JPII 10 (3) (2021) 400-406

Jurnal Pendidikan IPA Indonesia

http://journal.unnes.ac.id/index.php/jpii

THE EFFECT OF MACROZOOBENTHOS DIVERSITY MODULE BASED ON PROBLEM-BASED LEARNING ON JUNIOR HIGH SCHOOL STUDENTS' ENVIRONMENTAL ATTITUDES

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DOI: 10.15294/jpii.v10i3.30766

Accepted: June 17th 2021. Approved: September 28th 2021. Published: September 30th 2021

ABSTRACT

It is necessary to build students' responsibility character when dealing with life problems such as environmental pollution. Because there is much pollution, it is important for students to analyze the condition of the polluted environment because they are expected to overcome the problems. The effort made is to teach students using problem-based learning modules. This module contains material of macrozoobenthos diversity as bioindicators of river water quality. This study aims to determine the effect of macrozoobenthos diversity as a bioindicator module based on problem-based learning on students' environmental attitudes. The research design is quasi-experimental using a nonrandomized control group pretest-posttest design. The sample in this study was 60 students divided into experimental class and control class. The test results showed that the significance value for PBL modules is $0,016 \leq 0.005$, so the hypothesis is accepted. There is a difference between students who use the PBL module, which improves students' environmental attitudes than science textbooks. Students' initial environmental attitudes also influence it.

Keywords: environmental attitude; PBL module

INTRODUCTION

Education has functions to elaborate abilities and shape students' character to educate the nation's life (Council et al., 2012; Singh, 2019). Education also plays a role in building belief, understanding, and behavior in the human environment (Frantz & Mayer, 2014; Ardoin et al., 2020; Powdthavee, 2021). The need to build a character that cares for the environment cannot be separated from the essential crisis due to irresponsible human activities (Arthur et al., 2012; Omeri, 2015; Shofiyah et al., 2019). One of the bad habits of the Indonesian people is littering (Lestari & Trihadiningrum, 2019). This bad habit arises because of the low caring character for the environment, causing environmental problems such as water pollution (Suriadikusumah et al., 2021).

Environmental problems need to be recognized by students to overcome them as human successors (Kuppusamy & Mari, 2017). One implementation to improve students' environmental attitudes can be integrated into science learning materials that suggest students care about nature. Science learning is expected to be a means for students to learn about themselves and their natural surroundings because learning is more meaningful if related to their environment. One of the natural resources in Malang to learn about nature is the Metro River. This river is 54.55 km long (Ali et al., 2013) and is still used by the surrounding community to dispose of wastewater from household activities such as bathing, washing, and defecating. These activities result in pollution to the Metro River, affecting the organisms that live in it (Bahriyah et al., 2018; Novitasari, 2019; Putri et al., 2019). The decrease or increase in species diversity can be considered a bioindicator of river pollution (Nikinmaa, 2014).

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One biota that can be used as a bioindicator in determining water quality is macrozoobenthos (Markert et al., 2003). Each macrozoobenthos species has a different sensitivity to environmental changes and a relatively fixed habitat, therefore changes in water quality and the substrate in which it lives intensely affect its abundance (Ziglio et al., 2008). Previous research also stated that macrozoobenthos are more likely used because their diversity can represent water quality specifically (Prihanta et al., 2020; Shofiyah et al., 2021; Sueb et al., 2021).

The macrozoobenthos diversity as a bioindicator of river quality can be designed as science teaching materials for students. The module is one of the teaching materials designed in learning guidelines that students can use without guidance from others (Syamsussabri et al., 2019). Students can use the modules' advantages independently (self-instruction) to achieve the specified competencies (Husgafvel, 2017; Yulastri et al., 2017). One of the most widely used learning methods or approaches to stimulate higher-order thinking skills in situations oriented towards real problems is Problem-based Learning (PBL) (Delisle, 1997; Schwartz et al., 2001; Mudlofir & Rusydiyah, 2017). PBL assumes that the teacher does not constantly spoon-feed the students, but students can study independently. On the other hand, the role of the teacher is still needed as a companion so that students do not experience misconceptions. In this lesson, students are asked to work on daily problems to compile their knowledge, develop independence and self-confidence (Wicaksono et al., 2019; Fitriani et al., 2020).

Previous research used several methods to improve environmental attitudes (Susilawati et al., 2017; Flowers et al., 2018; Miarsyah et al., 2019; Yustina et al., 2020). The novelty offered in this study is the use of the most tangible learning resources around students. Some researchers state that environmental education will not be effective if it is just a one-way transfer of information (Bergman, 2016; Ardoin et al., 2020). However, field practice must also be facilitated to maximize attitudes, knowledge, and positive human actions towards the environment. The research stated that the realization of environmental activities applied in the classroom could improve students' environmental attitudes (Littledyke, 2008; Sobri et al., 2017).

Based on these needs, students must see the environmental problems around them as a contextual learning source. Therefore, researchers developed teaching materials in Macrozoobenthos Diversity as Bioindicator Module Based on Problem-based Learning. This study aims to determine the effect of the developed module on students' environmental attitudes. The module will be taught to junior high school because the material is in the second semester of seventh grade.

