

**IMPROVING ENVIRONMENTAL SENSITIVITY THROUGH PROBLEM-BASED HYBRID LEARNING (PBHL): AN EXPERIMENTAL STUDY****S. Amin\*<sup>1</sup>, Sumarmi<sup>2</sup>, S. Bachri<sup>2</sup>, S. Susilo<sup>2</sup>, R. L. Mkumbachi<sup>3</sup>, A. Ghozi<sup>4</sup>**<sup>1,4</sup>Universitas Islam Negeri Maulana Malik Ibrahim Malang, Malang, Indonesia<sup>2</sup>Universitas Negeri Malang, Malang, Indonesia<sup>3</sup>Stella Maris Mtwara University College, Mtwara, United Republic of Tanzania<sup>4</sup>Doctoral Student, Universitas Sebelas Maret, Surakarta, Indonesia

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Accepted: August 7<sup>th</sup> 2022. Approved: September 29<sup>th</sup> 2022. Published: September 30<sup>th</sup> 2022**ABSTRACT**

Students need to possess sensitivity to the environment in order to behave positively when they notice a problem and find the right solution. This study intends to investigate whether the PBHL model affects the environmental sensitivity of Social Science Education students on environmental issues and conservation materials. The quasi-experimental design of the pretest-posttest controlled group was used in this study. Students of the Social Science Education Department, Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia, were selected as research subjects using a purposive sampling technique. The research subjects were determined to consist of class D as the experimental class (29 students) and class B as the control class (29 students). Questionnaires with a Likert scale of 1 (strongly disagree) – 4 (strongly agree) were used in taking student environmental sensitivity data on environmental issues and conservation materials, totaling 28 items with indicators: knowledge, attitudes, and skills. Subsequently, the data were tested for normality and homogeneity and analyzed using an independent sample t-test. The results showed that the PBHL model had a significant effect on the environmental sensitivity of Social Science Education students on environmental issues and conservation materials ( $p(0.009) < \alpha(0.05)$ ). The average results of the sensitivity of the experimental class environment (N-Gain = 13.29) were higher than the control class (N-Gain = 8.75). This goal can be achieved through the syntax in the PBHL model. The suggestion for further research is that it is necessary to develop further by combining the PBHL model and interactive mobile learning media as a means for students to investigate and actualize problem-solving.

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Keywords: environment; hybrid learning; PBHL; problem-based learning; sensitivity

**INTRODUCTION**

Sensitivity to the environment is essential for students. Graduates of the university are expected to be able to collaborate and be sensitive and care for the community and the environment (Amin, 2018), especially for education students as prospective teachers who will educate the younger generation in protecting the environment (Turan, 2019). Ocal and Altinok (2016) report that environmental sensitivity is a positive

behavior when one realizes a problem and finds the right solution. However, the facts show that there are still many students who are less sensitive to problems and phenomena in the surrounding environment. It is proven in a study examined by Amin et al. (2020), which presents that concern for the campus environment among social studies education students is still relatively low. It was further explained that they did not care about the garbage scattered in the classroom and even around the campus. Students' lack of knowledge about the environment and the importance of protecting the environment can hinder their awa-

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renewal of preserving the environment (Ahmadi, 2018). Environmental conservation practices are still deplorable among adolescents (Mahat et al., 2021). Teenagers are less interested in environmental knowledge, according to Abubakar et al. (2016), because they do not practice environmental sustainability. This will be a big problem if teenagers are not concerned about the environment. In addition, the findings of research by Gurbuz and Ozkan (2019) state that environmental knowledge among students in Turkey is low, thus affecting a low level of environmental sensitivity.

One learning subject that can foster student environmental sensitivity is geography. Students can build environmental sensitivity through geography learning by maintaining awareness and preserving the environment (Puspitaningrum et al., 2018). Environmental sensitivity in learning geography in higher education requires students to understand, feel, and provide solutions to environmental problems (Kahraman, 2016; Cater, 2021). A reasonable effort that can accommodate learning problems related to the sensitivity of the student environment is by applying the problem-based hybrid learning model (PBHL). PBHL is the development of the Problem Based Learning (PBL) model. PBL is a constructive and innovative learning model developed by Howard Barrows at a lecture for health students at the McMaster University School of Medicine, Canada (Scott, 2017; Servant-Miklos, 2019). This PBL model has a positive effect on the sensitivity of the student environment. This assumption is reinforced because the PBL model is based on constructivism theory, i.e., students build their own knowledge when solving authentic problems (Arends, 2012; Orozco & Yangco, 2016). Therefore, this PBL model emphasizes the interaction between the environment as a stimulus and students as a response (Hung, 2016; Sugiharto et al., 2019). The environment provides problems and assistance, while students respond to them with investigation and analysis to get solutions. The process requires a high level of critical thinking from students to encourage environmental sensitivity (Sukardi, 2015).

