

Development e-worksheet using PjBL on environmental pollution to enhance environmental literacy of tenth grade high school

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Abstract: The increasing environmental issues demand environmental literacy among the younger generation. 21st-century learning with PjBL-based worksheet can make the learning process more interactive, contextual, and focused on solving real-world problems. This research aims to: (1) produce an E-worksheet with the PjBL model on environmental pollution that is feasible as a learning model for 10th grade high school; (2) produce an E-worksheet with the PjBL model on environmental pollution that is practically for biological teachers and 10th grade high school; (3) produce an E-worksheet with the PjBL model on environmental pollution that is effective in improving environmental literacy for 10th grade high school. This research uses the R&D mode, specifically the 4D model. The research instruments included interview sheets, practitioner assessment questionnaires, material and media validation sheets, and multiple-choice and descriptive test sheets. Based on the data obtained: (1) The E-worksheet with the PjBL model on the topic of environmental pollution is valid according to material and media experts, scoring in the "very good" category; (2) The E-worksheet is practical based on teacher assessment and student responses with scores included in the "very good" category; (3) The research results indicate that the N-gain for cognitive domain environmental literacy is ($\langle g \rangle = 0.43$) and for the affective domain is ($\langle g \rangle = 0.63$), which are categorized as moderate. Based on this, it can be concluded that the Electronic Worksheets (E-worksheet) with the PjBL model is feasible and practical and can enhance the environmental literacy of class X SMA students.

Keywords: electronic worksheet; environmental literacy; PjBL model

1. Introduction

All countries around the world, including Indonesia, are facing environmental issues. The main environmental problems in Indonesia include deforestation, water pollution, air pollution, waste, and others. Human activities can cause these issues. If conducted intensively, human activities, whether intentionally or unintentionally, can worsen environmental conditions. Environmental degradation can lead to ecological crises, loss of natural resources, climate change, and environmental pollution (Ramadhan *et al.*, 2019).

Environmental problems are closely related to environmental literacy. According to Yadav *et al.* (2022), low-quality education, awareness, knowledge, and community approaches to the environment contribute to declining environmental quality and natural resources. Wardani *et al.* (2018), state that students environmental literacy (especially in knowledge aspects) still needs to improve on pollution and environmental change factors. This indicates that students environmental literacy is only low on specific learning topics, particularly those seen in real life. Furthermore, Veisi *et al.* (2019), explain that inappropriate teaching methods can reduce students environmental literacy levels.

Educational institutions are implementing 21st-century learning, including collaboration, communication, literacy, citizenship, problem-solving, critical thinking, creativity, and product creation (Van Laar *et al.*, 2017). According to Wardani (2022), 21st-century learning requires students to possess skills needed in the present and future, namely 4C skills. The 4C skills are critical thinking, problem-solving, communication, collaboration, creativity, and innovation (Wulandari, 2021). Therefore, educational institutions must improve the quality of their teaching implementations, such as teaching modules, learning media, student worksheets, and assessment instruments, to achieve 21st-century skills (Siregar *et al.*, 2023).

Student Worksheets (worksheet) are one innovative learning tool that can enhance learning quality. Worksheet can be developed through learning activities designed according to the Merdeka curriculum, which focuses on developing soft skills (Salym *et al.*, 2022). Some soft skills developed include collaborative abilities, communication skills, and critical and creative thinking skills. The Project-Based Learning (PjBL) model is one teaching model that can be used to develop these soft skills.

Project-based Learning (PjBL) is a teaching model that aims to help students acquire knowledge and skills by working over a certain period to investigate and respond to authentic and complex problems or challenges (Sudjimat, 2020). Learning using the PjBL model requires considerable time, making it essential to have teaching tools, in this case, Student Worksheets (worksheet). Worksheet aims to assist and facilitate teaching and learning activities, fostering effective interaction between students and educators (Umbaryati, 2016). Research by Prabowo *et al.* (2021), indicates that students often become passive when completing tasks assigned by teachers. They show little enthusiasm for creating worksheet, resulting in many students failing to finish their tasks. Therefore, there is a need to modify worksheet to address these issues by transforming it into electronic or online worksheet. Based on this exposition, it is necessary to develop electronic worksheet using the PjBL model on environmental pollution material to enhance environmental literacy of grade X high school students.

