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Development of Student Worksheets for Environmental Based Physics Learning With a STEM Approach for Students SMA Negeri 1 Sendana

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ABSTRACT: This research on the development of student worksheets for environmental based physics learning with a STEM approach aims to: 1) design an student worksheets for environmental based physics learning with a STEM to students SMA Negeri 1 Sendana that is valid from a theoretical and empirical persective, 2) to analyze practitioners asessments of student worksheets for environmental based physics learning with a STEM for students SMA Negeri 1 Sendana, 3) to analyze the effectiveness of student worksheets for environmental based physics learning with a STEM for students SMA Negeri 1 Sendana. The research method with 4D model. The test subjects for this research were class XI IPA 1 students as the control class and XI IPA 4 as experimental class. Based on the results of the analysis, the following concludions wewe obtained: 1) the student worksheets for environmental based physiscs learning with a Stem approach based on theoretical and empirical validity is recommended as suitable for use. 2) the analysis of practitioners' responses to the developed LKPD showed that the average score wa 131,67 which shows very good criteria. 3) the average physics learning outcomes for classes that use Environmentally Based Physics Learning LKPD with a STEM Approach are higher (effective) than the average physics learning outcomes for classes that do not use Environmentally Based Physics Learning LKPD with a STEM Approach. the student worksheets for environmental based physiscs learning with a Stem approach is declared valid, practical and effective so it is suitable for use as a learning resource.

KEYWORDS: LKPD, Environment, STEM, Learning outcomes, theoretical, empirical

INTRODUCTION

The 2013 curriculum is a competency and character-based curriculum that emphasizes the use of a scientific approach in the learning process. This aims to provide students with an understanding of recognizing and understanding various materials using a scientific approach(Mahjatia, Susilowati, & Miriam., 2021). One of the assessments in the 2013 curriculum learning is the cognitive aspect assessment, which can measure students' cognitive abilities during learning (Nabila, Stepanus, & Hamdani., 2020). Based on the results of interviews and observations with physics subject teachers at SMA Negeri 1 Sendana, it shows that the learning that occurs is teacher-centered, and only uses textbooks, using conventional methods, namely learning methods using lectures and practice questions. This is supported by the results of interviews with several students at SMA Negeri 1 Sendana, that learning is only carried out using theory and practice questions. The use of laboratories or practicums for physics subjects is very rare. During the learning process, teachers also rarely connect the material being studied with concepts of everyday life, rarely use LKPD either from publishing institutions or self-made LKPD due to limited facilities and infrastructure. This method makes students bored and does not develop the knowledge obtained from the teacher, so that the learning carried out is less effective. This causes the learning outcomes of students in this category to be less. One of the causes of students' low cognitive abilities is that learning is still teacher-centered, in this case the teacher acts as the center for the information conveyed by the teacher.

Efforts made to overcome the above problems are by developing learning tools. One learning tool that can be developed is LKPD. The application of LKPD can provide motivation and foster students' curiosity about the learning material being studied, namely by using a model that is appropriate to the students' environment or centered on students' activities, such as activities or explanations given that contain problems found in the students' environment, so that participants Students do not have difficulty understanding lessons and can develop their thinking abilities. A good LKPD is a LKPD that suits the needs and characteristics of students which are linked to current developments (Utama, Rahmatan, & Azhar., 2019).

It is feared that the problems above will make students unable to achieve what is expected, such as not achieving the expected competencies, namely cognitive, interpersonal and intrapersonal abilities. It is difficult to understand physics subject matter which they should be able to master to support interrelated learning because cognitive abilities are the basis for learning achievement and capacity building which is needed in preparing students for higher education or the world of work. For this reason, an approach is needed that can connect several scientific disciplines in accordance with the 2013 curriculum, namely an integrative approach. The STEM approach is a learning approach that uses an inter-science approach where the application is carried out using active learning, so that it can guide students in the process of developing cognitive abilities to solve various problems. The STEM approach is one way to make learning more connected and relevant for students (Sukma & Mairi, 2018). Of the several existing studies, there are still few that have conducted research related to the development of environment-based physics learning LKPD using a STEM approach. The development of environment-based LKPD with a STEM approach should be able to overcome the problems of teachers and students.

