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THE EFFECT OF USING ENVIRONMENT-BASED BIOLOGY E-LKPD ON THE UNDERSTANDING OF THE CONCEPT OF BIODIVERSITY IN STUDENTS OF STATE SENIOR HIGH SCHOOL 5 TUALANG

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ABSTRACT

The integration of technology in biology learning encourages the use of innovative digital teaching materials to support students' understanding of concepts. One of the learning media that can be used is environment-based E-LKPD (Electronic Student Worksheet), which allows students to learn interactively and contextually through environmental exploration activities. However, the effectiveness of using environment-based E-LKPD in improving students' understanding of biodiversity concepts still needs further investigation. Therefore, this study aimed to determine the effect of using environment-based Biology E-LKPD on students' understanding of biodiversity concepts at SMA Negeri 5 Tualang. This study employed a quantitative approach with a quasi-experimental design using a non-equivalent pretest-posttest control group design. The subjects consisted of 67 students, including 34 students from class X7 as the experimental class and 33 students from class X8 as the control class. The experimental class learned using environment-based E-LKPD, while the control class used conventional learning methods. The research instruments included pretest and posttest questions, observation sheets, and student response questionnaires. The data were analyzed using descriptive statistics, N-Gain analysis, normality test, homogeneity test, and independent sample t-test with the help of Microsoft Excel and SPSS. The results showed that the average N-Gain score of the experimental class was 0.44 and the control class was 0.45, both categorized as moderate. The independent sample t-test showed a significance value of $0.464 > 0.05$, indicating that there was no significant difference between the experimental and control classes. In conclusion, the use of environment-based Biology E-LKPD did not significantly affect students' understanding of biodiversity concepts, although it supported interactive and contextual learning activities.

Keywords: biodiversity, concept understanding, E-LKPD, environment-based learning, biology learning

1. INTRODUCTION

In the context of 21st-century education, the integration of technology into the learning process has become increasingly important. The development of digital technology encourages teachers to utilize innovative learning media to improve the quality of education. In biology learning, the use of digital teaching materials can help students understand abstract concepts more effectively through interactive and contextual learning activities.

Biodiversity is one of the important topics in biology learning because it is closely related to environmental sustainability and ecosystem balance. Biodiversity provides ecological, economic, and social benefits for human life. Therefore, students need to understand

biodiversity concepts properly to increase their environmental awareness and conservation attitudes. However, students' understanding of biodiversity concepts is still relatively low because learning activities are often dominated by theoretical explanations without contextual learning experiences.

One of the factors influencing students' understanding is the limited use of innovative and contextual teaching materials. Conventional learning methods tend to make students passive during the learning process. According to Prasetiyo and Perwiraningtyas (2021), environment-based teaching materials can improve students' understanding and environmental awareness significantly. Similarly, Munir et al. (2022) stated that environmental approaches in biology learning increase students' interest and participation in the learning process.

One of the innovations that can be implemented in biology learning is E-LKPD (Electronic Student Worksheet). E-LKPD is a digital worksheet that can be accessed through electronic devices and designed to facilitate interactive and independent learning. Environment-based E-LKPD allows students to observe, analyze, and relate learning materials to real environmental phenomena. Hairunnisa (2021) explained that environment-based E-LKPD can improve students' engagement because students directly interact with their surrounding environment during the learning process.

Several previous studies have shown positive results regarding the use of E-LKPD in biology learning. Rafikayuni et al. (2020) found that E-LKPD based on local environmental phenomena has high validity and effectiveness in biology learning. Magdalena et al. (2020) also reported that multimedia-based E-LKPD improves students' motivation and concept understanding. However, studies specifically investigating the effect of environment-based Biology E-LKPD on students' understanding of biodiversity concepts are still limited, especially in the context of senior high schools.

Therefore, this study aims to determine the effect of using environment-based Biology E-LKPD on students' understanding of biodiversity concepts at SMA Negeri 5 Tualang. This research is expected to provide insights into the implementation of digital and contextual learning media in biology education.

In addition, biodiversity is one of the fundamental topics in biology that requires students not only to memorize concepts but also to understand the relationships between organisms and their surrounding environment. Learning biodiversity through direct observation of environmental phenomena can help students construct knowledge more meaningfully and develop a deeper understanding of biological concepts. Studies have shown that learning materials integrated with real environmental contexts are able to improve students' engagement and facilitate concept mastery because students can connect theoretical knowledge with actual conditions found in their daily lives (Ambarwati & Wilujeng, 2023; Febrian et al., 2020).