2. Materials and Methods

2.1. Research model

This development study uses the Research and Development (R&D) model 4D by Thiagarajan, (1976). The 4D model consists of four stages: define, design, development, and dissemination (Sugiyono, 2018).

2.2 Population and Sample

The population in this study consists of all 10th-grade students at State Senior High School 2 Banguntapan. The sample selection uses random sampling techniques, meaning sample members are selected randomly from the population. The aim is to ensure that every individual in the population has an equal chance of being chosen as a sample (Sugiyono, 2018). The sample for this research is the students of class X.5 Phase E.

2.3 Instrument

The research instruments include validation tools consisting of material and media expert validation, practicality validation by biology teachers, and student response instruments. The environmental literacy instruments for the cognitive domain use objective multiple-choice tests, while the affective domain employs questionnaires with a Likert scale (Anggraini & Nazip, 2022).

2.4 Procedure

The electronic Worksheets (E-worksheet) development process using the PjBL model has four stages: define, design, development, and disseminate. Figure 1 illustrates the research development procedure following the 4D model.

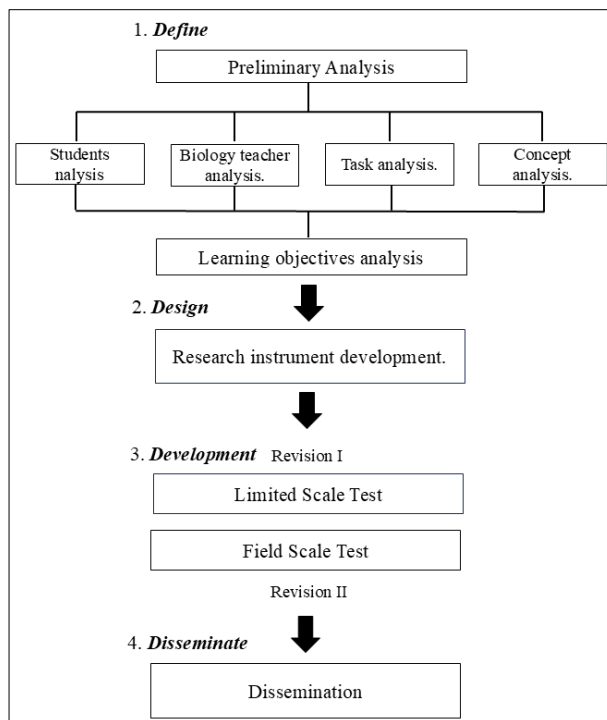


Figure 1. Research and Development Flow Diagram of the 4D Model. (Source: Pangabea et al., 2023).

The define stage involves preliminary analysis (of students, tasks, concepts, and learning objectives). The design stage includes creating the learning device (Electronic worksheet) and assessment instruments such as feasibility, practicality, student feedback sheets, environmental literacy tests, and validation by expert judgment. The development stage consists of product testing in two phases: small-scale and large-scale trials. The disseminate stage refers to the diffusion of the developed worksheet to be adopted and used in the learning process.

2.5 Data Analysis Techniques

The data analysis technique involves both qualitative and quantitative analysis. Qualitative data includes suggestions and comments from experts, practitioners, and students regarding the developed product. The results of this analysis are presented descriptively and used for revision purposes. Meanwhile, quantitative data consists of expert, practitioner, and student assessment scores. This quantitative data is analyzed to determine the developed product's feasibility, practicality, validity, and effectiveness.

2.6 Analysis of Expert Validation

Expert validation analysis consists of validation from content and media experts, product practicality, and student responses. It is conducted quantitatively by analyzing the evaluation scores from experts. Each statement item is rated on a scale of 1-4 (4-point scale). The analysis results are interpreted based on the assessment system and criteria outlined in Table 1.

Table 1. Score interpretation and criteria

Score Range	Criteria
$M_i + 1.5 SD_i \leq \bar{M} \leq M_i + 3,0 SD_i$	Excellent
$M_i + 0 SD_i \leq \bar{M} < M_i + 1,5 SD_i$	Good
$M_i - 1.5 SD_i \leq \bar{M} < M_i + 0 SD_i$	Poor
$M_i - 3 SD_i \leq \bar{M} < M_i - 1,5 SD_i$	Very Poor

(Source: [Muslich, 2014](#))

2.7 Empirical Validity Analysis

Empirical validity consists of testing the validity and reliability of the environmental literacy instrument. The validity analysis is conducted using SPSS Ver. 27. The instrument is valid if the significance value is <0.05. Next, the reliability test is performed using Cronbach's alpha. The Cronbach's alpha scale, with the help of SPSS Ver. 27, is presented in [Table 2](#).

