THE IMPACT OF THE USE OF RESEARCH-BASED BIODIVERSITY E-LEARNING ON THE DEVELOPMENT OF CONSERVATION LITERACY SKILLS IN MIDDLE SCHOOL STUDENTS IN GRADE VII

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Abstract. *The low ability of conservation literacy is the main problem currently faced, one of which is caused by an inappropriate learning system. Therefore, contextualized teaching materials are needed to solve this problem. The purpose of this study is to describe whether or not there is an effect of using electronic student worksheets based on research results on the topic of biodiversity on students' conservation literacy skills, and cognitive, affective, and psychomotor aspects. This study uses a type of quantitative research with the method being quasi-experimental with a nonequivalent control group design. The sample in this study was taken using the Slovin method. The data analysis technique used was the T-test. In the research, the experimental class used an electronic student worksheet and the control class used an electronic student worksheet developed by the subject teacher. The conclusion of the study is that there is an effect of electronic student worksheets based on research results on biodiversity on students' conservation literacy skills.*

Keywords: *electronic student worksheet, research-based; conservation literacy; biodiversity*

INTRODUCTION

In the process of learning science, the materials presented often include topics related to environmental conservation. These environmental protection materials are important to raise students' awareness of the importance of preserving and protecting the environment around them. Conservation behavior is a real effort to save, protect, and preserve the environment wisely. This behavior is very important to develop early in order to support broader conservation efforts (Helida et al., 2019). In addition, conservation behavior can be formed through knowledge and skills in making decisions related to environmental issues faced (Utina et al., 2018). The issue of conservation literacy in education is an important focus at this time, as

students still do not know more about protected areas in Indonesia, as evidenced by students' inability to answer questions related to the existence and condition of the ecosystem in TNUK and its biodiversity. Thus, the issues of conservation problems in TNUK are not yet known by the students. In addition, problems were found in the learning process used, which only aimed at mastering the material and rarely carried out learning outside the classroom. For example, the pupils have an indifferent attitude towards the environment, such as stepping on plants in the schoolyard. Another problem found is that the teaching materials used by teachers in schools still use printed government teaching materials, and teachers have not developed teaching materials that focus on the environment as an alternative companion teaching material to promote students' environmental literacy. (Endang, 2024) Based on the results of the research conducted, the level of conservation literacy of students in school is still quite low. This is evidenced by the fact that students were asked several questions about Ujung Kulon National Park and how to protect the surrounding environment. Based on the results of the students' answers, many students do not know about the Friends of Ujung Kulon National Park, and students only know that TNUK has one-horned rhinos. This is caused by several factors, such as the teaching materials used by teachers are not optimal, and the lack of learning that discusses conservation areas.

One effective way to protect the environment is to teach students about conservation from an early age so that they can take better care of the environment around them. Another important step is the establishment of national parks to protect the diversity of flora and fauna. An example of a national park that plays an important role in conservation is Ujung Kulon National Park (TNUK), located in the western tip of Banten Province. This area is dominated by lowland tropical forest ecosystems with very high biodiversity. It is home to typical fauna such as the Javan rhinoceros (Rhinoceros sondaicus), which is an endemic and protected animal. In addition, this area also has different types of flora that are widespread and show extraordinary diversity (Nurmayulis & Hermita, 2015)

In the learning process to improve conservation literacy, students need to be trained to develop skills, knowledge, and communication skills related to conservation actions that can be taken. In addition, teachers also need to develop teaching materials that meet the needs of science materials, especially on biodiversity, which includes cognitive, affective, and psychomotor aspects. One of the advantages of electronic student worksheet products is the existence of interesting learning activities equipped with videos and images about biodiversity and the ecosystem of Ujung Kulon National Park (TNUK). In addition, this product also provides access to a website that contains information about biodiversity, conservation activities, endangered animal species, and ways to protect the ecosystem. Through these resources, it is hoped that students will develop a greater awareness of preserving the environment around them.

Based on the explanation of the above problems, researchers are interested in testing electronic student worksheet products developed by previous researchers. Therefore, the researchers conducted a study entitled "The Effect of Using

Electronic Student Worksheet on the Theme of Biodiversity Based on Research Results to Improve Conservation Literacy Skills of Junior High School Students in Grade VII".

