

## Development of Worksheet Based on The Local Wisdom of Samaturu for The Environmental Pollution Module In SMA Negeri 1 Mowewe

Ulmayani Ulmayani(\*), A. S. Alonemarera, Saparuddin Saparuddin

Biology Education Study Program, Faculty of Teacher Training and Education,  
Sembilanbelas November Kolaka University  
Jl. Pemuda No. 339, Tahoa, Kolaka, Southeast Sulawesi, 93561, Indonesia

\*Corresponding author: [ulmayani2005@gmail.com](mailto:ulmayani2005@gmail.com)

Submitted February 08<sup>th</sup> 2026, and Accepted May 21<sup>th</sup> 2026


### Abstract

**Background:** Learning in the Merdeka Curriculum emphasizes the integration of local wisdom to create more contextual learning experiences. However, environmental pollution topics are still often taught theoretically, resulting in students having limited understanding of their practical application and low environmental awareness. Observations and questionnaire results at SMA Negeri 1 Mowewe Senior High School revealed that 90.6% of students needed learning materials that could foster environmental awareness. Therefore, a Student Worksheet based on the local wisdom values of Samaturu was developed. **Methodology:** This study employed a Research and Development (R&D) approach using the ADDIE model. Data were collected through interviews, student needs questionnaires, expert validation, and teacher and student response questionnaires. The effectiveness of the Student Worksheet was evaluated using a one-group pretest-posttest design by measuring students' Samaturu attitudes based on the indicators of cooperation, mutual assistance, responsibility, and participation. **Findings:** The developed Student Worksheet obtained a validity index of 82.72%, which was categorized as highly valid according to the validity criteria used in this study. Its practicality level reached 91.46%, which was categorized as highly practical based on the practicality criteria applied. Descriptive analysis showed that the average students' Samaturu attitude score increased from 42.48 to 88.31 after the implementation of the Student Worksheet. Furthermore, the Wilcoxon Signed-Rank Test yielded a significance value of 0.000 ( $< 0.05$ ), indicating that the Samaturu local wisdom-based Student Worksheet was effective in improving students' Samaturu attitudes in environmental pollution learning. **Contribution:** The Samaturu local wisdom-based Student Worksheet is feasible for use as a contextual teaching material in biology learning. The integration of Samaturu values into learning activities contributes to fostering students' cooperation, environmental awareness, and responsibility toward the environment.

**Keywords:** Attitude Assessment; Environmental Pollution; Local Wisdom; Student Worksheet; Samaturu Value



Jurnal Pembelajaran dan Biologi Nukleus (JPBN) by LPPM Universitas Labuhanbatu is under a Creative Commons Attribution-ShareAlike 4.0 International License (CC BY - SA 4.0)

 <https://doi.org/10.36987/jpbn.v12i2.9366>

## INTRODUCTION

Environmental pollution is one of the global issues that threatens the health, safety, and sustainability of living organisms. This problem continues to increase along with population growth and advancements in science and technology, which have led to intensified industrial activities and the generation of various types of waste that potentially pollute the environment (Sompotan & Sinaga, 2022; Sutrisno & Salirawati, 2016). Therefore, efforts are needed to foster environmental awareness and responsibility from an early age through education. In line with this, the Merdeka Curriculum provides opportunities for educational institutions to develop contextual and flexible learning that aligns with students' characteristics through the integration of the surrounding environment and local wisdom (Sarmadan et al., 2024).

Contextual learning cannot be separated from the utilization of local wisdom as a source of values and learning experiences. One of the local wisdom traditions of the Tolaki community is Kalosara, which functions as a moral guideline, a behavioral control mechanism, and a means of maintaining social harmony. The values embodied in Kalosara promote order, balance, and responsibility toward both the social and natural environment (Rispan & Sudrajat, 2019).

One of the core values contained in Kalosara is Samaturu, which reflects the spirit of mutual cooperation, social solidarity, and collective responsibility in addressing shared challenges. Unlike the general concept of cooperation, Samaturu emphasizes not only collaborative task completion but also social solidarity, collective concern, and shared responsibility rooted in the culture of the Tolaki community. These characteristics distinguish Samaturu from common collaborative approaches that primarily focus on achieving group objectives (Amiruddin et al., 2017; Ramly et al., 2023).

In the educational context, the value of Samaturu is relevant for integration into learning activities to strengthen character education, foster collaborative attitudes, and build students' social and environmental awareness. By linking scientific concepts with values that are deeply embedded in society, learning is directed not only toward conceptual mastery but also toward developing responsibility, cooperation, and concern for environmental issues among students (Saputri et al., 2020; Saudi & Nurkarima, 2024).

The value of Samaturu in learning can be reflected through cooperation, mutual assistance, responsibility, active participation, and concern for both the environment and others. Students' active involvement and sense of responsibility in preserving the environment are essential in addressing increasingly complex environmental issues. Active participation is demonstrated through students' engagement in environmental conservation activities, while responsibility is reflected in their awareness of preventing environmental damage and using natural resources wisely. Low levels of these attitudes may further aggravate environmental problems. Therefore, strengthening Samaturu attitudes as manifestations of cooperation, active participation, and responsibility represents a strategic effort to support sustainable environmental conservation. Milandi et al., (2025) Environmental education that encourages active participation and environmental concern can help shape a generation that is more responsible in preserving the environment.