Table 2. Interpretation of scores and criteria

No	Reliability Score (R)	Reliability Interpretation
1	0.81 < rll 1,00	Very High Reliability
2	0.61 < rll 0.80	High Reliability
3	0.41 < rll 0.60	Mediun Reliability
4	0.21 < rll 0.40	Low Reliability
5	0.00 < rll 0.21	Very Low Reliability

(Source: [Malik, 2018](#)).

2.8 Analysis of the Improvement in Environmental Literacy Learning Outcomes

The improvement of environmental literacy is analyzed using the N-Gain score. The N-Gain score illustrates the improvement in students environmental literacy after the learning process using electronic worksheet with the PjBL model. The calculation of the N-Gain score is based on [Formula 1](#). The N-Gain score for environmental literacy is then converted into qualitative categories according to the guidelines for determining quantitative categories in [Table 3](#).

$$g = \frac{\text{Skor posttest} - \text{skor pretest}}{\text{Skor maksimum} - \text{skor pretest}} \tag{1}$$

(Source: [Sukarelawan et al., 2024](#)).

Table 3. N-Gain score category

No	N-Gain Score range	Category
1	(g) ≥ 0.7	High
2	0.7 > (g) ≥ 0.3	Medium
3	(g) > 0.3	Low

(Source: [Sukarelawan et al., 2024](#))

3. Results

3.1 Define

a. Analysis of Teachers and Students

The preliminary analysis results indicate that students face difficulties in understanding the topic of environmental pollution. These challenges include using foreign vocabulary or terms related to pollution and difficulties understanding the types of pollutants. Additionally, students mentioned that environmental issues were not addressed while using the worksheet during biology lessons.

State Senior High School 2 Banguntapan has adequate Wi-Fi facilities in every classroom, but biology lessons have not utilized this internet access. Teachers have not used smartphones as media or teaching materials, assuming that using smartphones in class could enhance the learning experience.

b. Analysis of Tasks and Concepts

The analysis of tasks and concepts consists of analyzing the curriculum and learning objectives related to learning activities. The results of the task analysis are presented in [Table 4](#).

Table 4. Results of Curriculum Analysis

No	Analysis	Results
1	Learning Objectives	Students can be responsive to global issues and actively participate in problem-solving. These abilities include observing, questioning, and predicting; planning and conducting research; processing and analyzing data and information; evaluating and reflecting; and communicating through simple projects related to alternative environmental pollution and using waste and natural materials. These efforts are directed toward achieving sustainable development goals. Scientific attitudes and Pancasila student profiles are also developed through process skills
2	Learning Goals	<ul style="list-style-type: none"> a. Students can accurately express types of waste and their environmental impact through discussion. b. Students can analyze efforts to address environmental pollution. c. Students can create a simple composting tool that is beneficial for life accurately.
3	Learning Materials	<ul style="list-style-type: none"> a. Concepts of environmental pollution b. Causes of environmental pollution c. Definition of waste and types of waste d. Impacts of environmental pollution e. Efforts to address environmental pollution f. Waste processing

3.2 Design

The design stage involves creating the Electronic worksheet product and developing assessment instruments. The initial product includes a preface, a menu displaying learning instructions, learning objectives, concept maps, learning materials, learning activities, learning evaluations, developer profiles, and a bibliography.

The assessment by material experts covers several aspects, namely material suitability, material accuracy, didactic aspects, construction, and technical aspects. The results indicate that the material of the Electronic worksheet using the PjBL model falls into the "Very Good" category. The feasibility results of the product assessed by material experts are presented in [Table 5](#).

Table 5. Product Feasibility Results by Material Experts

No	Aspects	Score	Category
1	Material Suitability	16	Very Good
2	Material Accuracy	19	Very Good
3	Didactics	15	Very Good
4	Construction	38	Very Good
5	Technical	20	Very Good

The media experts assessment includes aspects of software engineering, visual communication, display quality, language, ease of operation, and illustration quality. Based on the media expert assessment results, the Electronic WORKSHEET developed using the PjBL model falls into the "Very Good" category. The feasibility results of the product assessed by the experts are presented in [Table 6](#).