METHODS

The method in this research was quasi-experimental with a nonequivalent control group design. This method is research that is close to real testing, where there will be no manipulation process on relevant variables (Nazir, 2014). In this study, two study groups were conducted, in which the experimental class received learning using research-based electronic student worksheet teaching materials and the control class received different treatments, namely the teaching and learning process using student worksheets developed by the subject teacher.

Table 1. Research Design

Kelas	Pretest	Treatment	Posttest
Eksperimen	O_1	X_1	O_2
Kontrol	O_3	X_2	O_4

(Sugiyono, 2017)

Description:
O_1: Experiment class pretest results
O_3: Control class pretest results
X_1: Experiment class treatment
X_2: Treatment in control class
O_2 : Experiment class posttest results
O_4 : Control class posttest results

The subjects of this study were seventh-grade students in one of the junior high schools in Pandeglang Regency. This study involved two class groups, namely the experimental class that used the research-based electronic student worksheet and the control class that used the subject teacher-developed student worksheet. Each class had 34 students. Three indicators of environmental literacy were used to measure the research outcomes, namely: cognitive indicators (with pre- and post-tests), affective indicators (with attitude questionnaire), and psychomotor indicators (measured by a poster-making task). The skill indicators of conservation literacy proposed by the World Wild Fund in 1996 have a psychomotor component, namely 1) Knowing how to conserve biodiversity and 2) Being able to apply students' skills in processing the environment around them. Where to evaluate this psychomotor indicator there are evaluation criteria for each component, making posters made by students on conservation activities has a value, so the higher the value obtained by students, the students have conservation literacy skills on psychomotor indicators. Data collection was carried out using test and non-test instruments arranged according to the components of the conservation literacy sub-indicators. The components of the conservation literacy indicators are listed below:

Table 2. Indicator components of conservation literacy skills

No.	Conservation Literacy Indicators	Conservation Literacy Sub-Indicators
1	Cognitive Outcome	Principles and processes of Biodiversity Ecology
		Problems with biodiversity issues
		Knowledge of action strategies for saving biodiversity
2	Affective Outcome	Sensitivity to positive values of environmental prevention
		Remediation of personal and community belief issues with biodiversity
3	Psikomotorik	Understand how to carry out activities biodiversity conservation
		Apply skills in managing the surrounding environment

(WWF, 1996)

The test instrument is used to measure students' cognitive indicators through 20 multiple-choice questions in the form of cognitive sub-indicators of conservation literacy skills, namely principles and ecological processes of biodiversity, biodiversity issues, knowledge of action strategies to save biodiversity, which aims to assess students' conservation literacy skills in understanding the concept of biodiversity. Meanwhile, the non-test instrument consisted of two parts, namely a questionnaire sheet with 15 statements and a poster assignment assessment. The purpose of this non-test instrument is to measure students' sensitivity to biodiversity values and to predict their conservation literacy behavior. Both instruments will first be tested for validity through a theoretical validity test, while the reliability test on this instrument uses the Hoyt reliability coefficient, where all research instruments are rated by experts using a Likert scale validity sheet.

In order to determine the effect of the research-based electronic student worksheet on conservation literacy, the data were analyzed using a t-test with SPSS version 26, preceded by checking the assumptions of normality and homogeneity. The independent samples t-test was used to test the hypothesis after ensuring that the data were normally distributed and homogeneous. This test allows the researcher to conclude the differences between the two groups. The significance level used is 0.05 with statistical criteria based on the significance value (2-tailed). If the

significance value (2-tailed) is < 0.05, H_0 is rejected and H1 is accepted; conversely, if the significance value (2-tailed) is > 0.05, H_0 is accepted and H_1 is rejected.

RESULTS AND DISCUSSION

Results

The following are the results of the analysis of the cognitive indicators of conservation literacy based on the frequency distribution of the pretest and posttest scores in the experimental and control classes. Before discussing the results of the pre-test and post-test, the assumption test was carried out first, which includes the homogeneity test and the hypothesis test (t-test). The calculated results of the statistical analysis of the cognitive indicators in both classes are as follows.

