

DEVELOPMENT OF ETHNO-STEAM-BASED LIVE WORKSHEETS ON SENDANG LESTARI BATIK TO IMPROVE JUNIOR HIGH SCHOOL STUDENTS' SCIENCE LITERACY IN TEMPERATURE AND HEAT TOPICS

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Abstract

This research aims to improve junior high school students' science literacy on temperature and heat through the implementation of Ethno-STEAM-Based Live Worksheets on Sendang Lestari Batik. Live Worksheets is an interactive online platform that transforms conventional activity sheets into engaging digital formats. This study is motivated by the low level of students' science literacy on temperature and heat topics. The development of STEAM-based e-LKPD (electronic student worksheets) is necessary to meet 21st-century learning demands. The Ethno-STEAM approach integrates local wisdom (batik) with science, technology, engineering, arts, and mathematics. The ethnoscience aspect of this study is batik. This research employs the ASSURE model. The validation test results show that the live worksheet meets the "very valid" criteria with a score of 3.78. Furthermore, the analysis using normalized n-gain to measure pre-test and post-test improvements indicates an increase of 0.72, classified as high. Additionally, student response surveys show a high level of practicality with a percentage of 87.28%. The study is expected to demonstrate the process and effectiveness of implementing live worksheets to enhance students' science literacy in temperature and heat topics.

Keywords: Live Worksheet, Ethno-STEAM, Science Literacy, Temperature, Heat

INTRODUCTION

In 2022, the Indonesian Ministry of Education and Culture implemented the "Merdeka Curriculum" across all education levels (Fikrina, 2023). This curriculum emphasizes the role of educators in facilitating integrated learning and fostering independent lifelong learners (Arifa, 2022). Education in Indonesia focuses on 21st-century learning, which includes the development of 4C competencies: critical thinking, communication, collaboration, and creativity (Andrian & Yusman, 2019). These competencies can be developed through integrated Ethno-STEAM project-based learning (Sumarni et al., 2022). The Ethno-STEAM approach combines local wisdom with science, technology, engineering, arts, and mathematics (Reffiane et al., 2021). This study explores batik as an ethnoscience component.

As part of traditional culture, batik has two techniques: stamped batik and hand-drawn batik. Hand-drawn batik is made using a curved tool called a canting, which is used to apply hot wax to the fabric surface (Adli, 2023). The ethnosience aspects of batik making include the waxing, dyeing, and wax removal processes (Puspasari et al., 2019). During the waxing process, the wax is melted by heating and then applied to the fabric using a canting. This process involves a physical change from liquid to solid as the wax cools and hardens due to temperature influence (Khoerul, 2022). In the dyeing process, heat transfer occurs through convection when the fabric is heated with dye. The application of heat affects color change and penetration into the fabric fibers. The final stage in batik making is wax removal, where the remaining wax is boiled off to reveal the batik patterns. Water boils when it reaches 100°C. This process causes the wax to change from solid to liquid due to heat exposure. The batik fabric is then dried, allowing water to evaporate (Khoerul, 2022). The concepts of heat and heat transfer are highly relevant in these processes, making an understanding of temperature and heat essential in batik production. Currently, rapid technological advancements, particularly the internet, greatly assist teachers in developing electronic learning materials. In today's digital era, creating teaching materials is a crucial responsibility of educators to ensure effective student learning. This is a fundamental task for teachers. Hamijoyo states that educational innovation involves transforming teaching and learning activities with new and high-quality methods to achieve learning objectives. A survey conducted by Mu'minah showed that Indonesia ranked 63rd out of 72 countries in science and mathematics. The 2015 Global Creativity Index survey also indicated that Indonesia ranked 115th out of 139 countries. In the same year, the TIMSS (Trends in International Mathematics and Science Study) results showed that Indonesia ranked 63rd out of 139 countries. These survey results suggest that Indonesian students have low levels of creative and critical thinking. Additionally, the Indonesian Ministry of Education and Culture stated that the STEAM teaching method can help increase students' interest and motivation to learn, as PISA results indicate a low level of learning interest (Noor, 2023). As an alternative solution to this problem, the researcher will produce more creative and innovative learning materials. Pratowo stated that the objectives of using learning materials are as follows: to make the material easier for students to understand; to provide innovation in learning activities by modifying the learning materials; to make learning easier and more engaging; and to make learning more creative and interesting.