Practitioner assessments include content quality, media, and language. Based on the practicality assessment results by biology teachers, the developed Electronic WORKSHEET falls into the "Very Good" category. The practicality results of the product by Biology Teachers are presented in [Table 7](#).

Table 6. Product Feasibility Results by Media Experts

No	Aspects	Score	Category
1	Software Engineering	15	Very Good
2	Visual Communication	19	Very Good
3	Display Quality	19	Very Good
4	Language	16	Very Good
5	Ease of Operation	11	Very Good
6	Illustration Quality (Articles, images, and videos)	8	Very Good
7	Ease of Use	4	Very Good

Table 7. Results of Practicality Assessment by Biology Teachers

Aspects	Indicator	Score	Category
Content Quality	Suitability of the material	24	Very Good
	Suitability of the material with environmental literacy indicators	12	Very Good
	Suitability of the material with creative thinking indicators	12	Very Good
Media	Suitability with the steps of the PjBL model	54	Very Good
Language	Suitability with the rules of the Indonesian language	12	Very Good
	Use of appropriate sentences	19	Very Good

The validity and reliability test of the environmental literacy instrument aims to determine the suitability of the questions that will be trialed in field testing, which can be used as pre-test and post-test questions. The results of the validity and reliability test of the environmental literacy instrument are presented in Tables 8, 9 and 10.

Table 8. Validity of the Environmental Literacy Instrument in the Competency Domain

Question No	Pearson correlation	Sig. Score	Conclusion	Interpretation
1	0.717	0.003	Valid	Very High
2	0.571	0.026	Valid	Average
3	0.571	0.026	Valid	Average
4	0.881	<0.001	Valid	Very High
5	0.708	0.003	Valid	High
6	0.619	0.014	Valid	High
7	0.579	0.024	Valid	Average
8	0.503	0.056	Tidak Valid	-
9	0.885	<0.001	Valid	Very High
10	0.630	0.012	Valid	High

Table 9. Validity of the Environmental Literacy Instrument in the Affective Domain

Question Number	Pearson correlation	Sig. Score	Conclusion	Interpretation
1	0.836	<0.001	Valid	Very High
2	0.672	0.006	Valid	High
3	0.566	0.028	Valid	Average
4	0.568	0.027	Valid	Average
5	0.625	0.013	Valid	High
6	0.709	0.003	Valid	High
7	0.533	0.041	Valid	Average
8	0.592	0.020	Valid	Average
9	0.606	0.017	Valid	High
10	0.517	0.049	Valid	Average

Table 10. Results of Instrument Reliability Test

Results of Instrument Reliability Test		
Instrument	Crobach's alpha score	Category
Environmental Literacy (Multiple Choice)	0.752	High Reliability
Environmental Care Attitude Questionnaire	0.801	High Reliability

The environmental literacy test's reliability scores for the competence and affective domains fall into the high-reliability category, concluding that the overall instruments are reliable and can be used in field testing.

The instruments deemed suitable by material and media experts were then revised according to the suggestions and comments provided. Revisions were made to aspects of the teaching device instruments assessed as not meeting the criteria. The critiques and suggestions material and media experts give regarding evaluating the Electronic WORKSHEET are presented in Tables 11 and 12.

Table 11. Critiques and suggestions for improvement from material experts

No	Aspects	Correction
1	Content Accuracy	-Improve the concepts of environmental pollution and pollution management -Provide examples for each type of waste -Improve the concept of composting in relation to soil -Add examples of metabolic reactions in primary decomposer microorganisms
2	Construction	- Mention the project name being worked on by the students - Improve the use of conjunctions - Improve the triggering questions in the teaching module - Correct typos throughout the material and teaching module.