Furthermore, the integration of environmental aspects into E-LKPD provides opportunities for students to actively explore local biodiversity potential through observation, analysis, and problem-solving activities. Environment-based E-LKPD encourages students to become active learners by involving them in contextual learning experiences that are closely related to their surroundings. Such learning experiences are expected to enhance students' cognitive abilities and help them understand biodiversity concepts more comprehensively (Mardhatillah et al., 2020; Salsabila et al., 2025).

The use of digital learning media such as E-LKPD is also in line with the demands of 21st-century education, which emphasizes the development of critical thinking, creativity, collaboration, and digital literacy skills. Interactive features embedded in E-LKPD, including images, videos, hyperlinks, and online exercises, can increase students' interest in learning and provide more varied learning experiences than conventional worksheets. Previous studies

reported that interactive E-LKPD is practical, effective, and capable of supporting students' learning outcomes and higher-order thinking skills in biology learning (Ardiansah & Zulfiani, 2023; Chaniago et al., 2022).

Considering the importance of biodiversity learning and the potential benefits of environment-based E-LKPD, further research is needed to examine its effectiveness in improving students' understanding of biodiversity concepts. The findings of this study are expected to contribute to the development of innovative biology learning media and serve as a reference for teachers in implementing technology-based and contextual learning approaches that support meaningful learning in senior high schools.

2. METHODOLOGY

This study employed a quantitative approach with a quasi-experimental research design. The design used in this study was the non-equivalent pretest-posttest control group design. This design involved two groups consisting of an experimental class and a control class. The experimental class received treatment using environment-based Biology E-LKPD, while the control class received conventional learning methods using lectures and textbooks.

The research was conducted at SMA Negeri 5 Tualang during the 2025/2026 academic year. The population of this study consisted of tenth-grade students. The sample included class X7 as the experimental class with 34 students and class X8 as the control class with 33 students. Therefore, the total number of participants was 67 students. The sampling technique used was purposive sampling because the selected classes had similar characteristics based on the biology teacher's consideration.

The research instrument used in this study was a biodiversity concept understanding test administered in the form of a pretest and posttest. The test was designed based on the learning objectives and indicators of biodiversity concepts taught in the tenth-grade biology curriculum. Prior to its implementation, the instrument was validated by experts to ensure its content validity and suitability for measuring students' conceptual understanding. The pretest was administered before the learning intervention to determine students' initial knowledge, while the posttest was conducted after the completion of the learning activities to assess students' learning outcomes.

Data collected from the pretest and posttest were analyzed using descriptive and inferential statistical techniques. Descriptive statistics were used to describe students' learning outcomes, including minimum scores, maximum scores, mean scores, and N-Gain values. Inferential statistics were employed to test the research hypotheses. Before hypothesis testing, the data were subjected to prerequisite analyses, including normality and homogeneity tests. Subsequently, an independent samples t-test was conducted to determine whether there was a significant difference between the learning outcomes of students in the experimental and control classes. All statistical analyses were performed at a significance level of 0.05.

The research instruments included pretest and posttest questions to measure students' understanding of biodiversity concepts. In addition, observation sheets and student response questionnaires were used as supporting instruments. The pretest and posttest were administered before and after the learning activities.

The collected data were analyzed using descriptive statistical analysis with the help of Microsoft Excel and SPSS. The improvement of students' understanding was measured using the normalized gain score (N-Gain). Furthermore, normality and homogeneity tests were conducted before performing the independent sample t-test. The Kolmogorov-Smirnov test was used to determine data normality, while Levene's test was used to determine data homogeneity.

The independent sample t-test was applied to identify significant differences between the experimental and control classes.

3. RESULTS

This section presents the findings of the study related to students' understanding of biodiversity concepts after the implementation of environment-based Biology E-LKPD. The analysis focused on pretest and posttest scores, normality and homogeneity tests, and N-Gain analysis.

3.1 Pretest and Posttest Results

This section presents the descriptive statistical analysis of students' pretest and posttest scores in both the experimental and control classes. The results are presented in Table 1 below.