METHODS

All students of SMP Negeri 15 Malang are the population in this study. The samples used were class VII A and VII B after the equivalence test. The sample was determined using the random cluster sampling through a lottery with the results of class VII A as experimental class and class VII B as control class with 30 students in each class. The research is a quasi-experimental research type (Leedy & Ormrod, 2015), and the research design is shown in Table 1.

Table 1. Research Design

Subject	Pretest	Treatment	Posttest
Control Class	O1	-	O2
Experimental Class	O1	x	O2

Source: (Leedy & Ormrod, 2015)

Legend	O_1:	Pretest (Environmental Attitudes)	- :	Use of Science Textbooks
	O_2:	Post-test (Environmental Attitudes)	x :	Use of Developed Module

Environmental attitudes were measured with questionnaires modified by researchers from the Environmental Attitudes Scale (EAS) (Milfont & Duckitt, 2010; Ugulu et al., 2013), which initially contained 35 statement items (before the test) with a Likert scale as the measurement scale. Yusoff & Janor (2014); Wu & Leung (2017) concluded that the Likert scale could be considered an interval scale continuous measurement; references and discussion can be found The indicators of environmental attitudes are as follows: (1) environmental awareness; (2) attitude towards recovery; (3) attitude towards recycling; (4) environmental consciousness and behavior.

Items that measure environmental attitude (EA) are tested first to determine the validity and reliability before use. The validity test was carried out using the KMO, Bartlett, and Anti Image tests (MSA). The KMO and Bartlett test was carried out up to three times until a valid value (0,771>0,05) so that it could be continued with the MSA test with results indicate that 27 items of environmental attitudes have MSA values > 0.5 so that all items are declared "valid" and can be used as a measuring tool for students' environmental attitudes. Besides the validity test, a reliability test was carried out to determine the measurement consistency of environmental attitudes. In this study, the Cronbach α method was used with results that the reliability of 27 environmental attitudes items is 0.906, which is accepted and in the "High" category. Before testing the hypothesis, activities that must be carried out are the prerequisite test (normality test and homogeneity test). After it is known that the data is normal and homogeneous, hypothesis testing is continued using the ANCOVA test.

RESULTS AND DISCUSSION

As explained in the method, there are two classes used in this study. The control class used science textbooks as teaching materials and followed the whole series of lessons. In comparison, the experimental class used the developed PBL module. The developed module was divided into two learning activities, identification of river environmental pollution and causes and impacts of river pollution. In the first activity, students were asked to identify the pollution of the Metro River by matching the macrozoobenthos species they found in the river with the guidelines in the module. According to the module guide, students gave a score of the species found and then calculated using the Family Biotic Index (FBI) method to determine river quality. After knowing the condition of the river, the lesson continued to the second activity, where students were asked to analyze the causes and impacts of river pollution. In addition, at the end of the lesson, students were also asked to provide ideas for overcoming the problems found.

The mean results of the environmental attitude questionnaire from the pretest-posttest scores in the experimental and control classes can be seen in Table 2 below.

Table 2. The Mean Results of the Students' Pretest and Posttest Environmental Attitudes

Class	Treatment	Pretest ± SD	Posttest ± SD	Enhancement ±SD
Experimental	PBL Module	86,37 ± 7,89	90,74 ±10,63	4,37 ± 6,58
Control	Science Textbooks	86,76 ± 6,58	86,96 ± 9,29	0,20 ± 9,29

Table 2 above shows the mean posttest results of environmental attitudes in the two classes increased from the pretest results. However, the experimental class increase was higher (4.37) than the control class (0.20), so there were changes in the two classes' environmental attitudes after being given different treatments. After knowing the change in students' environmental attitudes after treatment, the difference between the students' pretest and posttest scores was also detailed for each indicator, as shown in Table 3 below.

Table 3. The Mean Results of the Pretest and Posttest for each Students' Environmental Attitudes Indicators

No	Indicators	Experimental Class			Control Class		
		Pretest ± SD	Posttest ± SD	Enhancement	Pretest ± SD	Posttest ± SD	Enhancement
1	Environmental awareness	4,42 ± 0,48	4,57 ± 0,35	0,15	4,37 ± 0,64	4,46 ± 0,57	0,09
2	Attitude towards recovery	4,62 ± 0,48	4,74 ± 0,44	0,12	4,63 ± 0,59	4,53 ± 0,53	0,10
3	Attitude towards recycling	3,91 ± 0,41	4,47 ± 0,35	0,56	4,14 ± 0,62	4,31 ± 0,48	0,17
4	Environmental consciousness and behaviour	4,35 ± 0,54	4,60 ± 0,41	0,25	4,31 ± 0,57	4,33 ± 0,53	0,02

Table 3 above shows the mean posttest score of each indicator of environmental attitudes in the experimental class and control class increased from the pretest value. However, the class that used the PBL module was higher than the class that used the science textbook. The indicators that experienced the most significant increase were attitudes towards recycling, while environmental awareness, attitude towards recovery, and environmental consciousness and behavior showed low changes.