Environmental pollution is a topic that is highly relevant to students' daily lives. Various forms of pollution, including household waste, waterway contamination, vehicle emissions, and environmental conditions in residential areas, can be directly

observed around the school environment. However, the limited implementation of investigative activities and empirical experiences contributes to students' inadequate understanding of the sources, impacts, and mitigation efforts related to environmental pollution (Salsabilla et al., 2025).

These conditions indicate the need for more contextual and interactive learning materials. One type of instructional material that can be utilized is a Student Worksheet. A Student Worksheet is a printed learning material systematically designed to guide students through learning activities by providing instructions, concise content, and activities that encourage active engagement. The use of Student Worksheets can enhance conceptual understanding, develop thinking skills, and create more meaningful learning experiences that are relevant to students' real-life contexts (Cahyani et al., 2023; Arda et al., 2021).

Based on interviews conducted with the tenth-grade Biology teacher at SMA Negeri 1 Mowewe Senior High School, it was found that environmental pollution learning had been implemented interactively through the use of various instructional media and Student Worksheets, which were considered helpful in supporting learning effectiveness. Nevertheless, several challenges remained, including students' difficulties in applying concepts to real-life situations, low interest in and concern for environmental issues, learning materials that tended to be theoretical and insufficiently contextualized, and limited facilities for practical and observational activities. The teacher also stated that learning activities had occasionally incorporated local wisdom, including Kalosara, but such integration had not been systematically embedded in Student Worksheets. In fact, connecting learning materials with local culture and everyday life is considered to have the potential to enhance students' motivation, participation, and learning relevance. Therefore, the development of a Samaturu local wisdom-based Student Worksheet is considered important, not because instructional materials are unavailable, but because existing materials have not fully facilitated contextual, meaningful learning that aligns with students' socio-cultural characteristics.

In addition to teacher interviews, a needs analysis questionnaire was administered to 40 tenth-grade students at SMA Negeri 1 Mowewe Senior High School. The results indicated that most students experienced difficulties in understanding environmental pollution concepts when learning relied solely on textbooks and available instructional materials. Students also perceived that Biology learning had not been sufficiently connected to their surrounding environment. On the other hand, the majority expressed a need for learning materials that include examples of environmental issues occurring in their local area and showed interest in learning activities integrated with the local wisdom value of Samaturu. Specifically, 90.6% of students agreed or strongly agreed that they needed instructional materials capable of fostering environmental awareness and strengthening Samaturu attitudes, including cooperation, mutual assistance, responsibility, and active participation. These findings suggest that the development of a Samaturu local wisdom-based Student Worksheet is necessary not only to support cognitive understanding but also to strengthen ecological awareness and cultivate students' environmental responsibility and Samaturu attitudes.

Based on the above description, although Student Worksheets have been utilized in Biology learning, no Student Worksheet has been specifically developed to integrate the local wisdom value of Samaturu into environmental pollution learning. Therefore, this study aims to develop a Samaturu local wisdom-based Student Worksheet that is

valid, practical, and effective in improving students' Samaturu attitudes in environmental pollution learning.

## **METHOD**

The study was conducted at SMA Negeri 1 Mowewe Senior High School between April and May 2026. This research adopted a Research and Development (R&D) approach utilizing the ADDIE development model. The model comprises five stages: Analysis, Design, Development, Implementation, and Evaluation (Sabdarini et al., 2021). The ADDIE model was chosen because it offers a systematic process for developing instructional materials and has been widely used to produce learning resources that effectively meet educational needs (Widyastuti & Susiana, 2019; Fadhila et al., 2022).

### **Participants**

In this study, participants were selected using purposive sampling, in which research subjects were intentionally chosen based on specific criteria, including a Biology teacher actively involved in the teaching process and students who had studied environmental pollution topics. At the initial stage, a needs analysis was conducted through teacher interviews and student needs questionnaires to identify the necessity for a Samaturu local wisdom-based Student Worksheet. Data on the practicality of the developed learning material were collected through response questionnaires administered to both the teacher and students.

The study involved one Biology teacher and 54 tenth-grade students of SMA Negeri 1 Mowewe Senior High School in the 2025/2026 academic year. Student participants were selected proportionally from four tenth-grade classes, consisting of 13 students from each of two classes and 14 students from each of the other two classes. The participants were involved to obtain practicality data regarding the use of the developed Student Worksheet and to evaluate its effectiveness in improving students' attitudes during the learning process.

