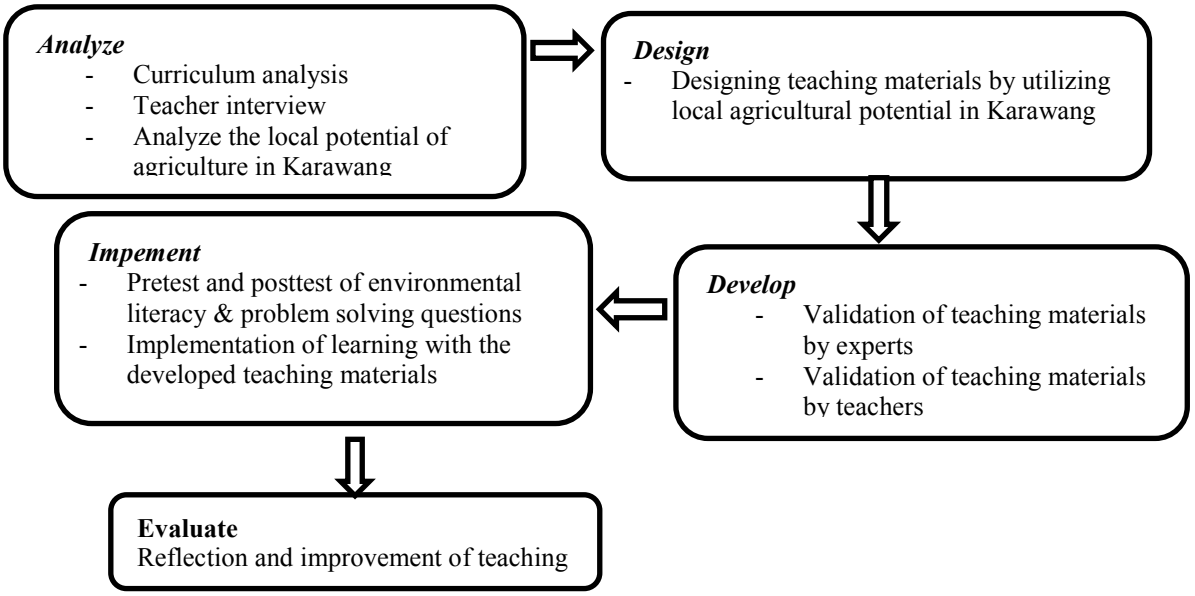

Figure 1. ADDIE stages

The research sample was 35 experimental class students and 35 control class students. The research design used is using *Quasi Experiment* with *Nonequivalent Pretest-Posttest Control Group Design*. Teaching materials that have been designed are then validated by media, content and graphic expert validators.

Teaching materials that have been validated will be tested to determine their effect on improving environmental literacy and problem solving skills. Questions to measure environmental literacy skills refer to the *North American Association for Environmental Education* (NAAEE) formulating four components of environmental literacy including *knowledge*, *attitude*, *cognitive* competence/skills, and environmentally responsible *behavior*. Meanwhile, to measure problem solving based on Bransford and Stein (Nitko & Brookhart, 2011). The feasibility of teaching materials can be seen in table 1.

Table 1. Feasibility criteria according to Ridwan and Akdon (2013)

Value Scale	Category	Percentage (%)
1	Very valid	81-100
2	Valid	61-80
3	Fair	41-70
4	Not valid	21-40

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5	Not valid at all	0-20

Based on the data obtained from the validation sheet, the percentage of feasibility of teaching materials will be calculated. For data on the results of environmental literacy and problem solving skills seen from the N-Gain value and t-test.

Results and Discussion

Based on the results of the following research is the result of an analysis that refers to the stages of ADDIE:

Analyze

The analysis stage is carried out to identify the needs of students for learning based on the local potential of rice farming in Karawang Regency. Conducting field observations, analyzing the curriculum, conducting interviews with teachers from schools adjacent to the location of rice fields, conducting interviews with farmers related to changes in the agricultural environment in Karawang Regency, and reviewing materials related to students' environmental literacy and problem solving skills. The material contained in the interaction of living things and environmental changes, students must be able to analyze ecosystems and environmental changes, their causes and impacts on daily life. Learners are required to formulate ideas for solving problems of ecosystem changes and changes in the surrounding environment.