As previously explained, before testing the hypothesis, the prerequisite test is first carried out. The normality and homogeneity test results that have been carried out are shown in Table 4 as follows.

Table 4. Results of Data Normality Test and Homogeneity Test for Environmental Attitude

Prerequisite Test	Class		N	Significance	α	Decision
Normality Test	Experimental Class	Pretest	30	0,112	0,05	Normal
		Posttest	30	0,071	0,05	Normal
	Control Class	Pretest	30	0,102	0,05	Normal
		Posttest	30	0,179	0,05	Normal
Homogeneity Test	All Classes	Posttest	60	0,118	0,05	Homogeneous

Based on Table 4, it showed that the variables of environmental attitude in the pretest-posttest of experimental and control class have a significance value > 0.05, so it could be concluded that all the data in this study were normally distributed. Also, it could be seen that data on the homogeneity test had a significance value (0,118) > 0.05, so it could be concluded that all the data in this study are homogeneous. After knowing that all data are normal and homogeneous, the ANCOVA test determines the effect of the PBL module on students' environmental attitudes after controlling the pretest. The test results can be seen in Table 5 as follows.

Table 5. ANCOVA Test Results of Students Environmental Attitude

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1757.192[a]	2	878.596	22.586	.000
Intercept	1108.229	1	1108.229	28.489	.000
Pretest	1543.055	1	1543.055	39.667	**.000**
Learning Materials	239.577	1	239.577	6.159	**.016**
Error	2217.298	57	38.900		
Total	477660.496	60			
Corrected Total	3974.490	59			

Table 5 showed that the significance value for the initial skill (pretest) was $0.000 \leq 0.05$. It means a linear relationship or an effect of the initial skills (pretest) on the students' final grades. This statement indicated that Ancova's assumptions were fulfilled. Furthermore, the significance value for the learning material was $0.000 \leq 0.05$. It could be concluded that there were differences in environmental attitude between students who used the PBL module and students who used science learning textbooks, which was also influenced by their initial (pretest) environmental attitude.

The results of students' environmental attitudes generally show an increase after learning using the PBL modules. However, not all indicators of environmental attitudes have increased significantly. Based on the pretest and posttest mean test results for each environmental attitude indicator, the class that used the PBL based module was quite good at increasing the attitude towards recycling and environmental consciousness and behavior. Several statements from the two indicators that received the highest scores can be seen as follows: (a) It feels sad when I see people throwing things that can still be recycled into the river; (b) factories must be required to use recycled materials even though the processing costs are higher than new raw materials; (c) I will look for ways to deal with river water pollution; (d) people who live near the river should not dispose of their used bathing and washing water directly into the river; (e) We should not sacrifice the environmental sustainability of the river for our benefit.

Although the mean results of the pretest and posttest indicators of the environmental attitude questionnaire have increased, it is not as significant as the other two indicators. Students' scores tend to be low for the statements in them. Some of the averages that received low scores from this indicator are as follows: (a) I would instead donate money to improve the environment than build a luxury highway; (b) if water pollution continues, I am worried that our future children and grandchildren will lack clean water; (c) I will play a role in preserving the river environment; (d) factories should only manage new raw materials because their product prices are low. *

Although several statements received low scores and did not significantly increase environmental awareness and attitude towards recovery indicators, the PBL module affected students' environmental attitudes. Efforts to train students' environmental attitudes, in general, are found at each stage of PBL in the developed module. The most influential stage for shaping students' environmental attitudes is the initial stage, identifying problems. The module contains a picture and a statement describing environmental problems, and then students are asked to identify what problems can be found in the picture. According to Suhadi et al. (2019), real problems can help students determine the environmental causes and impacts to raise or improve environmental attitudes. PBL, which invites students to observe, see problems directly, discussion, and question-answer, also plays an essential role in improving students' environmental attitudes (Husnah et al., 2017; Sueb et al., 2020; Ural & Dadli, 2020). The module's analysis and evaluation section also plays an important role because, through this activity, students re-evaluate their performance in solving problems to increase student awareness to care more about the environment. The results of students' environmental attitudes showed improvement after using the developed modules. PBL-based modules stimulate students to think at higher levels and improve their environmental attitudes by identifying problems and proposing ideas. Also, research results show that PBL can improve environmental attitudes (Candra et al., 2019; Kuvac & Koc, 2019; Amin et al., 2020). Other research that showed the same thing, applied to the PBL module to environmental pollution material, can strengthen junior high school students' environmental attitudes (Badria et al., 2021). As described earlier, many studies have been carried out to measure environmental attitudes with various methods, but the novelty found in this research is using real learning resources that students can find every day in their school activities.

CONCLUSION

There was a difference between students who use the macrozoobenthos diversity as bioindicator module based on problem-based learning, which is superior in empowering environmental attitudes, than students who use science textbooks adjusting the students' initial (pretest) environmental attitudes. It means if students use the macrozoobenthos module as a learning resource, they can improve their environmental attitudes.

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