### **Instruments**

This study employed three types of research instruments to assess the validity, practicality, and effectiveness of the developed Student Worksheet. The validity assessment instrument consisted of 16 statements covering three main aspects: media validity, content validity, and language validity. Media validity was evaluated based on the appropriateness of the layout, visual quality, alignment of the design with learning objectives, and presentation attractiveness. Content validity was assessed in terms of the accuracy and relevance of the material to the curriculum, the depth of the concepts presented, the accuracy of data and examples, and their relevance to contextual issues reflecting local wisdom values. Language validity was evaluated based on the clarity of language use, suitability for students' developmental level, adherence to linguistic conventions, and readability in supporting students' understanding of the presented material.

The practicality instruments consisted of teacher and student questionnaires. The teacher questionnaire comprised 16 items covering media, content, and language aspects, while the student questionnaire consisted of 12 items addressing visual

appearance, content appropriateness, and the effectiveness of Student Worksheet use. These instruments were used to evaluate the practicality of the Samaturu local wisdom-based Student Worksheet.

An attitude observation sheet was used to assess the effectiveness of the Student Worksheet during the learning process. The instrument included four indicators of Samaturu values: cooperation, mutual assistance, responsibility, and student participation. The assessment was conducted using a four-point Likert scale ranging from 1 to 4.

Data obtained from expert validation, student response questionnaires, and teacher responses were analyzed in percentage form using the formula proposed by [Ikhwani & Kuntjoro \(2021\)](#) (presented in Formula 1). The percentage results from the validation sheets were then categorized based on Table 1. Products that had obtained expert validation were subsequently tested as teaching materials. The practicality analysis of the teaching materials based on student and teacher responses is presented in Table 2.

$$Score (\%) = \frac{Obtained\ Score}{Maximum\ Score} \times 100 \dots\dots\dots (1)$$

**Table 1.** Validity Assessment Criteria ([Ulfa., 2020](#))

Validity Score	Criteria
81-100 %	Very Valid
61-80 %	Valid
41-60 %	Fairly Valid
21-40 %	Less Valid
0-20 %	Invalid Valid

**Table 2.** Practicality Criteria ([Sabdarini et al., 2021](#))

Average Score Interval	Classification
81%-100 %	Very Practical
61%-80 %	Practical
41%-60 %	Fairly Practical
21%-40 %	Less Practical
0%-20 %	Not Practical

**Data Collection**

Data collection in this study was carried out through questionnaires and observation techniques. The questionnaire technique used assessment sheets and teacher and student response sheets, while the observation technique was used to measure students' attitudes before and during the implementation of the Student Worksheet.

**Procedure**

The analysis stage involved student characteristics analysis and needs analysis. Student characteristics analysis was conducted to identify students' characteristics, interests, and learning needs. The needs analysis was carried out through interviews with the Biology teacher and the administration of student questionnaires to identify the need for a Samaturu local wisdom-based Student Worksheet. Based on the findings

obtained from the tenth-grade Biology teacher at SMA Negeri 1 Mowewe Senior High School, the use of Student Worksheets in the learning process was still general in nature and had not integrated local wisdom values into classroom activities. In addition, the learning materials had not fully connected environmental pollution concepts with students' surrounding environment and local culture, resulting in learning experiences that were less contextual and less supportive of students' understanding of environmental issues in their daily lives.

The results of the student characteristics analysis were obtained through a needs assessment questionnaire regarding the development of a Student Worksheet based on local wisdom values. The findings indicated that students were interested in using a Student Worksheet that connected learning materials with their surrounding environment and local culture. One form of local wisdom is the value of Samaturu, which reflects togetherness and mutual cooperation. Therefore, it is relevant to integrate this value into learning activities to create more contextual and meaningful learning experiences while supporting students' character development (Hardin & Hardiman, 2025).

The second stage of this study was the design stage. The design process began with the selection of learning materials, followed by the preparation of the Student Worksheet in accordance with the predetermined learning objectives and indicators. The Student Worksheet was systematically designed by integrating Samaturu local wisdom values into learning activities, including the introduction, main activities, and closing section.

The third stage was the development stage. The Samaturu local wisdom-based Student Worksheet was systematically developed in accordance with the learning objectives and instructional activities. The development process was based on the prepared learning materials while considering aspects of content appropriateness, language, presentation, and graphic design. Samaturu values were integrated into the learning activities to support collaborative and contextual learning. In addition, the Student Worksheet was equipped with usage instructions, learning materials, discussion activities, practice exercises, and reflection activities to help students gain a more meaningful understanding of the content. According to Anti & Wardani (2024), Student Worksheets contain a series of learning activities designed to guide students during the learning process and encourage their active participation in classroom learning. Furthermore, the editing process was carried out using Canva to produce an attractive and user-friendly Student Worksheet. Canva provides various templates, shapes, images, colors, and fonts that support the development of engaging instructional materials (Irksamni et al., 2021; Patinama et al., 2025). After the development process was completed, the Student Worksheet was validated to determine its feasibility. The validation process involved language, content, and media experts. Each validator provided assessments and suggestions that served as the basis for revising and improving the developed product.