PBHL learning on the PBL model platform is carried out through online and face-to-face lectures, referred to as hybrid learning (HL). HL is often referred to as blended learning (BL) (Helms, 2014). The concept of BL developed into HL, with the number of online meetings ranging from 50-74%, while the rest is offline (Widyartono, 2018). The use of the HL system is based on the reasons for minimizing weaknesses in online

learning carried out so far. Tran (2016) said that the lack of presence of educators in the classroom reduces learning motivation. Low student motivation in online learning can decrease productivity and learning outcomes (Zounek & Sudický, 2012). Especially when internet services are weak, and instruction in learning is poorly understood can cause communication errors so that learning outcomes become low (Rahmawati, 2016; Astuti & Febrian, 2019). Another disadvantage of online learning is that it requires a high cost. Lecturers and students must provide adequate computer software, sufficient internet access, and training costs for using computer software (Luaran et al., 2014; Tran, 2016; Naserly, 2020). Lecturers who are not familiar with the new computer program will have difficulty in teaching online. Likewise, students who do not understand computer software will be left behind and feel isolated (Zounek & Sudický, 2012). Furthermore, another weakness expressed by Sadikin and Hamidah (2020) is that students are not supervised during online learning. This raises the problem of academic dishonesty, such as someone other than a student can be the person who sends and completes assignments (Chen et al., 2020; Chiang et al., 2022). Another fraud is the work of students who only copy-paste from various sources, so plagiarism increases (Rahmawati, 2016).

In addition, HL can overcome weaknesses in face-to-face PBL learning. This opinion is in line with Sugiharto et al. (2019) that combining HL lectures is beneficial for overcoming the weaknesses of conventional learning (face-to-face). Some weaknesses in the application of PBL face-to-face are 1) students have difficulties with PBL because they are not used to group discussions in solving problems (Guido, 2016), so they need to adapt when learning with PBL (Dubec, 2017); 2) students have difficulties during the final exam because the habit of learning with PBL makes students only fixate on the problem-solving process so that the mastery of the material is reduced (Ghufron & Ermawati, 2018), while the teacher or lecturer considers that the preparation of PBL questions is not easy (Guido, 2016); 3) PBL requires more time (Dubec, 2017) both preparation and implementation, especially during discussions and presentations (Amin, 2014; Fatani, 2015); and 4) teachers or lecturers experience difficulties in PBL planning (Dubec, 2017).

Empirically, research that combines PBL and blended/hybrid learning models has been conducted by several researchers. Aeni et al.

(2017) concluded that the blended learning model based on problems effectively improves student learning outcomes. In line with the research of Dewi (2013), it concluded that learning with PBL and blended learning can improve student learning outcomes, including cognitive, affective, and psychomotor domains. Furthermore, the research of Alfi et al. (2016) explained that there is an impact between problem-based geography learning combined with blended learning on students' critical thinking skills. Carrió et al. (2016) found that an H-PBL curriculum can improve the students' learning outcomes, such as generic competencies, long-term knowledge acquisition, and problem-solving skills. The blended learning application and PBL utilizing the website are worthy of use in tutorial teaching in student classes (Lestarringsih, 2017). While Salari et al. (2018) compared pure PBL (PPBL) with hybrid PBL (HPBL), the findings showed that the HPBL strategy is more effective than the PPBL strategy in learning.

Although there has been research on the combination of the PBL learning model with blended/hybrid learning that has been conducted by Aeni et al. (2017), Alfi et al. (2016), Dewi (2013), Lestarringsih (2017), and Salari et al. (2018), there has not been much done to find out the effect in improving the environmental sensitivity of the Social Science student. In addition, the characteristics of contextual environmental material in geography learning in Social Science students are the differentiator of this study from others. Applying PBHL in this study is a modification of previous studies by Amin et al. (2020). The difference lies in the applied learning syntax. The learning syntax was modified in this study by adding an actualization step. This is done to determine whether the PBHL model significantly affects the environmental sensitivity of Social Science Education students on environmental issues and conservation materials. Specifically, the steps of PBHL learning in this study can be seen in Table 1.