The researchers aim to develop an interactive online LKPD using Live Worksheets, a website for creating interactive LKPD teaching materials (Inayah et al., 2022). Herawati (Nurhidayati, 2019) stated that LKPD development should

be optimized by enhancing its design, content, and application in learning. Digital-based LKPD learning can make lessons more engaging and prevent boredom. This is because learning activities become more convenient, students become more active, and the learning process is less monotonous, ultimately improving students' science literacy (Nurhidayati, 2019).

METHOD

This study is a Research and Development (R&D) project using the ASSURE model, which includes the following stages: Analyze Learner Characteristics, State Performance Objectives, Select (Methods, Media, and Materials), Utilize Materials, Require Learner Participation, and Evaluate and Revise (Ignasia et al., 2022). In this research, the researchers developed an Ethno-STEAM-based Live Worksheet on Sendang Lestari Batik for teaching temperature and heat in seventh-grade science classes. The study subjects were seventh-grade students from SMP Negeri 3 Kota Blitar, selected using purposive sampling. The research was conducted in stages, starting from student analysis to the evaluation and revision of the teaching materials.

In the initial stage, the researchers analyzed the students' characteristics. After that, specific learning objectives were established. The researchers also selected appropriate media based on the student analysis results. The next step was designing the Live Worksheet, which included content development and validity sheets for assessing the feasibility of the Live Worksheet. Additionally, a student response questionnaire was created to evaluate the practicality of the Live Worksheet. Once the development was complete, validation was conducted by subject matter and media experts. After validation, the Live Worksheet was tested with students at SMP Negeri 3 Kota Blitar to assess its practicality. Based on the test results, revisions were made. After final revisions, the researchers compiled a final report based on the collected data. The outcome of this research is the creation of a valid, effective, and practical Live Worksheet.

The responses from the validity test were analyzed using the Likert scale, which had been validated by experts. Meanwhile, the responses from the readability test were analyzed using a descriptive quantitative approach, classified according to the Guttman scale scoring categories, where "Yes" is scored as 1 and "No" is scored as 0. Data analysis was conducted using the percentage score equation, as expressed in the following formula (Sugiono, 2017):

$$\%score = \frac{\text{score from respondents}}{\text{max score}} \times 100\%$$

The average score (P) from the validation assessment results of the e-LKPD by the validators is aligned with the assessment criteria in Table 1.

Table 1. Model Assessment Criteria

Score Interval	Assessment Criteria	Description
3.25 < P < 4.00	Highly valid	Can be used without revision
2.50 < P < 3.25	Valid	Can be used with minor revisions
1.75 < P < 2.50	Less valid	Can be used with major revisions
1.00 < P < 1.75	Not valid	Cannot be used and still requires consultation

Source: (Prahani dkk, 2017)

After obtaining the readability score percentage, the results are then grouped according to the following criteria:

90% - 100% with the criterion "highly valid"

80% - 89% with the criterion "valid"

65% - 79% with the criterion "fairly valid"

55% - 64% with the criterion "less valid"

Less than 55% with the criterion "invalid"

N-Gain Analysis

To assess the improvement in students' science literacy skills, the analysis can be done using the N-Gain method. The N-Gain calculation is performed using the N-Gain index analysis as follows:

$$\langle g \rangle = \frac{SPost - Spre}{Smax - Spre}$$

Description:

$\langle g \rangle$ = improvement in students' science literacy

Spre = Pretest score

Spst = Posttest score

Smax = Maximum score

(Sukarelawa, 2022)

Table 2. Interpretation Criteria for Gain Scores

Value (g)	Category
$(g) \geq 0,7$	High
$0,7 > (g) \geq 0,3$	Medium
$g < 0,3$	Low

(Sukarelawa, 2022)

RESULTS AND DISCUSSION

According to the ASSURE method used in this research, the following are the development results:

1. Analyze Learners

Based on the observations, this study's subjects were 31 seventh-grade students with varying abilities (low, medium, and high). They were also studying temperature and heat during this semester and were in the same class. Therefore, students need to understand the fundamental concepts of temperature and heat.

2. State Performance Objective

The purpose of developing the Etno-STEAM-based e-LKPD is to introduce students to one of the local cultures, Batik Sendang Lestari from Blitar, through the STEAM approach (Science, Technology, Engineering, Art, and Mathematics). Liveworksheet is also expected to help students enhance their understanding of technology.

3. Select Method, Media, and Material

At this stage, a design plan for the e-LKPD and the platform to be used is developed. The e-LKPD will be designed using the Canva application and then uploaded to the Liveworksheet website. Below is an example of the Etno-STEAM-based e-LKPD display:

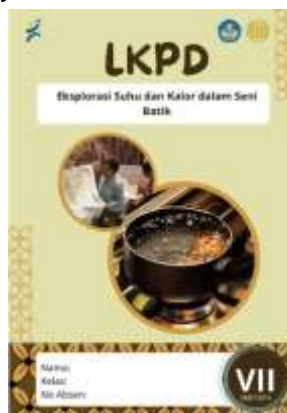


Figure 1. E-LKPD Cover



Figure 2. Instructions for Using the e-LKPD



Figure 3. Exploration of Temperature and Heat Material in Batik

4. Utilize Materials

Validators, namely two science teachers from SMP Negeri 3 Kota Blitar, Mrs. Erwin Yudiastuti, S.Pd., and Mrs. Dra. Yayuk P. R., assessed the validity of the e-LKPD by filling out a validity questionnaire. The results of the validity data analysis are presented in Table 4.

Table 3. Results of the Validity Test Evaluation

No.	Validation Aspects	Average	Criteria
1	Feasibility of content components	3,5	Highly Valid
2	Feasibility of presentation	4	Highly Valid
3	Language	3,83	Highly Valid
Total		11,33	Highly Valid
Average		3,78	

Based on the validity assessment results in Table 4, the e-LKPD was found to be highly valid, with an average score of 3.78. This indicates that the developed e-LKPD is valid in terms of content feasibility, presentation feasibility, and language aspects.

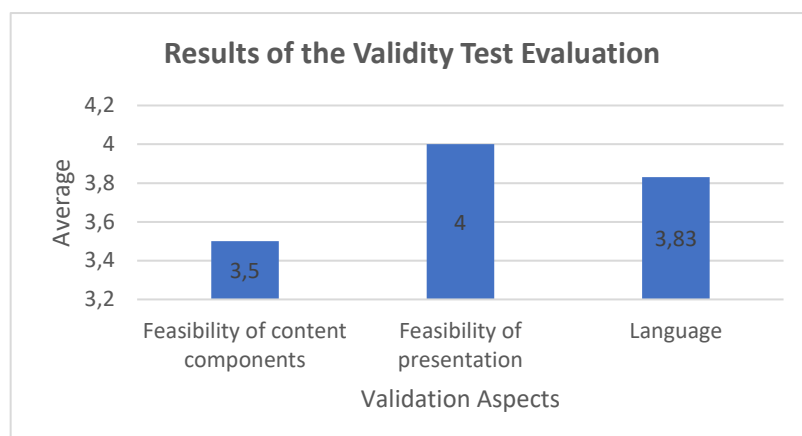


Figure 4. Results of the Validation Test Assessment

Based on Figure 4, the order of the e-LKPD validation aspects at the high criteria level is as follows: language aspect, content feasibility, and presentation feasibility. These results indicate that teachers rated the content feasibility aspect as superior compared to the other aspects, achieving a score of 4.