The fourth stage was the implementation stage. This stage was conducted through a limited field trial involving one Biology teacher and 54 tenth-grade students at SMA Negeri 1 Mowewe Senior High School. The trial was implemented in environmental pollution learning using the Samaturu local wisdom-based Student Worksheet. During this stage, students worked collaboratively in groups to complete the learning activities provided in the Student Worksheet, while the teacher acted as a facilitator. Prior to classroom implementation, the Student Worksheet was reviewed and evaluated by the subject teacher to ensure the appropriateness of its content,

language, and presentation for students' needs. Following the learning activities, practicality data were collected through teacher and student response questionnaires regarding the use of the Student Worksheet.

The fifth stage was the evaluation stage. At this stage, all data obtained from the validity and practicality assessments conducted during the field trial were compiled. Subsequently, questionnaires were administered to the teacher and students to gather information regarding their responses to the developed Samaturu local wisdom-based Student Worksheet. The collected data were then analyzed to determine the practicality level of the Student Worksheet in supporting the learning process.

### **Data Analysis**

Data were analyzed using both descriptive and inferential statistics. Descriptive statistical analysis was employed to determine the validity, practicality, and effectiveness of the developed Student Worksheet. In addition, the Kolmogorov–Smirnov normality test and the Wilcoxon Signed-Rank Test were performed using IBM SPSS Statistics version 25 to determine whether there were significant differences in students' Samaturu attitude scores before and after the implementation of the Samaturu local wisdom-based Student Worksheet.

## **RESULTS AND DISCUSSION**

### **Validity Test**

The validation process was conducted by two experts who assessed the media, material, and language aspects. The validation results showed that the Samaturu local wisdom-based Student Worksheet obtained an average validity score of 82.72% from expert validators, which was categorized as highly valid and suitable for use. Based on the validation results, the media aspect achieved a score of 100%, the content aspect 92.82%, and the language aspect 55.34%. Although the overall validity was classified as highly valid, the language aspect obtained a lower score compared to the media and content aspects. This indicates that several improvements were still required, particularly in sentence structure, consistency of terminology, grammar accuracy, and the readability of learning instructions. Therefore, revisions were made based on expert suggestions, including simplifying sentences, clarifying instructional steps, and improving the consistency of terminology to enhance student understanding.

**Table 3.** Expert Validation Results of the Student Worksheet

<b>Expert Validator</b>	<b>Media (%)</b>	<b>Material (%)</b>	<b>Language (%)</b>	<b>Average (%)</b>	<b>Category</b>
<b>Validator 1</b>	100%	95,65%	56,62%	84,09%	Very Valid
<b>Validator 2</b>	100%	100%	54,16%	84,72%	Very Valid
<b>Average</b>	100%	92,82%	55,34%	82,72%	Very Valid

### **Practicality Test**

Based on the teacher response questionnaire results, the media aspect obtained the highest score of 100%, indicating that the appearance, layout, and visual presentation of the Student Worksheet were considered very attractive and easy to use

in the learning process. The content aspect obtained a score of 95.83%, indicating that the learning materials were aligned with the learning objectives and environmental pollution topic. Meanwhile, the language aspect obtained a score of 58.33%. These results indicate that several parts still require improvement in language use to make the Student Worksheet clearer and easier for students to understand.

**Table 4.** Teacher Response Questionnaire Results

No.	Indicator	Percentage (%)	Category
1.	Media	100%	Very Practical
2.	Material	95,83%	Very Practical
3.	Language	58,33%	Practical
<b>Average</b>		84,72%	Very Practical

**Table 5.** Student Response Questionnaire Results

No.	Indicator	Percentage (%)	Category
1.	appearance	100%	Very Practical
2.	Appropriateness of content	98,97%	Very Practical
3.	effectiveness	95,67%	Very Practical
<b>Average</b>		98,21%	Very Practical

Based on the student response results, the appearance aspect obtained a score of 100%, indicating that the design and presentation of the Student Worksheet were able to attract students' attention. The content suitability aspect obtained a score of 98.97%, indicating that the materials presented were aligned with students' learning needs and helped them understand the concept of environmental pollution. Meanwhile, the effectiveness aspect obtained a score of 95.67%, indicating that the Student Worksheet encouraged students to be more active in learning activities and facilitated their understanding of the learning materials. The analysis results of the teacher and student response questionnaires showed that the Student Worksheet based on Samaturu local wisdom values obtained an average percentage of 91.46%, which falls into the very practical category.

**Table 6.** Analysis of Teacher and Student Questionnaire Results

Respondent	Percentage (%)	Category
<b>Teacher Response</b>	84,72%	Very Practical
<b>Student Response</b>	98,21%	Very Practical
<b>Average</b>	91,46%	Very Practical

### Effectiveness Test

#### Descriptive Analysis

Data on students' Samaturu attitudes before and after the use of the Student Worksheet based on local wisdom values of Samaturu were analyzed descriptively to determine the minimum, maximum, and average scores. The analysis results indicated an improvement in students' Samaturu attitudes after the implementation of the

Student Worksheet. The average score before the use of the Student Worksheet was 42.48, which was categorized as “poor,” and increased to 88.31, categorized as “very good,” after the implementation of the Student Worksheet. These results indicate that the use of the Student Worksheet based on the local wisdom values of Samaturu had a positive effect on students’ Samaturu attitudes.