**Table 1.** PBHL Model Syntax

Stages	Activity	Description
Problem orientation	Students are explained of the orientation of the problems around them.	Face-to-face & on the pitch
Troubleshooting planning	Students categorize the details of the problem discussed. Then students are asked to understand the details of the problem to be discussed and plan the process of solving the problem.	Online
Observation and investigation	Students conduct investigations to solve problems. Students are given a worksheet to solve the problems collected to the lecturer along with a photo of the activity.	Online & on the pitch
Preparation and presentation of results	Students prepare a problem-solving report of the results of the investigation and explain it through class presentations.	Online
Analysis and Evaluation	Students analyze the process of overcoming problems and determine the problem-solving methods.	Online
Actualization	Students take action in the field to actualize the selected problem-solving.	Online & on the pitch

Based on various theoretical and empirical studies described, the researcher assumes that applying PBHL in environmental learning for social science students can increase their environmental sensitivity. Problem-based learning that is applied hybridly through a mix of face-to-face and online will be more effective in learning. Experimental research in applying the PBHL model

is essential because it can increase students' environmental sensitivity. This increase will encourage their concern for protecting the environment. This study intends to examine the effect of using the PBHL model on the environmental sensitivity of Social Science Education students in environmental issues and conservation materials.

**METHODS**

This study is quasi-experimental with a pretest-posttest control group design. The detailed research design can be seen in Table 2.

**Table 2.** Pretest-Posttest Control Group Design

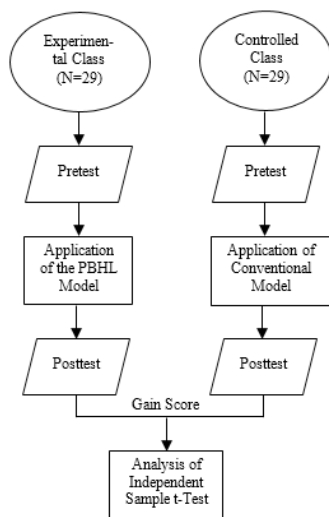
Group	Pre-test	Treatment	Post-test
Experimental class	O <sub>1</sub>	X	O <sub>2</sub>
Controlled class	O <sub>3</sub>	-	O <sub>4</sub>

Sources: Creswell & Creswell (2018)

Notes:

- O<sub>1</sub> : Tests before learning in the experimental class
- O<sub>2</sub> : Tests after learning in the experimental class
- X : PBHL learning in the experimental class
- O<sub>3</sub> : Tests before learning in the controlled class
- O<sub>4</sub> : Tests after learning in the controlled class
- : Conventional learning (full online lectures and discussions) in the controlled class

While the research flow can be seen in Figure 1. Based on the research flow chart, the experimental group was given treatment in PBHL.



**Figure 1.** Research Flow Chart

This learning combines the PBL model face-to-face with online and in the field to identify environmental problems, solve environmental problems, and carry out actualization in conserving the surrounding environment. The syntax of the PBHL model can be seen in Table 1. The control class was given treatment using a conventional model and a full online discussion. A pretest was given to both groups to determine the initial conditions before treatment. Posttest was given to determine differences in environmental sensitivity between the control and experimental groups. Thus, the gain score was obtained from the reduction between the posttest and pretest in each class. Finally, the gain score will be analyzed to determine the differences in the learning model applied to the experimental and controlled classes.

The subjects in this study are students of the Social Science Education Department, Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia, who are studying the subject of Physical Geography sub-matter environmental issues and conservation, even semester of the 2020/2021 academic year. The subject determination technique was carried out by purposive sampling, i.e., the subject was taken based on the characteristics of cognitive abilities that are almost the same based on the even midterm exam score for the 2020/2021 academic year. Based on the average midterm exam score data, class D was determined as the experimental class (29 students) and class B as the controlled class (29 students).