Table 3. Analysis Statistics Indicator Kognitif Literasi Konservasi

Statistics	**Experiment Class**	**Control Class**
Normality *	0,155 (normally distributed)	0,101 (normally distributed)
Test Homogeneity **	0,998 (homogenized)	
t-test	0,000 (significant)	

* *Kolmogorov–Smirnov* (Normal sig >0,05)
** *Levene Statistic* (Homogen, sig >0,05)

Statistical analysis using normality and homogeneity tests showed that the sample data from the population were normally distributed and homogeneous, with sig > 0.05. Hypothesis testing using the independent samples test (t-test) shows a significant difference with a sig (2-tailed) value of 0.000. This means that hypothesis H0 is rejected and H1 is accepted. Therefore, it can be concluded that the use of electronic student worksheets based on the research results affects the conservation literacy skills of seventh-grade students on cognitive indicators. The results of the analysis of the cognitive indicators of conservation literacy in the experimental and control classes can be seen from the calculation data of the pretest and posttest scores of the students in the experimental class presented in Figure 1.

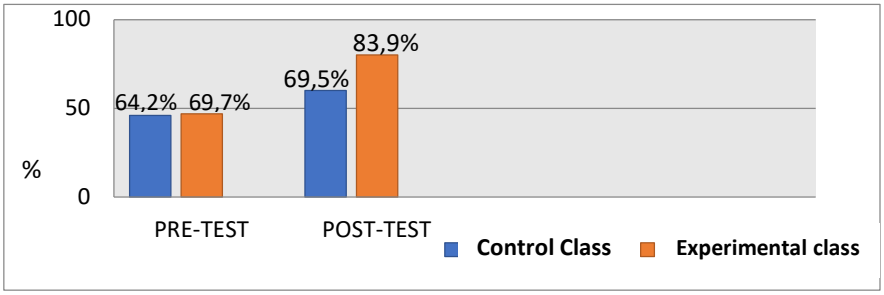

Figure 1. Comparison of results of cognitive indicators between experimental and control classes

Furthermore, the results of the analysis of cognitive indicators of conservation literacy skills of experimental and control class students were obtained from the results of distributing attitude questionnaires. Where the results show that the experimental class has a higher value than the control class, this is due to different treatments in the control and experimental classes, the experimental class uses an electronic student worksheet based on research results on the theme of biodiversity while the control class uses student worksheet developed by the subject teacher.

Table 4. Statistical analysis of affective indicators of conservation literacy

Statistics	**Experiment Class**	**Control Class**
Normality *	0,200 (normally distributed)	0,200 (normally distributed)
Test Homogeneity **	0,233 (homogenized)	
t-test	0,000 (significant)	

* *Kolmogorov–Smirnov* (Normal sig >0,05)
** *Levene Statistic* (Homogen, sig >0,05)

Statistical analysis using normality and homogeneity tests showed that the sample data from the population were normally distributed and homogeneous, with a significance value (sig) > 0.05. Hypothesis testing using the independent samples test (t-test) shows a significant difference with a sig (2-tailed) value of 0.000. This means that hypothesis H0 is rejected and H1 is accepted. Therefore, it can be concluded that the use of research-based electronic student worksheets affects the conservation literacy skills of seventh-grade students on effective indicators.

The results of the data processing on the affective skills of conservation literacy in the experimental and control classes were obtained from the attitude questionnaires distributed to the students. The following data show the comparison of scores on each sub-indicator of the affective indicators, providing an overview of the differences in attitudes and environmental awareness between students in the experimental class, which used research-based electronic student worksheets, and students in the control class, which used student worksheet developed by subject teachers. Below are the averages for comparing the affective indicator scores of the two classes.