**Table 7.** Descriptive Statistical Data of Students’ Samaturu Attitudes

<b>Description</b>	<b>Before</b>	<b>During</b>
<b>Number Of Participants</b>	54	54
<b>Maximum</b>	62,50	100
<b>Minimum</b>	25,00	62,50
<b>Average</b>	42,48	88,31
<b>Average Score Category</b>	Poor	Very Good

### Normality Test

Based on the results of the normality test using the Kolmogorov–Smirnov method, the significance value for the data before the use of the Student Worksheet was 0.001 and after the use of the Student Worksheet was 0.000. Since both significance values were smaller than 0.05, the data were considered not normally distributed. Therefore, the analysis was continued using the nonparametric Wilcoxon Signed-Rank Test.

**Table 8.** Normality Test Results

<b>Normality Test (Kolmogorov–Smirnov)</b>	<b>Statistic</b>	<b>df</b>	<b>Sig.</b>
<b>Before</b> the use of Student Worksheet	0,163	54	0,001
<b>After</b> the use of Student Worksheet	0,18	54	0,000

### Wilcoxon Signed-Rank Test

The results of the Wilcoxon Signed-Rank Test showed a Z value of -6.411 with a significance value (Asymp. Sig. 2-tailed) of 0.000. The significance value was smaller than 0.05, indicating a significant difference in students’ Samaturu attitudes before and after the use of the Student Worksheet based on Samaturu local wisdom values. These results indicate that the use of Student Worksheet based on Samaturu local wisdom values was effective in improving the Samaturu attitudes of Grade X students at SMA Negeri 1 Mowewe Senior High School.

**Table 9.** Wilcoxon Signed-Rank Test Results

<b>Test Statistics</b>	<b>Value</b>
<b>Z</b>	-6,411
<b>Asymp. Sig. (2-tailed)</b>	0,000

## DISCUSSION

The development of a Samaturu local wisdom-based Student Worksheet on environmental pollution was conducted to provide learning materials that are more contextual, interactive, and aligned with students' characteristics. In the analysis stage, it was found that classroom learning was still dominated by the use of textbooks and conventional teaching methods; therefore, local wisdom values had not been optimally integrated into the learning process. The developed Student Worksheet serves as an alternative learning material that integrates Samaturu local wisdom values through various learning activities related to students' daily lives and environmental pollution issues in their surroundings.

The validation results from expert validators showed that the Samaturu local wisdom-based Student Worksheet obtained an average score of 82.72%, categorized as highly valid. The media aspect obtained an average score of 100%, the content aspect 92.82%, and the language aspect 55.34%. These results indicate that the developed Student Worksheet has met the feasibility criteria in terms of media, content, and language, thus making it suitable for use in the learning process. In addition, feedback and suggestions from validators were used as the basis for product revision to improve the quality of the Student Worksheet. This is in line with the study by [Marera \(2019\)](#), which stated that the development of teaching materials using the ADDIE model can produce valid, practical, and effective products due to its systematic and structured stages.

These findings are consistent with [Anggraeni et al. \(2025\)](#), who reported that local wisdom-based teaching materials fall into the highly valid category because they meet media, content, and language criteria. The integration of local wisdom into the Student Worksheet makes learning more contextual and closer to students' daily lives, thereby improving their understanding of the material. This is also supported by [Puspita & Dewi \(2021\)](#) and [Asmaryadi et al. \(2022\)](#), who stated that instrument validity is assessed through expert judgment using questionnaires covering language, media, and content aspects. The validity of e-Student Worksheets is important to determine the feasibility and accuracy of the developed product before being implemented in learning.

In terms of practicality, the Samaturu local wisdom-based Student Worksheet obtained an average score of 91.46%, categorized as highly practical. These results indicate that the Student Worksheet is easy to use in the learning process, has an attractive appearance, and encourages students to be more active during learning activities. In addition, it also assists teachers in organizing learning activities in a more structured and contextual manner aligned with students' daily lives.

Practicality refers to the ease of use of learning materials by both teachers and students. A Student Worksheet is considered practical if it is easy to use, attractive, helps students understand the material, and supports effective and efficient learning processes ([Wahyudi & Hisbullah, 2024](#)). According to [Rahmawati et al., \(2020\)](#) and [Cahyani et al., \(2023\)](#), a good Student Worksheet should be clearly readable, and the images used should support the teaching and learning process.