Table 1 Descriptive Statistics of Pretest and Posttest Scores

Class Scores	N	Results			Mean
		Ideal Score	Minimum Score	Maximum Score	
Pretest	Control	33	100	43.33	80.00
	Experimental	34	100	43.33	90.00
Posttest	Control	33	100	73.33	93.33
	Experimental	34	100	76.67	100.00

Table 1 shows the pretest and posttest scores of students in the control and experimental classes. Before the learning intervention, both groups had relatively similar initial abilities, with an ideal score of 100. The control class (N = 33) obtained pretest scores ranging from 43.33 to 80.00, while the experimental class (N = 34) obtained scores ranging from 43.33 to 90.00. After the learning process, students in both classes demonstrated improved achievement. The posttest scores in the control class ranged from 73.33 to 93.33, whereas those in the experimental class ranged from 76.67 to 100.00. The increase in both minimum and maximum scores from pretest to posttest indicates an improvement in students' understanding of biodiversity concepts. Moreover, the experimental class achieved a higher minimum score and reached the maximum possible score, suggesting that students who learned using the environment-based Biology E-LKPD performed better than those in the control class. These findings indicate that the implementation of environment-based Biology E-LKPD contributed positively to improving students' learning outcomes in biodiversity concepts.

3.2 Normality Test

The normality test was conducted using the Kolmogorov-Smirnov test to determine whether the data were normally distributed. The results are presented in Table 2 below.

Table 2 Results of Pretest and Posttest Normality Test

Data Type	Class	Normality Test Results			
		Asymp. Sig. (2-tailed)	α	Decision	Description

Pretest	Control	0.055	0.05	Accept H_0	Normal
	Experimental	0.131	0.05	Accept H_0	Normal
Posttest	Control	0.452	0.05	Accept H_0	Normal
	Experimental	0.135	0.05	Accept H_0	Normal

Table 2 presents the results of the normality test for the pretest and posttest data in both the control and experimental classes. The normality test showed that all significance values (Asymp. Sig. 2-tailed) were greater than the significance level of 0.05. For the pretest data, the control class obtained a significance value of 0.055, while the experimental class obtained a value of 0.131. Similarly, for the posttest data, the control class obtained a significance value of 0.452 and the experimental class obtained a value of 0.135. Since all significance values exceeded $\alpha = 0.05$, H_0 was accepted for all datasets, indicating that the data were normally distributed. Therefore, it can be concluded that both the pretest and posttest scores in the control and experimental classes met the assumption of normality, allowing further statistical analyses using parametric tests.

3.3 Homogeneity Test

The homogeneity test was conducted using Levene's test. The results are presented in Table 3 below.

Table 3 Results of the Pretest and Posttest Homogeneity Test

Data Type	Sig. (2-tailed)	α	Decision	Description
Pretest	0.521	0.05	Accept H_0	Homogeneous
Posttest	0.141	0.05	Accept H_0	Homogeneous

Table 3 presents the results of the homogeneity test for the pretest and posttest data of the control and experimental classes. The analysis showed that the significance value for the pretest data was 0.521, while the significance value for the posttest data was 0.141. Both values were greater than the significance level of $\alpha = 0.05$. Therefore, H_0 was accepted for both datasets, indicating that the variances of the control and experimental classes were homogeneous. These findings demonstrate that there was no significant difference in variance between the two groups for either the pretest or posttest scores. Since the assumption of homogeneity was fulfilled, the data were considered suitable for further analysis using parametric statistical tests, such as the independent samples t-test, to determine the effect of the environment-based Biology E-LKPD on students' understanding of biodiversity concepts.

3.4 Independent Sample t-Test

The independent sample t-test was conducted to determine whether there was a significant difference between the experimental and control classes. The results are presented in Table 4 below.

Table 4 T-Test Results of Pretest and Posttest Data

Data Type	Sig. (2-tailed)	α	Decision	Description
Pretest	0.087	0.05	Accept H_0	Not significantly different
Posttest	0.464	0.05	Reject H_0	Significantly different

Table 4 presents the results of the independent samples t-test conducted to determine whether there were significant differences between the control and experimental classes. The pretest analysis yielded a significance value (Sig. 2-tailed) of 0.087, which was greater than the significance level of $\alpha = 0.05$. Therefore, H_0 was accepted, indicating that there was no significant difference between the initial abilities of students in the control and experimental classes before the learning intervention. This finding suggests that both groups had comparable prior knowledge of biodiversity concepts.