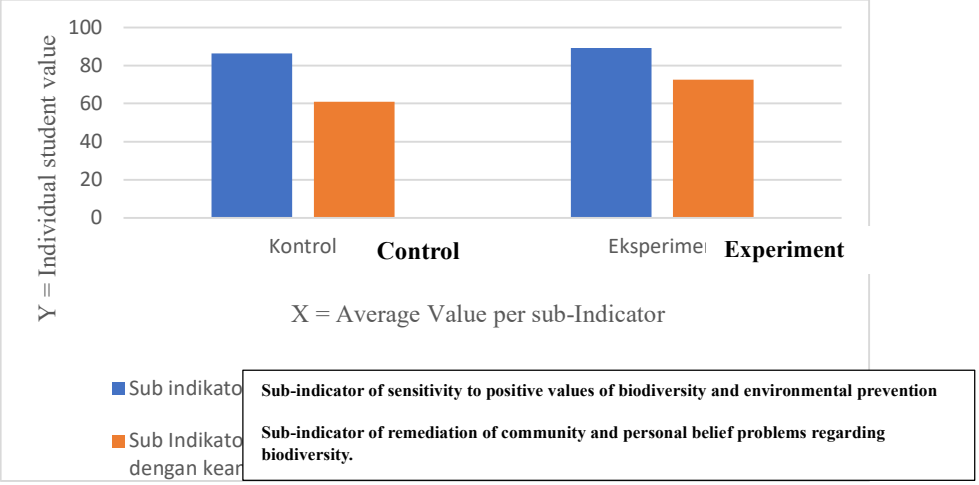

Figure 2. Results of the assessment of the affective aspects of nature conservation literacy based on the questionnaire assessment

The average results show that the experimental class scored higher than the control class on the sub-indicator of sensitivity to positive values related to environmental conservation, biodiversity, and restoration efforts for personal and community belief problems related to biodiversity.

Furthermore, the results of the analysis of psychomotor indicators of conservation literacy skills in experimental and control class students were obtained through the assessment of poster tasks given to the students. Features in the electronic student worksheet are videos about different types of animals and plants found in TNUK, and news about threats to biodiversity, this electronic student worksheet has activities that students can discuss so as to provide direct experience, it can promote conservation literacy skills. Before discussing the results of the poster evaluation, a preliminary test was carried out, which included a homogeneity test and a hypothesis test (t-test). The calculated results of the statistical analysis of the psychomotor indicators in both classes are as follows.

Table 5. Statistical analysis of psychomotor indicators of conservation literacy

Statistics	Experiment Class	Control Class
Normality *	0,200 (normally distributed)	0,140 (normally distributed)
Test Homogenity **	0,195 (homogenized)	
t-test	0,000 (significant)	

* *Kolmogorov–Smirnov* (Normal sig >0,05)
** *Levene Statistic* (Homogen, sig >0,05)

Statistical analysis using normality and homogeneity tests showed that the sample data from the population were normally distributed and homogeneous, with a significance value (sig) > 0.05. Hypothesis testing using the independent samples test (t-test) shows a significant difference with a sig (2-tailed) value of 0.000, so hypothesis H0 is rejected and H1 is accepted. Thus, it can be concluded that the use of based on research results affects the conservation literacy skills of seventh-grade students on psychomotor indicators.

The poster task was designed to assess students' ability to apply the concept of biodiversity conservation through visual work. The following data represent the average comparison of the results of the psychomotor indicators for each sub-indicator between the experimental and control classes.

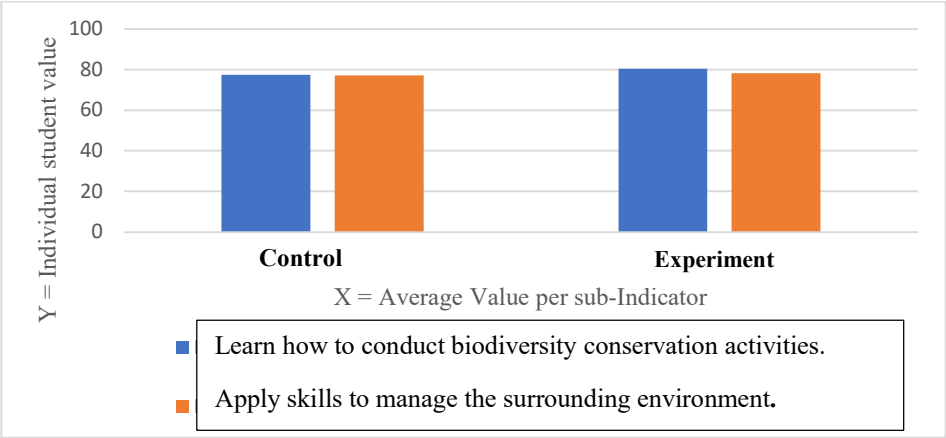

Figure 3: Results of the assessment of the psychomotor aspects of the conservation literacy skills based on the poster assessment

The results of the calculation of the average value of each sub-indicator show that the experimental class obtained higher results than the control class.