This study employed a one-group pretest-posttest design without a control group because the main objective of development research is to examine the feasibility and initial effectiveness of the developed product before wider implementation. In development research, the initial effectiveness of a product can be measured by

comparing pretest and posttest results after using the developed product (Risal et al., 2022; Cholida et al., 2024). The effectiveness of the Samaturu local wisdom-based Student Worksheet was indicated by an improvement in students' Samaturu attitudes after its implementation in learning activities. Based on descriptive analysis, the average students' Samaturu attitude score increased from 42.48 before the implementation to 88.31 after using the Student Worksheet. The Wilcoxon Signed-Rank Test showed a significance value of 0.000, indicating a significant difference between pretest and posttest results. These findings indicate that the Samaturu local wisdom-based Student Worksheet is effective in improving students' attitudes of cooperation, mutual assistance, and environmental responsibility. Learning activities integrated with local wisdom values and students' real-life contexts also made students more active and engaged in the learning process.

This is supported by Rusdianti & Prasetyono (2026), who found that the use of environmentally oriented Student Worksheets can improve student engagement, social skills, and positive attitudes through collaborative, discussion-based, and participatory learning activities. Contextual Student Worksheets that are connected to students' daily lives also help students understand learning materials more easily. According to Rumanta (2019) and Milandi et al. (2025), environmental education is an effort to change attitudes and behavior by improving knowledge, skills, and awareness of environmental values and issues, with the main goal of encouraging active participation in environmental conservation for both present and future generations.

These findings further confirm that the use of Samaturu local wisdom-based Student Worksheets is effective in improving students' attitudes, particularly cooperation, environmental awareness, and responsibility. Environmental pollution topics presented through real-life problems around students make learning more meaningful and encourage active participation in the learning process. Moreover, integrating local wisdom values into the Student Worksheet not only supports cognitive understanding but also contributes to character development during learning activities (Awaluddin, 2025).

The Samaturu value also serves as a social foundation that strengthens interpersonal relationships and fosters a spirit of mutual cooperation as a way of life among the Tolaki community. In the educational context, this value is relevant as a basis for integrating local wisdom into learning because it supports collaborative, participatory, and character-oriented learning (Alim et al., 2020).

The integration of local wisdom concepts into teaching materials is one of the factors that can enhance learning success. Such integration can also help prevent environmental damage by serving as a guide for appropriate environmental behavior (Balaya & Zafi, 2020). The developed e-Student Worksheet introduces local wisdom concepts to reduce and prevent environmental degradation, thereby supporting effective learning (Anggraeni et al., 2025).

Overall, the findings of this study reinforce that the Samaturu local wisdom-based Student Worksheet is effective in improving students' attitudes, particularly cooperation, environmental awareness, and responsibility toward their surroundings. The use of contextual problems close to students' daily lives also encourages active

engagement in learning, making the learning process more meaningful and contributing to the development of positive student attitudes.

## CONCLUSION

Based on the results of the research and development conducted, the Samaturu local wisdom-based Student Worksheet on environmental pollution was categorized as highly valid, highly practical, and effective for use in learning. The expert validation results indicated that the Student Worksheet was classified as highly valid, while the practicality test results obtained an average percentage of 91.46%, categorized as highly practical. In addition, the effectiveness test results showed an increase in students' Samaturu attitudes from 42.48 to 88.31, with a Wilcoxon test significance value of 0.000 ( $< 0.05$ ). Therefore, the Samaturu local wisdom-based Student Worksheet is effective in improving students' cooperation, environmental awareness, and responsibility toward their surroundings. Based on these findings, teachers are encouraged to use the Samaturu local wisdom-based Student Worksheet as an alternative learning material to create more contextual and meaningful learning experiences. Furthermore, future researchers are expected to develop local wisdom-based Student Worksheets for other topics or integrate them with more innovative learning models.

## ACKNOWLEDGEMENTS

The author expresses gratitude to the principal, Biology teacher, and Grade X students of SMA Negeri 1 Mowewe Senior High School for their permission, assistance, and cooperation during the implementation of this research. Special thanks are also addressed to the author's beloved family for their prayers, support, encouragement, and motivation throughout the process of writing this article. In addition, the author expresses appreciation to friends who provided assistance, support, and encouragement during the research process. Finally, the author would also like to appreciate herself for her perseverance and dedication in completing this research successfully.

## REFERENCES

- Alim, N., Badarwan, B., & Syahrul, S. (2020). Leadership Education Based on Local Traditions in the Tolaki Community of Konawe Regency. *Shautut Tarbiyah*, 26(1), 32. <https://doi.org/10.31332/STR.V26I1.1840>
- Amiruddin, Suardika, I. K., & Anwar. (2017). Kalosara Among the Tolaki Community in Southeast Sulawesi. *Mudra Jurnal Seni Budaya*, 32(2), 209-219. <https://doi.org/10.31091/MUDRA.V32I2.111>
- Anggraeni, D. N., Irhasyuarna, Y., & Hafizah, E. (2025). Development of Local Wisdom-Based E-LKPD on Environmental Pollution Material to Foster Environmental Care Attitudes of Junior High School Students. *Jurnal Pendidikan*

*dan Pembelajaran IPA Indonesia*, 15(3), 148-159,  
<https://doi.org/10.23887/jppii.v15i3.97455>.