For the posttest data, the significance value (Sig. 2-tailed) was 0.464, which was also greater than $\alpha = 0.05$. Consequently, H_0 was accepted, indicating that there was no statistically significant difference between the posttest scores of the control and experimental classes. These results suggest that although both groups showed improvement after the learning process, the difference in learning outcomes between students who learned using the environment-based Biology E-LKPD and those who received conventional instruction was not statistically significant at the 0.05 level.

3.5 N-Gain Analysis

The N-Gain analysis was conducted to determine the improvement in students' understanding of biodiversity concepts. The results are presented in Table 4 below.

Table 5 Statistik Deskriptif Data N-Gain pada kelas Kontrol dan Eksperimen

No.	Class	N	N-Gain			Mean	Category
			Ideal Score	Minimum Score	Maximum Score		
1	Control	33	1.00	0.11	0.80	0.45	Moderate
2	Experimental	34	1.00	0.10	1.00	0.44	Moderate

Table 5 presents the N-Gain analysis results for the control and experimental classes. The N-Gain analysis was conducted to measure the improvement in students' understanding of biodiversity concepts after the learning intervention. The control class, consisting of 33

students, obtained N-Gain scores ranging from 0.11 to 0.80, with a mean N-Gain score of 0.45, which falls into the moderate category. Meanwhile, the experimental class, consisting of 34 students, obtained N-Gain scores ranging from 0.10 to 1.00, with a mean N-Gain score of 0.44, which is also categorized as moderate. These findings indicate that both classes experienced a moderate improvement in their understanding of biodiversity concepts following the learning process. Although the experimental class achieved a higher maximum N-Gain score, reaching the ideal score of 1.00, the average N-Gain scores of the two classes were relatively similar.

Therefore, based on the N-Gain analysis, both the conventional learning approach and the use of environment-based Biology E-LKPD were effective in improving students' understanding of biodiversity concepts at a moderate level.

3.6 Results of N-Gain t-Test

Table 6 Results of the t-test on N-Gain data

Data Type	Sig. (2-tailed)	α	Decision	Description
N-Gain	0.464	0.05	Accept H_0	There is no significant difference

Table 6 presents the results of the independent samples t-test on the N-Gain scores of the control and experimental classes. The analysis yielded a significance value (Sig. 2-tailed) of 0.464, which is greater than the significance level of $\alpha = 0.05$. Therefore, H_0 was accepted, indicating that there was no significant difference in the improvement of students' understanding of biodiversity concepts between the control and experimental classes.

This result suggests that although both groups experienced learning gains after the instructional process, the increase in achievement was statistically comparable. The findings are consistent with the N-Gain analysis, which showed that both classes achieved moderate improvement, with mean N-Gain scores of 0.45 for the control class and 0.44 for the experimental class. Consequently, the use of environment-based Biology E-LKPD did not produce a significantly greater improvement in students' understanding of biodiversity concepts compared to the learning approach implemented in the control class. The Effect Of Using Environment-Based Biology E-Lkpd On The Understanding Of The Concept Of Biodiversity In Students Of State Senior High School 5 Tualang.

4. DISCUSSION

The findings of this study indicate that the use of environment-based Biology E-LKPD did not have a statistically significant effect on students' understanding of biodiversity concepts. This conclusion is supported by the results of the independent samples t-test, which showed that the posttest significance value was 0.464 ($p > 0.05$), indicating no significant difference between the experimental and control classes. Furthermore, the N-Gain t-test also produced a significance value of 0.464 ($p > 0.05$), confirming that the improvement in students' understanding of biodiversity concepts was statistically similar in both groups. Although the experimental class achieved a

higher maximum posttest score (100.00) than the control class (93.33), the overall learning gains were not significantly different.

The descriptive analysis revealed that students in both classes experienced improvements in their understanding of biodiversity concepts after the learning process. The experimental class showed an increase in posttest performance, while the control class also demonstrated substantial improvement. These findings indicate that both instructional approaches were effective in facilitating students' learning. The moderate N-Gain category achieved by both classes further suggests that students were able to enhance their conceptual understanding regardless of the learning media used. Therefore, the learning process itself played an important role in improving students' achievement.

The absence of significant differences between the two groups may be explained by the relatively similar learning conditions experienced by the students. Based on the pretest results, both classes had comparable initial abilities, as indicated by the insignificant pretest difference ($p = 0.087 > 0.05$). This finding demonstrates that the students started from a similar level of understanding before the treatment was administered. Consequently, the improvements observed in both classes may have been influenced more by the overall learning process than by the specific use of environment-based E-LKPD.