Design

The initial part of the teaching material is displayed "Getting to Know Agriculture in Karawang" aims to introduce the local potential of agriculture in Karawang and invite students to know more about the many agricultural potentials found in Karawang Regency. The section can be seen as in Figure 1 below:

Figure 1. display "getting to know agriculture in Karawang"

Furthermore, the "Let's Discuss" section is a column that displays articles that invite students to discuss certain problems in groups. This section links the problems taken from the material previously presented. The display of the "Let's Discuss" column can be seen in Figure 2 below:

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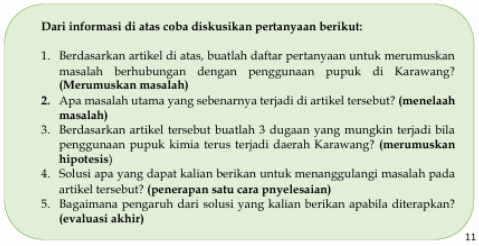

Figure 2. Display of Let's Discuss in Teaching Materials

Problem-solving exercises facilitate students in analyzing and finding environmental issues that are happening in the Karawang agricultural area. After students analyze the problems that occur such as the causes of environmental problems, the impact of problems and so on. Furthermore, students are trained to find the problems that actually occur in the article. The questions in this exercise are presented continuously to train students in solving problems that occur in their environment. Original image display, the images contained in teaching materials based on the local potential of agriculture in Karawang are original images taken directly by researchers in the environment of rice fields in Karawang. Can be seen as shown in Figure 3 below:

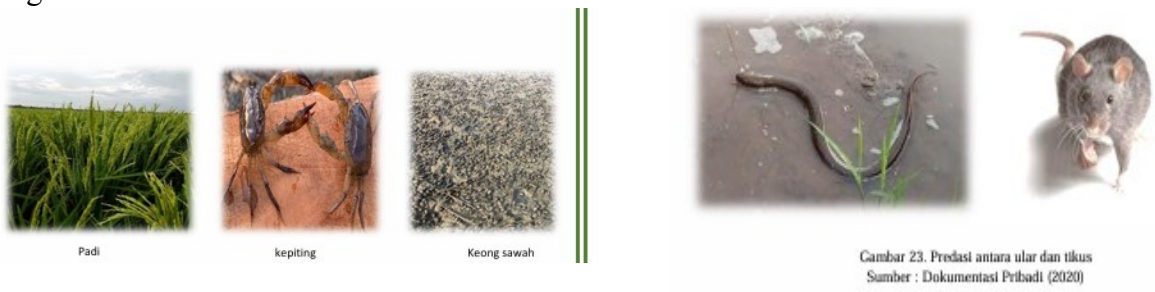

Figure 3. Display of individual examples in Karawang rice fields

Development

The third stage in the ADDIE development design model is developing or developing teaching materials based on local agricultural potential in Karawang. To support students' environmental literacy and problem solving skills, materials and exercises were developed to facilitate the knowledge component. The *develop* stage is carried out the stages of validation of teaching materials and research instruments and determining the materials and activities contained in teaching materials so that learning objectives can be achieved.

Implementation

After the teaching materials are considered valid then, teaching materials based on the local potential of Karawang agriculture are then used during learning. Teaching materials based on the local potential of Karawang agriculture are only used in experimental classes. As for before implementing teaching materials, a pretest was first carried out. The pretest questions tested were questions that included environmental literacy components and aspects of problem solving skills. The pretest questions in this study were also given to the control class. The existence of a control class aims for comparison in seeing the effectiveness of the use of teaching materials based on local agricultural potential in Karawang in improving environmental literacy and problem solving skills in students.

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Evaluate

The development stage of teaching materials based on local agricultural potential in Karawang is then evaluated by teachers and responded to by students. This is done to determine the effectiveness of teaching materials when used in learning, especially in improving students' environmental literacy and problem solving skills. It can be seen from the results of the evaluation of teaching materials based on the local potential of rice farming in Karawang can improve environmental literacy skills and problem solving abilities.