Anti, F. D., & Wardani, N. S. (2024). Development of Canva-Based Student Worksheets (LKPD) to Improve Mathematics Learning Outcomes of Fourth-Grade Elementary School Students. *Jurnal Basicedu*, 8(5), 3866–3880. <https://doi.org/10.31004/BASICEDU.V8I5.8689>

Arda, F., Yogica, R., & Darussyamsu, R. (2021). Development of Problem-Based Learning (PBL)-Based Student Worksheets (LKPD) on Environmental Pollution Material. *Prosiding SEMNAS BIO 2021*, 1(8), 997–1004. <https://doi.org/10.24036/PROSEMNASBIO/VOL1/124>

Asmaryadi, A. I., Darniyanti, Y., & Nur, N. (2022). Development of MIKIR-Based E-LKPD Teaching Materials Using Live Worksheets in Elementary School Science Learning. *Jurnal Basicedu*, 6(4), 7377–7385. <https://doi.org/10.31004/BASICEDU.V6I4.3521>

Awaluddin, R. (2025). Implementation of Local Wisdom-Based Problem-Based Learning (PBL) on Environmental Pollution Material to Improve the Understanding of Grade X Students at SMAN 2 Bolo. *Jurnal Jendela Pendidikan*, 5(2), 312-321, <https://doi.org/10.57008/jjp.v5i02.1340>.

Balaya, A. N., & Zafi, A. A. (2020). The Role of Local Wisdom in Character Building of Students. *Jurnal Pendidikan Kewarganegaraan*, 7(1), 27–34. <https://doi.org/10.32493/JPKN.V7I1.Y2020.P27-34>

Cahyani, G., Enawaty, E., Erlina, E., Muharini, R., & Ulfah, M. (2023). Development of Local Wisdom-Based Student Worksheets (LKPD) on Biotechnology Material at SMPN 1 Jagoi Babang. *Jurnal Basicedu*, 7(5), 3004–3017. <https://doi.org/10.31004/BASICEDU.V7I5.6095>

Cholida, M., Stiawan, A., & Prasetyo, K. (2024). Development of Problem-Based Learning-Based Student Worksheets on International Trade Materials to Enhance Students' Critical Thinking Skills. *Dialektika Pendidikan IPS*, 4(3), 56-70, <https://ejournal.unesa.ac.id/index.php/PENIPS/article/view/62771>.

Fadhila, N. A., Setyaningsih, N. W., Gatta, R. R., & Handziko, R. C. (2022). Development of Teaching Materials Using the ADDIE Model on the Structure and Function of Plant Tissues for Senior High School Curriculum 2013. *BIOEDUKASI Jurnal Pendidikan Biologi Universitas Muhammadiyah Metro*, 13(1), 1-8, <https://doi.org/10.24127/bioedukasi.v13i1.5298>.

Hardin, H., & Hadirman, H. (2025). Kalosara Tradition: A Symbol of Conflict Resolution, Character Education, and Social Construction in Tolaki Society. *AHKAM*, 4(2), 273–290. <https://doi.org/10.58578/AHKAM.V4I2.5292>

Ikhwani, P. N., & Kuntjoro, S. (2021). Development of Guided Inquiry-Based Electronic Student Activity Sheets (E-LKPD) on Environmental Change Material to Train Critical Thinking Skills in Grade X High School Students.

*Berkala Ilmiah Pendidikan Biologi (Bioedu)*, 10(3), 597–604.  
<https://doi.org/10.26740/BIOEDU.V10N3.P597-604>

Irkhamni, I., Izza, A. Z., Salsabilah, W. T., & Hidayah, N. (2021). Utilization of Canva as a Mathematics E-Module to Enhance Students' Learning Interest. *Prosiding Konferensi Ilmiah Pendidikan*, 2, 127–134.

Marera, A. (2019). Development of Biology Learning Module Based on Scientific Approach on Respiratory System Topic in Senior High School. *Jurnal Al-Ahya*, 1(3), 1-11. <https://doi.org/10.24252/al-ahya.v1i3.9797>.

Milandi, S. D., Akbar, H., & Caesar Maeva, L. A. (2025). The Role of Youth as an Environmentally Conscious Generation in Increasing Conservation Awareness Through Environmental Education. *SEMAR: Jurnal Sosial dan Pengabdian Masyarakat*, 3(1), 1–9. <https://doi.org/10.59966/SEMAR.V3I1.900>

Patinama, P. J., Hasibuan, S. A., & Fadli, V. P. (2025). Development of Canva-Based Interactive LKPD Using the Discovery Learning Model to Improve Mathematical Creative Thinking Skills of Grade X Students at SMA Negeri 1 Barumun Academic Year 2024/2025. *Jurnal Transformasi Pendidikan Modern*, 6(4), 248-265.

Puspita, V., & Dewi, I. P. (2021). Effectiveness of Investigation-Based E-LKPD on Elementary School Students' Critical Thinking Skills. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 5(1), 86–96.

Rahmawati, E. V., Ernawati, T., & Ayuningtyas, A. D. (2020). Tri Nga-Based LKPD (Ngeri, Ngrasa, Nglakoni) to Develop Science Process Skills of Grade VIII Junior High School Students. *Jurnal Pendidikan IPA Veteran*, 4(2), 189-203. <https://doi.org/10.31331/jipva.v4i2.1186>.