Despite the lack of statistical significance, the implementation of environment-based Biology E-LKPD provided several educational benefits. The E-LKPD encouraged students to actively participate in learning activities by engaging them in observing environmental phenomena related to biodiversity. Through contextual learning experiences, students were able to connect theoretical concepts with real-life situations in their surroundings. This finding is consistent with constructivist learning theory, which emphasizes that knowledge is more meaningful when learners actively construct their understanding through direct experiences and interactions with their environment.

The findings of this study are in line with the research conducted by Rafikayuni et al. (2020), who reported that environment-based E-LKPD developed from local environmental phenomena was valid, practical, and effective in supporting biology learning. Their study demonstrated that contextual learning materials could increase students' involvement in learning activities and help them relate biological concepts to real environmental conditions. Similarly, in the present study, students who used environment-based Biology E-LKPD were encouraged to observe biodiversity around them and connect their observations with the concepts being studied. Although the statistical results did not show significant differences, the improvement in students' posttest scores suggests that the E-LKPD contributed positively to the learning process.

Furthermore, the results are also supported by Magdalena et al. (2020), who found that multimedia-based E-LKPD improved students' motivation and conceptual understanding in biology learning. According to their findings, the integration of interactive digital features can enhance students' engagement and create more meaningful learning experiences. In the present study, the use of environment-based Biology E-LKPD similarly provided opportunities for students to learn through

interactive and contextual activities. However, unlike the findings reported by Magdalena et al. (2020), the improvement in conceptual understanding observed in this study was not significantly different from that achieved through conventional learning. This discrepancy may be related to differences in research settings, treatment duration, sample characteristics, and the implementation process.

Several factors may have contributed to the insignificant effect observed in this study. First, the duration of the treatment may have been insufficient for students to fully adapt to and benefit from the environment-based E-LKPD. Educational innovations often require extended implementation periods before measurable impacts on learning outcomes become evident. Second, students may have had varying levels of digital literacy and readiness to use electronic learning materials, which could influence the effectiveness of E-LKPD implementation. Third, external variables such as learning motivation, classroom atmosphere, teacher guidance, and students' study habits may have affected learning outcomes in both classes.

Another possible explanation is that the conventional learning approach used in the control class was still effective in delivering biodiversity concepts. The teacher's explanations, classroom discussions, and textbook-based activities may have provided sufficient support for students to understand the material. As a result, both groups achieved comparable learning gains, leading to the absence of statistically significant differences. This finding suggests that the quality of instruction and teacher facilitation remain crucial factors in determining learning success, regardless of the learning media employed.

From a pedagogical perspective, the findings imply that environment-based Biology E-LKPD should not be viewed merely as a digital replacement for conventional worksheets but as a complementary learning tool that requires appropriate instructional support. Teachers should integrate E-LKPD with collaborative learning activities, inquiry-based approaches, field observations, and reflective discussions to maximize its educational potential. Effective guidance and continuous feedback are also essential to ensure that students can fully engage with the learning materials and develop a deeper understanding of biodiversity concepts.

Overall, this study concludes that environment-based Biology E-LKPD contributed positively to the learning process and supported students' understanding of biodiversity concepts; however, its effect was not significantly different from that of conventional learning methods. The findings highlight the importance of instructional quality, student readiness, and implementation strategies in determining the effectiveness of digital learning media in biology education.

5. CONCLUSION

This study aimed to determine the effect of using environment-based Biology E-LKPD on students' understanding of biodiversity concepts at SMA Negeri 5 Tualang. Based on the findings, it can be concluded that the use of environment-based Biology E-LKPD did not significantly affect students' understanding of biodiversity concepts.

The results showed that both the experimental and control classes experienced moderate improvement in learning outcomes based on the N-Gain analysis. The independent sample t-test also indicated that there was no significant difference between the two classes.

Although the statistical results were not significant, environment-based Biology E-LKPD supported interactive and contextual learning activities. Students became more involved in observing and analyzing environmental phenomena related to biodiversity concepts.

Therefore, teachers are encouraged to integrate digital and contextual learning media appropriately to improve students' participation and engagement in biology learning. Future studies are recommended to involve larger samples and longer treatment durations to obtain more comprehensive findings regarding the effectiveness of environment-based E-LKPD.

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