The assessment instrument of students' environmental sensitivity using questionnaires measured by the Likert scale is 1 (strongly disagree) – 4 (strongly agree), totaling 28 items. Environmental sensitivity indicators in this study include: (1) knowledge, (2) attitudes, and (3) skills (Kim, 2019). The student's environmental sensitivity assessment instrument has been tested for validity using product moment correlation. The results of the validity test of the environmental sensitivity instrument in 35 students in this study were declared valid. Recapitulation of validity test results is explained in Table 3.



**Table 3.** Results of Validity Testing of Environmental Sensitivity Instruments

Item	r Count	r Table	Decision
1	0.760	0.430**	Valid
2	0.513	0.430**	Valid
3	0.589	0.430**	Valid
4	0.748	0.430**	Valid
5	0.748	0.430**	Valid
6	0.564	0.430**	Valid
7	0.452	0.430**	Valid
8	0.589	0.430**	Valid
9	0.703	0.430**	Valid
10	0.726	0.430**	Valid
11	0.424	0.334*	Valid
12	0.551	0.430**	Valid
13	0.454	0.430**	Valid
14	0.474	0.430**	Valid
15	0.432	0.430**	Valid
16	0.454	0.430**	Valid
17	0.581	0.430**	Valid
18	0.474	0.430**	Valid
19	0.765	0.430**	Valid
20	0.408	0.334*	Valid
21	0.472	0.430**	Valid
22	0.539	0.430**	Valid
23	0.630	0.430**	Valid
24	0.589	0.430**	Valid
25	0.718	0.430**	Valid
26	0.760	0.430**	Valid
27	0.493	0.430**	Valid
28	0.748	0.430**	Valid

\*Significance 0.05, \*\*Significance 0.01

Furthermore, a reliability test was carried out on environmental sensitivity instruments using Cronbach's alpha. The results of testing the reliability of environmental sensitivity instruments in 35 students in this study are reliable. Recapitulation of reliability test results is contained in Table 4.

**Table 4.** Reliability Test Results of The Instrument Environmental Sensitivity

Cronbach's Alpha	N of Items
0.929	28

The data needed in this study consisted of (1) environmental sensitivity (Y) before treatment in the experiment group; (2) environmental sensitivity (Y) before treatment in the control group; (3) environmental sensitivity (Y) of students taught using PBHL; (4) environmental sensitivity (Y) of students taught using the conventional model. The data collection procedure follows these steps. First, pretests are done before learning in experimental and controlled classes. Second, the implementation of learning, including the experimental class using the PBHL model and the controlled class using the lecture and discussion models through full online presentations. Third, the posttest was carried out in experimental and controlled classes. Fourth, students are given questionnaires to obtain responses about the learning that has been carried out.

Environmental sensitivity data in this study tested normality, homogeneity, and independent sample t-test. Data normality was performed by the Kolmogorov-Smirnov test with the following formula (Gio & Irawan, 2016).

$$D_i = |F(Z_i) - F(X_i)|, i = 1,2,3, \dots, k.$$

with

$$Z_i = \frac{X_i - \bar{X}}{s}, i = 1,2,3, \dots, k.$$

Notes:

$\bar{X}$  = sample mean

s = standard deviation

The greatest value (maximum) of  $D_i$  or  $D_{max}$  is the statistical value of the Kolmogorov-Smirnov test. Decision-making is done by comparing the probability value (p-value) to the significance level  $\alpha = 5\%$ . If the probability value is  $\geq \alpha$ , then the data is normally distributed (Purnomo, 2016).

The homogeneity of the data variants was tested with Levene using the following formula (Hartati et al., 2013).

$$W = \frac{(N - k) \sum_{i=1}^k n_i (\bar{Z}_i - \bar{Z}_{..})^2}{(k - 1) \sum_{i=1}^k \sum_{j=1}^{n_i} (Z_{ij} - \bar{Z}_i)^2}$$

Notes:

n = number of respondents

k = number of classes

$Z_{ij} = |Y_{ij} - \bar{Y}_i|$

$\bar{Y}_i$  = average of the group of  $i$

$\bar{Z}_i$  = average of the group of  $Z_i$

$Z_{..}$  = average of the group of  $Z_{ij}$

Decision-making is done by comparing the probability value (p-value) to the significance level  $\alpha = 5\%$ . If the probability value is  $\geq \alpha$ , then the data is homogeneous (Purnomo, 2016).