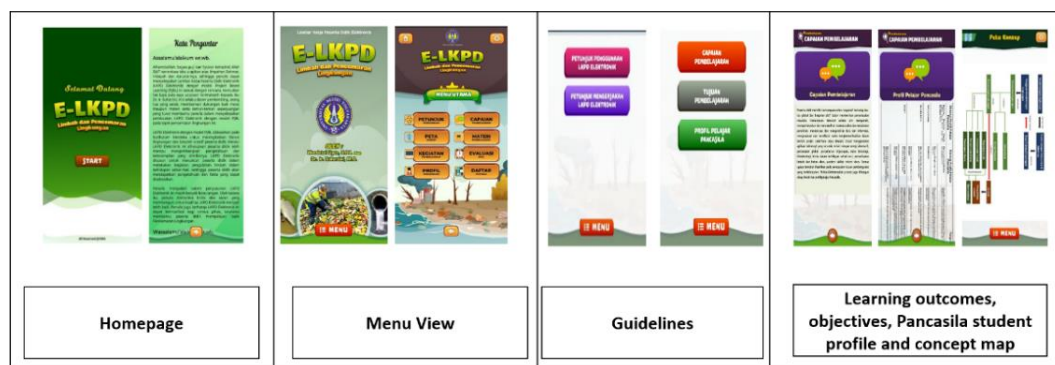
Table 12. Critiques and suggestions for improvement from media experts

No	Aspects	Correction
1	Software Engineering	- Add descriptions of the PjBL syntax for each learning activity in the Electronic worksheet
2	Visual Communication	- Include the Pancasila Student Profile in the Electronic worksheet
3	Ease of Operation	- Improve the application that runs slowly when opened

3.3 Development

3.3.1 Electronic worksheet Product

The development stage results are an Electronic worksheet using the PjBL model for environmental pollution, available in .exe, .apk, and .rar formats. The results of the Electronic worksheet are presented in Figure 2.



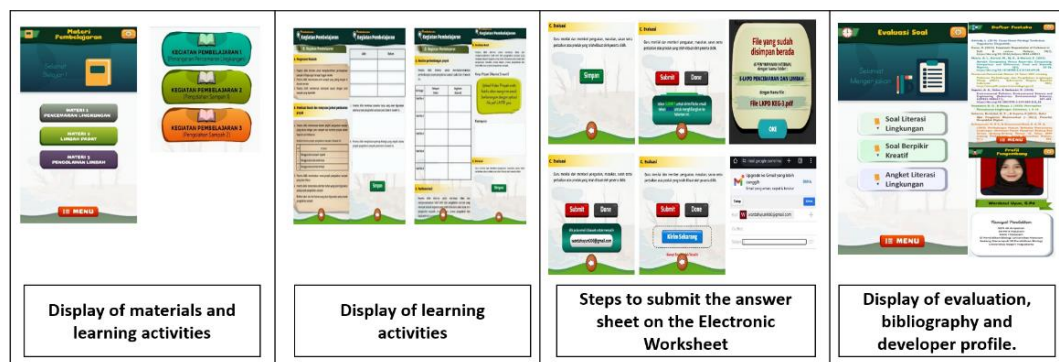


Figure 2. Electronic worksheet

3.3.2 Field test

Field testing includes pre-test and post-test activities, as well as the collection of feedback from students. The scores for the pre-test and post-test during learning using the Electronic worksheet are presented in Table 13.

Table 13. Pre-test and post-test scores and N-Gain score

Environmental Literacy Domain		Average	N-Gain	Category
Competence	Pre-test	61.21	0.43	Moderate
	Post-test	77.88		
Affective	Pre-test	74.47	0.63	Moderate
	Post-test	90.45		

The feedback results from students were obtained from those who engaged in learning using the Electronic worksheet in the experimental class. Table 14 presents the students feedback results. Students feedback indicates that the Electronic worksheet using the PjBL model is highly effective, making it practical as a learning tool on the topic of environmental pollution.

Table 14. Student Feedback Results

No	Aspects	Score	Category
1	Presentation	19	Very Good
2	Language	7,6	Very Good
3	Visual Communication	15,3	Very Good
4	Usefulness	14,6	Very Good

3.4 Disseminate

The dissemination stage refers to the distribution of the product. The Electronic worksheet using the PjBL model on environmental pollution was disseminated through publications in scientific journals. The final product of the development is the Electronic worksheet Application, which has been implemented at State Senior High School 2 Banguntapan. The product distribution was done by emailing the application download link.

4. Discussion

The development of Electronic Student Worksheets (E-worksheet) using the PjBL (Project-Based Learning) model on environmental pollution aims to improve the environmental literacy of 10th-grade high school students. The development of the Electronic worksheet follows the 4D model (define, design, develop, and disseminate). Based on the feasibility test results from media and material expert assessments, the Electronic worksheet using the PjBL model falls into the feasible category. The instrument used for the material evaluation of the product was a questionnaire consisting of several

aspects. The material evaluation included five aspects, while the media evaluation included seven aspects.