Discussion

In the learning process, there are differences in treatment between the experimental and control classes. The experimental class used a research-based electronic student worksheet, while the control class used a student worksheet developed by the subject teacher. This study aims to determine the effect of research-based electronic student worksheets on students' conservation literacy skills. This effect will be measured by the achievement of learning outcomes and learning process on three indicators of conservation literacy. The learning outcome indicators include cognitive aspects (measured by pre-and post-test questions) and affective aspects (measured by attitude questionnaire), while the learning process indicators include psychomotor aspects (measured by poster product assignment).

The analysis of the cognitive aspects showed that the distribution of post-test scores in the experimental and control classes showed an effect after the treatment. The experimental class had a mean score of 83.9, while the control class had a mean score of 69.5. Post-test scores increased in both classes after treatment, but the increase in the experimental class was more significant. The increase in the scores of the cognitive indicators in the experimental class can be identified through the most influential stages in the students' conservation literacy, namely the cognitive sub-indicators of conservation literacy, measured through pretest and posttest questions. As follows :

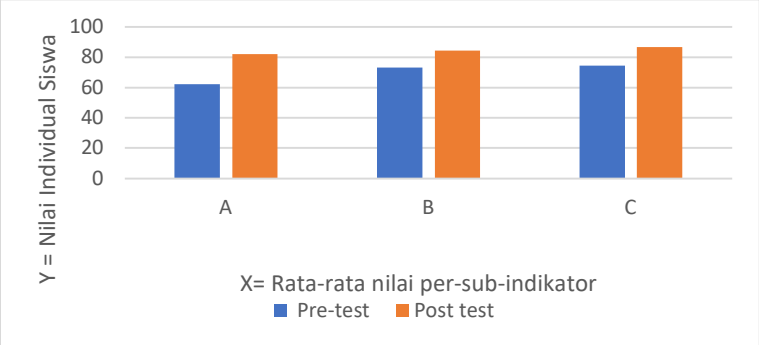

Figure 4. Category of the results of the cognitive sub-indicators of the experimental class

In the experimental class, there are three categories of cognitive sub-indicator results as follows:

- A: Principles and ecological processes of biodiversity,
- B: Problems and issues related to biodiversity,
- C: Knowledge of action strategies to save biodiversity.

The data in the figure above show the average of the pre-test for the experimental class on each sub-indicator, namely: the first sub-indicator was 62.18, the second sub-indicator was 73.11 and the third sub-indicator was 74.51. Meanwhile, the average value of the post-test in the experimental class was: the first sub-indicator was 81.93, the second sub-indicator was 84.45 and the third sub-indicator was 86.76.

The use of research-based electronic student worksheets has a significant effect on improving cognitive indicators of environmental literacy, due to the difference in treatment between the control and experimental classes in the use of teaching materials. The experimental class used research-based electronic student worksheets, while the control class used student worksheets developed by science teachers.

In the cognitive indicators of conservation literacy, there are several sub-chapters that students need to understand, namely the principles and ecological processes of biodiversity, understanding of biodiversity problems and issues, and knowledge of actions to save biodiversity. These results show that the research-based electronic student worksheet developed by Endang (2024) is effective in improving students' cognitive indicators of conservation literacy.

Research by (Ardoin et al., 2020) supports these findings, demonstrating that environmental education provides concrete environmental benefits and helps to address conservation issues. Environmental education not only improves students' values, attitudes, and knowledge about the environment but also builds skills that prepare individuals and communities to take positive environmental action together.

This research-based electronic student worksheet has a positive impact on students' conservation literacy skills by teaching them to identify, discuss, give opinions, offer solutions, and analyze biodiversity problems. This is in line with (Leksono et al., 2015) view that conservation biology learning aims to change students' behavior toward valuing nature and the environment around them.

In addition, students also learn through the contextual learning approach used in the research-based electronic student worksheet. This is in line with the research by Darmoatmodjo et al. (2024), which states that contextual learning is one of the learning methods that can improve students' science literacy. This approach positions students as individuals in need of knowledge by providing practical learning experiences that are interesting, enjoyable, and relevant to everyday life, especially in the context of their environment.