Furthermore, the independent sample t-test was used to investigate the difference in using the PBHL model, which affects the increase in environmental sensitivity of students from the experimental and controlled groups (Fagerland, 2012; Gerald, 2018). The independent sample t-test is formulated as follows (Gio & Irawan, 2016; Gerald, 2018).

$$t = \frac{\bar{X}_2 - \bar{X}_1}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Notes:

n = number of respondents

$\bar{X}$  = mean value

$s_p$  = estimated standard deviation

Decision-making is done by comparing the probability value (p-value) to the significance level  $\alpha = 5\%$ . If the probability value  $\geq \alpha$ , then  $H_0$  is accepted, and  $H_a$  is rejected (Creswell &

Creswell, 2018). The hypotheses in this study are as follows:  $H_0$ : there is no difference in the environmental sensitivity of students before and after the application of the PBHL model;  $H_i$ : there is a difference in the environmental sensitivity of students before and after the application of the PBHL model.

All statistical data analysis in this study used IBM SPSS 23.0 for the Windows program. This is intended to facilitate the calculation and also obtain accurate analysis results. The significance level used in this study is 5%.

## RESULTS AND DISCUSSION

Data analysis of experimental research intends to determine the effect of the PBHL model on the students' environmental sensitivity. The calculation of the analysis prerequisite test in this study includes normality and homogeneity tests. Both prerequisite tests were carried out on the score of increasing data (gain) of the experimental and controlled classes. Specifically, the gain score data can be seen in table 5.

**Table 5.** Students' Environmental Sensitivity Data

Group	Value	N	Mean
Experimental class	Pretest	29	76.48
	Posttest	29	89.77
	Gain	29	13.29
Controlled class	Pretest	29	75.06
	Posttest	29	83.81
	Gain	29	8.75

Table 5 shows that the average value of the gain for the experimental class, which is 13.29, is higher than the control class, which is 8.75. Based on these data, it can be concluded that the increase in environmental sensitivity of students in the experimental class is greater than in the control class, with a difference of 4.54. The stu-

dents' environmental sensitivity data were tested for normality with Shapiro-Wilk because the data of each group was less than 50, with details of the experimental class of 29 and the controlled class of 29. Specifically, a summary of the results of the normality test of student environmental sensitivity data is contained in table 6.

**Table 6.** Normality Data Test Result of Environmental Sensitivity of the Students

Group	Shapiro-Wilk		
	Statistic	df	Sig.
Experimental class	0.956	29	0.267
Controlled class	0.955	29	0.241

Table 6 shows that the results of the normality test of the experimental class obtained a significance value of  $p (0.267) > \alpha (0.05)$ . Furthermore, in the controlled class, the significance value of  $p (0.241) > \alpha (0.05)$  was obtained. Based

on the significance value of both groups, it can be concluded that the environmental sensitivity data of experimental and controlled class students are normally distributed.

Next, testing the homogeneity of the student's environmental sensitivity data using the Levene test. Specifically, a summary of the results of the normality test of student environmental sensitivity data is explained in Table 7.

**Table 7.** Results of Homogeneity Test of Student's Environmental Sensitivity Data

Levene Statistic	df1	df2	Sig.
3.534	1	56	0.065

Table 7 illustrates that the results of the homogeneity test in the experimental and control classes obtained a significance value of  $p (0.065) > \alpha (0.05)$ . Based on the significance value, it can be summarized that the environmental sensitivity data of experimental and controlled class students are the same (homogeneous). Hypothesis testing

was carried out with an independent sample t-test (equal variances assumed). This is based on the fact that the data on the sensitivity of the student environment is normally distributed and varied equally (homogeneous). Specifically, a summary of the results of the student environment sensitivity data t-test can be seen in Table 8.

**Table 8.** Independent Sample t-Test Results (Equal Variances Assumed)

		t-test for Equality of Means					95% Confidence Interval of the Difference	
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Environmental Sensitivity	Equal variances assumed	2.714	56	.009	4.55690	1.67912	1.19321	7.92058

The results of the t-test of student environmental sensitivity data obtained a significance value of  $p (0.009) < \alpha (0.05)$ . According to the results, it is decided that  $H_0$  is rejected, and  $H_a$  is accepted. Based on the study's results, it is concluded that the PBHL model has a significant effect on the environmental sensitivity of Social Science Education students on environmental issues and conservation materials. This term is referred to as environmental sensitivity.