Based on the assessment of material and media feasibility, the electronic worksheet (Student Worksheet) product being developed falls into the "very good" or "valid" category. Similar results were reported by [Ningtyas et al. \(2023\)](#), stating that the developed Electronic worksheet is categorized as "valid" with an average score of 3.69. However, some improvements are still needed for the developed worksheet, particularly regarding material accuracy and construction aspects.

Learning materials are a crucial component of the product being developed. Material feasibility includes learning content that aligns with the lesson plan, uses language following linguistic rules to be easily understood, and is presented in a way that does not burden learners and teachers ([Masrifah et al., 2023](#)). The improvements in material accuracy involve correcting concepts related to environmental pollution, composting, and types of waste, along with examples. According to [Damayanti et al. \(2020\)](#), the accuracy of material in the form of concepts in the worksheet must be precise and easy to learn. If project activities are involved, they must align with the contextual nature, particularly in connecting the material to its role in everyday life. The concept of environmental pollution in this electronic worksheet focuses on waste management, especially solid waste in the form of organic waste. The treatment of organic waste in compost is presented as an effort to prevent environmental pollution. As noted by [Hassan et al. \(2023\)](#), composting is an excellent way to help reduce the impact of climate change, indirectly reducing environmental pollution. Additionally, improvements in the construction aspect include adding the project name to the worksheet and correcting typos throughout the material.

Based on the media feasibility assessment, some improvements are necessary, such as incorporating the Pancasila Student Profile. According to [Pratiwi & Luh Indrayani \(2023\)](#), the Merdeka Curriculum requires teaching tools that can be used to implement the dimensions of the Pancasila Profile, making it necessary to include these dimensions in every teaching tool to support learning activities aligned with curriculum objectives. The dimensions of the Pancasila Student Profile added to this Electronic worksheet product are the dimensions of faith, piety to God Almighty and noble character, the dimension of cooperation, critical reasoning, and creativity. Applying these Pancasila Student Profile dimensions in the learning media makes the product more relevant to the educational goals being pursued. [Suhardi \(2022\)](#), noted that including the Pancasila profile in learning strengthens character and develops competencies as active global citizens. Students can actively and sustainably participate in planning learning, develop the necessary skills, attitudes, and knowledge for project completion within a specific period, practice problem-solving skills in various learning situations, take responsibility and care for issues around them, and appreciate the learning process while being proud of the outcomes they have achieved optimally.

According to [Saputra & Kuntjoro., \(2019\)](#), the purpose of practicality assessment is to determine the ease of use of the developed worksheet (Electronic Student Worksheets) in the learning process. During the research, practicality assessments were obtained from teachers and students. Teacher's practicality assessments were measured using a Likert scale questionnaire (scale of 1-4) and an evaluation system referenced from [Muslich \(2014\)](#). The research results show that the Electronic worksheet is rated as "very good" according to teacher evaluations and student responses. It aligns with research by [Alyspa et al., \(2021\)](#), which also found that worksheet is practical based on teacher assessments and student responses.

The teacher's practicality assessment is based on three main aspects: content quality, media, and language. The content quality aspect evaluates the alignment of the material presented in the Electronic worksheet with the Independent Curriculum, learning objectives, learning indicators, the Project-Based Learning (PjBL) model, and environmental literacy. The media aspect evaluates the alignment of the media design

with the PjBL model. The Electronic worksheet contains six steps that align with the PjBL syntax in student activities, including problem introduction, design creation, scheduling, project progress monitoring, result assessment, and evaluation. Meanwhile, the language aspect evaluates language that adheres to Indonesian language norms and uses appropriate sentences. Referring to [Wahyudi & Hisbullah, \(2019\)](#), it is stated that worksheet should have good and correct language order, a clear structure with appropriate levels of difficulty and clarity, making it understandable for students. Additionally, language that follows Indonesian language norms supports effective communication in the learning process. Research results indicate that the practicality of the Electronic worksheet using the PjBL model, as assessed by biology teachers, falls into the "very good" category. This practicality assessment, obtained from the questionnaire, illustrates that the Electronic worksheet with the PjBL model can be accepted and practically implemented in classroom learning contexts.