Based on the results of the development of teaching materials based on the local potential of rice farming in Karawang on the material of interactions between living things and environmental changes to improve students' environmental literacy and problem solving skills. The data obtained from the validation of teaching materials based on the local potential of rice farming in Karawang conducted by two expert validators and two science subject teachers who provided suggestions and input, are presented in table 2 and table 3 below:

Table 2. Results of validation of teaching materials by material experts

No	Assessment aspect	Average score	Percentage %
1.	Content Feasibility	3,65	91,4
2.	Presentation Feasibility	3,62	90,6
3.	Contextual feasibility	3,00	75
4.	Language	3.10	81,5
Average			

Table 3. Results of validation of teaching materials by biology teachers

No	Assessment aspect	Average score	Percentage %
1.	Content Feasibility	3,66	91,5
2.	Presentation Feasibility	3,62	90,6
3.	Contextual feasibility	3,20	81.0
4.	Language	3,25	82,5
Average			

Based on table 2, the results of the content feasibility test validation obtained a result of 91.4%, this shows that the feasibility of the content of teaching materials based on local agricultural potential in Karawang is very feasible. The presentation feasibility test obtained a result of 90.6%, this indicates that the presentation of teaching materials. Furthermore, the contextual feasibility test gets a value of 75%, this shows that the feasibility of contextual assessment is feasible, and finally the results of the Language validation test get a value of 81.5%. Based on the results of teaching materials based on the local potential of agriculture in Karawang, it is feasible and can be used in the learning process of material on the interaction of living things and environmental changes.

The results of the validation carried out by the feasibility test subject teacher get 91.5%, this shows that the feasibility of teaching materials based on the local potential of agriculture in Karawang is very feasible. The feasibility test of presentation gets a result of 90.6%, this shows that the presentation of teaching materials is feasible. The feasibility test of contextual assessment obtained a result of 81%, this shows that the feasibility of contextual assessment contained in teaching materials based on local agricultural potential in Karawang is feasible. As for the language assessment, the result is 82.5%. Based on the results of the validation of teaching materials, it can be concluded that teaching materials based on the local potential of agriculture in Karawang in the material of the interaction of living things and environmental changes can be used for the learning process. The teaching materials are

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then used in classroom learning to improve students' environmental literacy and problem solving skills. The results of the application of teaching materials can be seen in Table 4.

Table 4. Recapitulation of environmental literacy data

Data	Control Class		Experiment Class	
	Pretest	Posttest	Pretest	Posttest
Number of Students	35			
Average Value	50,97	61,71	51,54	78,97
Normality Test (*pretest*)	0,28		0,21	
Interpretation of Normality Test (*pretest*)	Data is normally distributed			
Homogeneity Test	0.336 (Homogeneous)			
Paired Sample T-test	0.050 (there is a significant difference)			

Based on Table 4, it shows that the average posttest value of the experimental class using teaching materials based on local agricultural potential in Karawang is greater than the average posttest value of the control class using teaching materials in the form of textbooks. This is because learning using teaching materials based on local agricultural potential will train students to think systematically so that understanding of the concepts learned can be optimized by students. The problems contained in teaching materials based on local potential are problems that occur in the Karawang agricultural area which results in students becoming more active in the learning process. The use of teaching materials based on local agricultural potential in Karawang is effectively used in the learning process and is able to improve students' understanding abilities. The learning process will be more fun and meaningful (Komalasari, 2019). Local potential-based learning invites students to think critically, creatively and innovatively in producing a product or characteristic that can become the identity of a region. In addition, it is expected that local potential-based learning can improve students' environmental literacy skills. by inviting students to learn from local excellence science can instill a scientific attitude, as well as the value of love for local excellence that develops in the community.

Based on the data above, there are differences in students' initial knowledge between the control class and the experimental class, then testing is carried out to see how the effect of the implementation of teaching materials based on local agricultural potential in Karawang on the interaction of living things and environmental changes seen based on N-gain which can be seen in table 5 below:

Table 5. N-gain of Environmental Literacy

Class	N-gain	Interpretation
Control	0,21	Low
Experiment	0,55	Medium

Based on Table 5, it shows that the average N-gain of the control class is smaller than the average N-gain of the experimental class in the moderate category. The control class has an N-gain value of 0.21 while the experimental class N-gain value reaches 0.55. This is because the experimental class was trained to answer questions based on environmental literacy presented in teaching materials based on the local potential of rice farming in Karawang. In the control class, students were not trained to answer questions that train environmental literacy skills. The use of textbooks used by the control class did not integrate the local potential of local agriculture in Karawang so that students had difficulty understanding the material.

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The average N-gain of experimental class students is greater because the learning process implements teaching materials based on the local potential of agriculture in Karawang so that it trains students to think actively and be involved in the learning process. According to Rusyadi (2021), learning based on local potential helps students develop knowledge, understanding of scientific ideas and higher order thinking skills. Sriyati et al, (2022) stated that learning using local wisdom can improve environmental literacy skills. Environmental literacy involves understanding environmental issues and can determine attitudes, behaviors, and active involvement to solve environmental problems (Pitalis et al. 2023).