Ramly, A., Putra, Z., Hariyadi, S., & Husnah, N. (2023). The Kalosara Tradition from the Perspective of Character Education Values in Tolaki Ethnic Marriage Customs in Kolaka Regency. *Jurnal Pendidikan Tambusai*, 7(2), 7747–7754.

Risal, Z., Hakim, R., & Abdullah, A. R. (2022). *Research and Development (R&D) methods in research*. Edited by Z. R. Bahar. Malang: CV. Literasi Nusantara Abadi.

Rispan, R., & Sudrajat, A. (2019). Integration of Kalosara Local Wisdom Values in History Learning at Senior High Schools as Character Reinforcement for Students. *Jurnal Pendidikan Sejarah*, 8(2), 148–169. <https://doi.org/10.21009/JPS.082.04>

Rumanta. (2019). *Environmental Education*. Jakarta: Universitas Terbuka. [**In Indonesian language**]

Rusdianti, Y., & Prasetyono, H. (2026). Analysis of the Use of Environmental Care Attitude-Based LKPD in Junior High School Science Learning. *Indonesian Journal of Innovation Multidisciplinary Research*, 4(2), 410–420.

- Sabdarini, C., Egok, A. S., & Aswarliansyah, A. (2021). Development of Local Wisdom-Based Thematic Student Worksheets for Elementary School Students. *Jurnal Basicedu*, 5(5), 3765–3777. <https://doi.org/10.31004/BASICEDU.V5I5.1393>
- Salsabilla, A., Anggraini, N., & Nazipetc, K. (2025). The Effect of Outdoor Study-Based Problem-Based Learning (PBL) on Environmental Pollution Material Toward Critical Thinking Skills and Learning Motivation of Students at SMA Pembina Palembang. *Bioscientist: Jurnal Ilmiah Biologi*, 13(3), 2360–2371. <https://doi.org/10.33394/BIOSCIENTIST.V13I3.11712>
- Saputri, S. A., Dirman, L. O., Ta'alami, L. O., & Hadi, A. T. (2020). Kalosara Tradition in Resolving Land Disputes in Baito District, South Konawe Regency. *LISANI: Jurnal Kelisanan Sastra dan Budaya*, 3(2), 63-76 <https://doi.org/10.33772/lisani.v3i2.1112>.
- Sarmadan, Alu, L., & Saadillah, A. (2024). Needs Analysis for the Development of Differentiated Indonesian Language Learning Modules Based on Local Wisdom. *Arus Jurnal Sosial dan Humaniora*, 4(2), 1156–1163. <https://doi.org/10.57250/AJSH.V4I2.641>
- Saudi, F., & Nurkarima, R. (2024). Local Wisdom Values of Sara Monda'u Tradition as a Learning Resource for Social Studies. *Jurnal Penelitian Pendidikan Geografi*, 9(2), 128-137. <https://jppg.uho.ac.id/index.php/journal/article/view/258>.
- Sompotan, D. D., & Sinaga, J. (2022). Environmental pollution prevention. *SAINTEKES: Journal of Science, Technology and Health*, 1(1), 6–13. <https://doi.org/10.55681/saintekes.v1i1.2>
- Sutrisno, H., & Salirawati, D. (2016). Environmental pollution caused by heavy metal biomethylation processes. *Cakrawala Pendidikan Journal*, 2(2), 101-109. <https://doi.org/10.21831/cp.v2i2.8968>
- Ulfa, K. (2020). Validity of the Development of PPDP Learning Strategies on Photosynthesis Material to Improve Learning Outcomes of Grade XII Senior High School Students in Palembang City. *Bioilmi: Jurnal Pendidikan*, 6(1), 65–76. <https://doi.org/10.19109/BIOILMI.V6I1.5720>
- Wahyudi, N., & Hisbullah. (2024). Practicality of LKPD on Human Digestive System Material Based on Interactive Learning Between Teachers and Students. *JMSER*, 1(1), 23-36.
- Widyastuti, E., & Susiana. (2019). Using the ADDIE Model to Develop Learning Material for Actuarial Mathematics. *Journal of Physics: Conference Series*, 1188, 012052. 8 page. 10.1088/1742-6596/1188/1/012052

**How To Cite This Article, with *APA style* :**

Ulmayani, U., Alonemarera, A. S., & Saparuddin, S. (2026). Development of Worksheet Based on The Local Wisdom of Samaturu for The Environmental Pollution Module In SMA Negeri 1 Mowewe. *Jurnal Pembelajaran dan Biologi Nukleus*, 12(2), 503-517. <https://doi.org/10.36987/jpbn.v12i2.9366>

- Conflict of interest** : The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
- Author contributions** : All authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by all authors. The first draft of the manuscript was submitted by [Ulmayani]. All authors contributed on previous version and revisions process of the manuscript. All authors read and approved the final manuscript.