The results of this study align with previous studies. Lingqiong's (2018) research discusses the relationship between ecological knowledge, environmental sensitivity, and personal norms and pro-environmental behavior in elementary school students. The results show that personal norms and environmental sensitivity are essential factors in determining students' pro-environmental behavior. Personal norms and ecological knowledge influence environmental sensitivity. In line with the research of the PBHL model, students' knowledge of environmental material increases after the learning process so that there is a sense of sensitivity or desire to preserve the environment.

Another study by Puspitaningrum et al. (2018) concluded that coral reef conservation education has an effect on students' environ-

mental sensitivity to coral reefs. This influence is caused by the learning process carried out by students in observing and analyzing the conditions of their surroundings that can affect the survival of coral reefs. This study aligns with the PBHL model in increasing environmental sensitivity by solving environmental problems.

Furthermore, Kim (2019) examined the effect of observing and reflecting on the daily environment in developing environmental sensitivity. Students use various sources, such as text, photos, and animations, to record observations and thoughts. Students create visual diagrams illustrating their time-geographic path using the Time-Geographic Interactive Framework (TGIF) application. This research has similarities with the development of PBHL conducted online in collecting data and presenting the results in class face-to-face.

In contrast to Liu (2018) that describes the role of documentary films in nature, students' sensitivity to the environment increases when films are only introduced to the classroom. The study by Liu (2018) brings the context of environmental issues into the classroom through documentary films. This is different from PBHL research which presents contextual problems outside the classroom (the surrounding environment).

Environmental sensitivity in this PBHL study is based on the environmental context, which is the reaction of students to act in solving the environmental problems around them. Reaction is defined as the ability to act quickly and appropriately on the problems of the surrounding environment. Students develop empathy for environmental conditions and are aware of the solutions that occur. Through learning geography in this study, students able to recognize the conditions of the surrounding geographical environment. Recognizing the geographical environment will foster concern for available areas (Aliman et al., 2018).

Environmental sensitivity is the ability to perceive and observe reactions or changes in the surrounding environment (Cheng & Wu, 2015; Canosa et al., 2020; Bala et al., 2022). Students with high environmental sensitivity will easily understand and realize positive and negative reactions so that they can behave and act appropriately to their surroundings (Angraini, 2015). Furthermore, students with environmental sensitivity will be able to read the reality around them. Students can identify the reality that exists in the surrounding environment, so that attempt to act to solve problems that must be solved immediately (Kim, 2019). Students with low ability — high sensitivity experience an increase in problem-solving when paired with students with high ability — high sensitivity (Coşkun et al., 2014). This indicates that collaborative problem-solving is effective in learning. Through PBHL learning, high environmental sensitivity can increase collaboration among students in solving problems.

The higher the sensitivity of students to the environment, the more positive they will behave in maintaining the environment. Pluess (2015) states that individual differences in environmental sensitivity to the environment are influenced by negative and positive factors. Similar to research conducted by Lingqiong (2018) that discusses the relationship between environmental sensitivity and norms with positive behavior toward the environment, the results show that norms and environmental sensitivity are essential factors in determining students' positive behavior toward the environment. Environmental sensitivity analysis is an approach that can ensure resilience in environmental governance (Corral & Hernandez, 2017).

Experts have developed indicators of environmental sensitivity to the environment. This development study adopts environmental sensitivity indicators by Kim (2019) consisting of 1) knowledge, 2) attitudes, and 3) skills. According

to Kim (2019), the selection of indicators is based on that the three indicators are a summary of indicators of environmental sensitivity to the environment from several previous researchers. This means that environmental sensitivity indicators consisting of knowledge, attitudes, and skills are complete indicators following the expected learning output. This indicator in PBHL learning is expected to measure learning completeness regarding knowledge, attitudes, and skills.

The effect of the PBHL model on student environmental sensitivity in preserving the environment is based on the advantages of PBL. PBL learning on environmental materials and their conservation applied in the experimental class includes examples of real environmental problems. Solving environmental problems around students is done repeatedly to motivate them to maintain the environment sustainably and be sensitive to the surrounding environment (Kışoğlu, 2018; Lee & Blanchard, 2018). Sensitivity to the environment is formed because students feel they have an obligation to maintain the environment (Wesnawa et al., 2017).