The results of the analysis of the conservation literacy skills on affective indicators (Figure 2) show an increase in the experimental class. The average score for the first sub-indicator was 89.08 and the second sub-indicator was 72.55. In the control class, the average value of the first sub-indicator was 86.27, while the second sub-indicator was 60.98. Based on these data, it can be seen that all sub-indicators of affective achievement have increased. The researcher's analysis shows that the use of the research-based electronic student worksheet on biodiversity has a positive impact on the conservation literacy of class VII.

(Leksono, 2017) research supports these findings, stating that the purpose of learning biodiversity conservation is for students to master and be able to apply the concepts of biodiversity conservation in order to change students' attitudes, skills, values, behaviors, and beliefs towards nature.

For the first sub-indicator, the average score of the experimental class was higher than that of the control class. This sub-indicator requires students to be sensitive to efforts to prevent environmental damage. Farihin (Farihin, 2023) Stated that through effective education, students are expected to have better knowledge of environmental issues and become more aware of the impact of their actions on the environment.

On the second sub-indicator, the average score of the experimental class was also higher than that of the control class. This sub-indicator requires students to overcome problems arising from individual or community beliefs about biodiversity. In the research-based electronic student worksheet, there is content that discusses the threat of extinction of the Javan rhino. Through this content, students are asked to identify the problems, causes, and effects of the extinction. This issue raises students' awareness of the importance of protecting biodiversity so that species do not become extinct, and so that future generations can enjoy the biodiversity that exists. A study by (Fitriarti, 2021)supports these findings, showing that environment-based learning can improve the environmental care attitudes of secondary school students.

The results of hypothesis testing showed an increase in conservation literacy skills in the experimental class, which was not seen in the control class. This is because the control class did not use research-based electronic student worksheets. Based on the analysis of psychomotor indicators, there is a positive effect of using research-based electronic student worksheets on biodiversity on the conservation literacy skills of Grade VII students.

On the first sub-indicator of the psychomotor indicator, the average score of the experimental class was higher than that of the control class. This sub-indicator requires students to understand how to conserve biodiversity, including an understanding of the problems, causes, and consequences associated with biodiversity issues. Therefore, in this study, students were given the task of creating a poster that measured their ability to analyze biodiversity issues. These posters should communicate the causes and effects of these problems, as well as solutions for conservation.

On the second sub-indicator of the psychomotor indicator, the experimental class scored higher than the control class. This sub-indicator requires students to use certain skills to manage, maintain, or improve the surrounding environment. (Kuspriyanto, 2015) stated that one way to overcome environmental problems is through conservation activities, both in-situ and ex-situ. In-situ conservation (in natural habitats) involves protecting populations and communities directly in their natural habitat. On the other hand, ex-situ conservation is carried out outside the

natural habitat, where fauna are moved and maintained in special places that are safe and in accordance with their ecological conditions.

Based on the discussion above the cognitive indicator shows the results of a great influence on the use of research-based electronic student worksheets where the experimental class got pretest results of 69.7% and after being treated with research-based electronic student worksheet got a posttest value of 83.9% this shows there is a significant increase so it can be said that the cognitive indicators of conservation literacy skills have a great influence on the use of research-based electronic student worksheet.

Based on the discussion above the cognitive indicator shows the results of a large influence on the use of research-based electronic student worksheets where the experimental class got pretest results of 69.7% and after being treated using research-based electronic student worksheets got a posttest value of 83.9% this shows there is a significant increase so that it can be said that the cognitive indicators of conservation literacy skills have a major influence on the use of research-based electronic student worksheet.

CONCLUSIONS

Based on the results of the study, it show that there is an effect of using research-based electronic student worksheets on biodiversity material on the conservation literacy of seventh-grade junior high school students. The results showed an increase in higher scores on cognitive indicators, affective and psychomotor indicators in the experimental class compared to the control class, this was due to the experimental class using research-based electronic student worksheets teaching materials on biodiversity, where this electronic student worksheet has features that can increase students' awareness of biodiversity around them and protect the nature around them. It is important for a teacher to use research-based electronic student worksheets on biodiversity to develop learning activities with more creative activities according to students' needs and easily accessible to students anywhere and anytime.

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