The practicality assessment by students uses four aspects: presentation, language, visual communication, and usefulness. The presentation aspect assesses the way objectives and material are presented attractively in the Electronic worksheet. The presentation should be displayed in an engaging and easy-to-understand manner. Sequential presentation makes it easier for students to learn and encourages them to think systematically. In contrast, unstructured presentation of learning materials can hinder learning and confuse students as they try to construct knowledge ([Supardi, 2020](#)). The language aspect in student responses evaluates the clarity and appropriateness of the language used in the Electronic worksheet. According to [Anggraini & Ardi., \(2022\)](#), media is considered practical if teachers or other parties find the content easy to understand. If the objectives and materials are presented attractively, students will be more motivated to engage in learning activities. Language that is overly complex or ambiguous can make it difficult for students to understand the learning content in the worksheet, whereas clear language helps students comprehend the material and instructions, making learning more effective.

The next aspect is visual communication. According to [Simon et al., \(2022\)](#), visual communication assessment aims to observe responses when someone views images, people, objects, or spaces and to see how students combine their experiences and knowledge in responding. In this study, visual communication assessment includes background color, font type, image clarity, and video clarity presented in the electronic worksheet. The usefulness aspect evaluates how the worksheet supports learning and benefits students in understanding the material. In this case, usefulness is related to how the use of electronic worksheet makes learning activities more engaging, less monotonous, and more flexible. The advantage of the Electronic worksheet is that it facilitates students in completing the answer sheet. Through the PjBL model Electronic worksheet, students can save their answer files in PDF format, so they do not need to write answers on paper. It also makes it easier for teachers to correct students work. Research results show that student responses to the Electronic worksheet with the PjBL model fall into the "very good" or practical category. This indicates that student responses to the PjBL model Electronic worksheet demonstrate not only practicality but also the ability to create an engaging and flexible learning experience.

The results of this study show that the affective domain score (90.45) is higher than the competence domain score (77,88). This may be influenced by the impact of the Adiwiyata school program. According to [Pratama et al., \(2020\)](#), students environmental care attitudes can be developed through the Adiwiyata program. Through the Adiwiyata program, schools create a learning environment that encourages students to actively participate in environmental conservation activities, such as recycling programs, tree planting, and waste management. Students direct involvement in these activities can foster attitudes of care and commitment to environmental preservation ([Gani., 2022](#)). In addition, through the implemented PjBL (Project-Based Learning) model, students not

only gain knowledge but also develop awareness and responsibility toward the environment. It aligns with research by [Risnani et al., \(2017\)](#) and [Perrault & Albert., \(2018\)](#), which found that students have a much more positive environmental attitude after completing projects in PjBL-based learning. Another factor contributing to the higher affective domain score is the age of the students. According to [Safitri et al., \(2020\)](#), environmental care attitudes in students can grow through habitual practices. Children's environmental attitudes strengthen from the age of 7 to 10, increase again at age 14, and then decline until age 18. The development of environmental attitudes at age 18 continues to increase and remains stable over time ([Otto et al., 2019](#)). Based on this explanation, it can be seen that the PjBL model in worksheet (Electronic Student Worksheets) not only enhances competency skills but also strengthens students attitudes and actions in preserving the environment.

According to the N-Gain score results, there was an increase in students environmental literacy by 0.43 in the competence domain and 0.63 in the affective domain, both falling into the moderate category. This is consistent with the findings of [Setiawan et al., \(2021\)](#), where an N-Gain score of 0.54 was achieved through the PjBL model, which is also classified as moderate. Thus, the PjBL-based Electronic worksheet on the topic of environmental pollution effectively enhances environmental literacy among 10th-grade high school students.

5. Conclusion

Based on the results and discussion, it can be concluded that the Electronic Student Worksheets with the Project-Based Learning (PjBL) model on the topic of environmental pollution for 10th-grade high school students are feasible and practical to use as teaching materials, according to assessments by subject matter and media experts, as well as practitioners (teachers and students). Additionally, the Electronic worksheet with the PjBL model on environmental pollution has proven to improve environmental literacy. This is evidenced by the post-test scores being higher than the pre-test and an N-Gain increase classified as moderate

Authors Contribution: Wardatul Uyun.: draft preparation, methodology, data analysis, writing original, editing; and Suhartini: methodology, review and approval.

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