5. Require Learner Participation

At this stage, the researcher conducted a limited trial of the e-LKPD with 31 junior high school students. Before the trial, students were asked to take a pre-test to assess their initial knowledge and understanding of the material. Afterward, they completed a post-test. The developed and revised e-LKPD was then tested on 31 seventh-grade junior high school students.

Students were asked to complete the e-LKPD using their tablets or smartphones. First, they took a pre-test, then worked on the e-LKPD, and finally completed the post-test questions. Some students still struggled with operating Liveworksheets. For example, some experienced automatic logouts, requiring them to restart their answers from the beginning. Additionally, students needed assistance with their tasks as the tools used were still unfamiliar to them.

5.1 Effectiveness Test of Using E-LKPD

After validation, the e-LKPD was then tested on a limited scale with 31 junior high school students. Students were given pre-test and post-test questions to analyze their level of understanding before and after using the e-LKPD. The pre-test and post-test results were analyzed using the N-gain score.

Table 4. Results of the Effectiveness Test Assessment

	Post test	Pret test	N-Gain Score	N-Gain Score(%)
MEAN	90	62,90323	0,72734255	72,73425499

Based on the data above, the N-gain score category for students' science literacy improvement shows that the average post-test results were higher

than the average pre-test results. The N-gain calculation yielded a score of 0.72. According to the N-gain interpretation criteria (Hake, 1999), the gain obtained falls into the high category. The percentage result of the N-gain calculation was 72%, which falls into the fairly effective category. This indicates that the application of the Liveworksheet based on Etno-STEAM Batik Sendang Lestari in the temperature material can improve students' science literacy with a high criterion and an effectiveness percentage within the fairly effective category.

5.2 Practicality Test Based on Student Response Questionnaire

In the next stage, students were given a response questionnaire with three indicators: attractiveness, presentation, and language. They were asked to rate each indicator on a scale of 1 to 4. The results of the questionnaire will be used to assess the practicality of using the e-LKPD, as presented in Table 5.

Table 5. presents the results of the practicality assessment of e-LKPD

No	Aspects Assessed	Question Items	Score		Percentage	Result
			Result	Expectation		
1.	Content	4	1407	1612	87,28%	Very Practical
2.	Presentation	2				
3.	Language	2				
4.	Motivation	2				
5.	Usefulness	3				

From the results above, the implementation of the Etno-STEAM-based e-Student Worksheet (e-LKPD) in the context of Batik Sendang Lestari has proven to be highly practical in enhancing student engagement and understanding of the material, demonstrating that the use of this e-LKPD is highly efficient and beneficial.

6 Evaluate and Revise

After the initial implementation of the Etno-STEAM e-Student Worksheet (e-LKPD) in the context of Batik Sendang Lestari, this study will enter the in-depth evaluation stage. The evaluation will involve analyzing student responses, teaching effectiveness, and the positive impact generated. The results of the evaluation will serve as a foundation for revising and refining the e-LKPD, integrating feedback from students and teachers to ensure that the material remains relevant and effective in the learning process.

CONCLUSION

Based on the research results, the following conclusions can be drawn: (1) The development of the e-LKPD used the ASSURE model and was validated by subject matter experts and media experts, resulting in a valid e-LKPD.

(2) Based on the N-gain score test results, the implementation of the Ethno-STEAM-based Liveworksheet with the context of Batik Sendang Lestari in the temperature material can enhance students' science literacy with a high criterion and an effectiveness percentage categorized as effective. (3) The response questionnaire assessment given to students has proven to be highly practical, and the e-LKPD is deemed suitable for further development. Thus, the e-LKPD developed is valid, effective, and practical.

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