Based on the results of the study, PBHL learning has a positive effect on the environmental sensitivity of students to the environment. The high score of environmentally conscious attitudes that occur after learning is carried out with the PBHL model shows that students' environmental sensitivity can develop. The average environmental sensitivity to the environment in the experimental class is higher because PBHL contains several stages of learning that students must carry out to involve them to actively think in order to find solutions to environmental issues (Hadzigeorgiou & Skoumios, 2013). Students actively construct knowledge based on what they already know, from the beginning to the end of the learning process. Students learning activities are thoroughly carried out so that the results obtained are more complex, durable, and integrated into comprehending environmental issues (Kuvac & Koc, 2018).

The PBHL model allows students to examine environmental issues with a complete understanding (Malik & Malik, 2018; Zarida et al., 2021). The assessment starts by mapping the problem, determining the priority of the problem, conducting field investigations, discussing the results of group work, presenting the results of work, and actualizing the results of solving environmental problems in the community. Such learning enables students to investigate various facts, events, and environmental issues. Students can form critical and logical thinking frameworks, cu-



riosity, inquiry, problem solving, and other cognitive skills in finding solutions to environmental issues that occur in the surrounding environment (Sumarmi, 2015).

The formation of an attitude of sensitivity to the environment will develop well when environmental problems are presented around it (Bergman, 2016). Students will be tempted to have a positive attitude towards their environment. This attitude will form a positive self-concept in responding to and behaving following ecological principles (Díez-Palomar et al., 2020).

Students' new knowledge after PBHL learning is used to make decisions about the environment. The problems in PBHL are open so that each student can develop solutions through various methods of data collection and discussion (Dewi et al., 2016). Students can use diverse information or data to determine various alternatives to solve problems. This new knowledge about preventing environmental damage is the foundation for students to behave towards the environment so that sensitivity in students is formed (Susilowati et al., 2020; Bala et al., 2022).

The improvement in students' environmental sensitivity to the environment is also caused by the stages/learning phases of the experimental class with the PBHL model. The problem orientation phase in this study was conducted online and face-to-face (on the pitch). Lecturers explain to students the orientation of problems in the surrounding environment online and synchronously. In contrast to the control class, the implementation of problem identification is carried out fully online by relying on secondary data on the web/internet. This makes students have difficulty in identifying the real problem, so they are less able to empathize with the problem. Activities in the field help students identify problems in the surrounding environment so that they will quickly get contextual data (Maulidiyahwanti et al., 2016; Susetyo et al., 2017; Bahri, 2020). Identifying problems in the surrounding environment can trigger the sensitivity of the student's environment to be higher because students can feel and empathize with solving them.

Furthermore, the actualization phase can increase students' sensitivity to the surrounding environment. This phase is carried out online and in the field. Students take action in solving problems on the field. This actualization action aims to realize the problem-solving process prepared based on the field investigation. Student experience learning directly from what has been done during the learning process. Learning activities such as observing and actual actions in the en-

vironment can increase students' sensitivity and involvement. However, since the learning process is in the controlled class, which limits their activities to directly solve the problem, they cannot solve the environmental problems, so their environmental sensitivity is not built correctly. Experience gained during PBHL learning can help students understand and learn to overcome problems directly (Sumarmi et al., 2020). This can enhance students' environmental sensitivity to the environment (Cater, 2021). Through the PBL learning stage, students not only accept the theory and memorize it but also act as solution seekers of environmental problems around them (Kuvac & Koc, 2018). This is similar to Gök and Kiliç's (2021) research that the actualization of environmental social activities can be increased to promote environmental awareness among students.

## CONCLUSION

PBHL model significantly affected the environmental sensitivity of Social Science Education students on environmental issues and conservation materials. PBHL learning makes students' empathy, responsibility, and reaction arise when faced with environmental problems. The problem-solving process that is carried out repeatedly will motivate students to maintain the environment. The problem orientation and actualization phase encourage students to act to maintain and preserve the environment. Time constraints and learning media were among the problems mentioned in this study. Therefore, the researchers recommend that time allocation planning needs to be added, especially at the investigation and actualization stages. Furthermore, development is needed by interactive mobile learning media as a means for students to investigate and actualize problem-solving in PBHL.

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