Improving environmental literacy skills through education emphasizes environmental issues and students' understanding of the importance of environmental preservation, also encourages students to be actively involved in taking concrete actions to preserve the environment (Maesaroh et al., 2021). The students' problem solving skills can be seen in table 6 below:

Table 6. Recapitulation of Problem Solving Data

Data	Control Class		Experiment Class	
	Pretest	Posttest	Pretest	Posttest
Number of students	35			
Average Value	56,95	76,74	55,05	84,00
Normality Test	0,586		0,127	
Homogeneity Test	0.218 Normally distributed data			
Interpretation of paired sample T-test (pretest)	0.367 There is a significant difference			

Based on table 6, it shows that the average posttest value of the problem solving ability of the experimental class using teaching materials based on local agricultural potential in Karawang shows the result of 84.00, which is higher than the control class that uses teaching materials for module books commonly used in schools, namely 76.74. This is because the control class is not used to answering questions that refer to problem solving. In contrast to the experimental class that is accustomed to answering questions that refer to problem solving contained in teaching materials based on the local potential of rice farming in Karawang. In accordance with the opinion of Kurniathunisa et al (2023) which suggests that thinking ability is an ability that must be trained and cannot be obtained in an instant way. Problem solving ability is a process for students to answer and provide solutions to overcome problems that exist in their environment with the knowledge they already have, therefore the ability to think to solve problems is an ability that must be trained in learning and must be done continuously. (Juliyanto, 2017)

The increase in learning outcomes of problem solving skills obtained N-gain value. The results of the N-gain value of the control class and experimental class are presented in Table 7. The recapitulation of the N-gain value of the control and experimental classes can be seen in table 4.14.

Table 7. Average N-gain of Problem Solving Ability

Class	N-gain	Interpretation
Control	0,36	Moderate
Experiment	0,63	High

Table 7. shows that the N-gain value of the Experiment class is greater than the N-gain value of the control class. The N-gain value of the experimental class is 0.63, while the control class is 0.36. Nevertheless, teaching materials based on local agricultural potential in

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Karawang have been given to students for further study at home. However, the increase in the experimental class was greater when compared to the control class.

The N-gain value in the control class shows that the improvement in problem solving skills is in the medium category. This is due to students' difficulties in answering problem solving exercises. students' difficulties in answering problem solving exercises should be done gradually and practiced. The N-gain results of the experimental class experienced an increase in problem solving skills with high criteria. The experimental class was trained to answer questions about problems that arise in the agricultural area in Karawang where it exists in students' daily lives. This is because students in the experimental class are used to answering questions that refer to problem-solving exercises contained in teaching materials based on the local potential of rice farming in Karawang. This is because students in the experimental group have been trained in understanding the problem and can determine the solution to solve the problem. Furthermore, students can also make formulations based on issues in articles contained in teaching materials. In accordance with the research of Gunawan et al. (2020) said that students who have the ability to describe the problem will more easily identify the relationship between the problem and the concepts of the subject. Ulya (2016) said that students' ability to solve problems cannot be obtained instantly, but must be practiced continuously. This process is not only enough to use memorization, but must be familiarized with various problems so that problem solving skills can develop optimally. Baskoro (2014) states that teaching materials that apply problem solving skills can improve evaluation skills in learning. This is in line with Rahman (2019) who stated that problem solving skills are 21st century skills that are needed by students.

Learning by using teaching materials based on the local potential of agriculture in Karawang during the learning process encourages students to analyze phenomena or facts that occur in the agricultural environment in Karawang. By implementing agricultural management in the material of interaction of living things and environmental changes, students can analyze the positive and negative impacts. With learning based on the local potential of agriculture in Karawang helps students to improve their problem-solving skills and can evaluate problems so as to come up with good solutions to problems that exist in the environment around students.

Conclusion

The results of this study concluded that teaching materials based on local agricultural potential in Karawang on the material Interaction of living things and environmental changes are declared valid and feasible to use in the biology learning process. Literacy and problem solving skills also increased significantly after implementing teaching materials in classroom learning.

Recommendation

The use of teaching materials based on the local potential of agriculture in Karawnag makes a reference for teachers in training students' environmental literacy and problem solving skills in the material of the interaction of living things and problem solving. This teaching material contains facts about agricultural management in the surrounding environment. And further research is needed.

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