METHOD

This research wa research and development (R&D) with the Thiagarajan 4D development model.The 4D model consists of 4 main stages, namely, defining, designing, developing and disseminating. This study used research subject were class XI IPA 1 students as the control class and XI IPA 4 as experimental class. It was held in the even semester of the 2022/2023 Academic Year ini SMA Negeri 1 Sendana located on Limbua, Kec. Sendana, Majene Regency. The instruments used in this research were validation sheets, practitioner assessment questionnaire sheets, and physics learning outcome test instruments which has been validated by experts and analyzed using the expert agreement index (Aiken's V). The researchers used the data analys techniques in the from of validation, analysis learning outcome, analysis questionnaires and analysis of the effectiveness of LKPD. The trial design use is "Post-Test Only Design". In this design the test is carried out once, namely after giving the treatment. There are two validation analyzes used, namely face validation analysis and expert validation analysis. The face validation analysis was essessed by 10 people with backgrounds in language aducation, psychology and physics. The analysis used to determine the level of relevance by three experts used the content validity coefficient (Aiken's V) with the following formula (Azwar, 2012):

$$v = \frac{\sum s}{n(r-1)}$$

The terms of the Aiken test, after calculating, if V ≥ 0.4 then the expert agreement index is said to be valid. Field test analysis on learning outcomes tests, namely analysis of question items and reliability. Item analysis is to determine the validity of multiple choice items by using the correlation between the scores of the test items and the total test score calculated using the Point Biserial Correlation equation (Arikunto, 2013):

$$\gamma_{pbi} = \frac{M_p - M_t}{S_t}\sqrt{\frac{p}{q}}$$

Meanwhile, to test the reliability of the learning outcomes test, KR-20 is used with the following formula:

$$r_{ii} = \left(\frac{n}{n-1}\right)\left(\frac{S^2 - \sum pq}{S^2}\right)$$

Percentage of student and practitioner responses to each statement using the criteria according to table 1 and table 2 below:
So, the criteria for seeing student responses can be seen in Table 1

Table 1. Categories of student responses

Interval Class	Category
119 – 139	Very Good
98 – 118	Good
77 – 97	Fair
56 – 76	Less
35 – 55	Very Less

So, the criteria for viewing practitioner responses can be seen in Table 2

Table 2. Practitioner Response Categories

Interval Class	Category
139 – 159	Very Good
112 – 135	Good
88 – 111	Fair
64 – 87	Less
40 – 63	Very Less

The effectiveness of environment-based physics learning LKPD using the stem approach was analyzed using descriptive statistics and inferential statistics. The learning outcome data obtained in this descriptive analysis before being included in the frequency distribution list is by calculating the average using the following formula:

$$\bar{x} = \frac{\sum x_i}{n}$$

As for determining variance, it will first be compiled into a list or frequency distribution table. According to Sudjana (2005), if data from a sample has been arranged in a frequency distribution list, then to determine the better variance (S2), use the following formula:

$$S^2 = \frac{n\sum f_i x_i^2 - (\sum f_i x_i)^2}{n(n-1)}$$

So, the criteria for viewing the categorization of student learning outcome scores can be seen in Table 3

Table 3. Categorization of Student Learning Outcome Scores

Interval Class	Category
16 – 19	Very Good
12 – 15	Good
8 – 11	Fair
4 – 7	Less
0 – 4	Very Less

The inferential statistical analysis used (Kadir, 2015) is as follows:

1. Data Normality Test

Normality test to find out whether the data distribution follows or approaches a normal distribution. Testing was carried out using the Lilliefors test technique. The hypothesis for testing data normality is:

H0: Data is normally distributed

H1: Data is not normally distributed

2. Homogeneity Test

The homogeneity test is used to determine whether several population variants are the same or not

The research hypothesis is:

$H_0: \sigma_1^2 = \sigma_2^2$

$H_1: \sigma_1^2 \neq \sigma_2^2$

3. Mann Whitney U Tesk

The Mann Whiteney test is a non-parametric test used to test whether there are differences between two independent populations. Following are the steps for testing the Mann Whiteney U test:

Statistical hypothesis

$H_0: \mu_1 = \mu_2$: The average learning outcomes of the experimental class are higher than the control class, meaning that there is no difference between the learning outcomes of the class that uses the Environment-based LKPD with a STEM Approach and the class that does not use the Environment-based LKPD with a STEM Approach

$H_1: \mu_1 \neq \mu_2$: The average learning outcomes of the experimental class are smaller than those of the control class, meaning that there is a difference between the learning outcomes of classes that use environmental-based LKPD with a STEM approach and classes that do not use environmental-based LKPD with a STEM approach

RESULT AND DISCUSSION

1. Validation Analysis Results

a. The results of the development analysis are viewed from the face validity side

The results of face validation by 10 people with backgrounds in language education, psychology and physics are Aspect a shows the determination of the items measuring the indicators. Aspect b shows the clarity of the language used (simple and easy to understand). Aspect c shows the quality of the graphic components (paper size/quality, simple typography (type and size of letters) and illustrations (if any) create attractiveness). The results of the analysis are as follows:

(1) **Face validation results of Physics learning LKPD**

Table 4. Face Validation Results of Physics Learning LKPD

Rated aspect		Average	Status
LKPD 1	Shows the accuracy of the measuring indicator items	46.0	ST
	Shows clarity of language used	43.0	J
	Shows the quality of graphic components	43.0	B
LKPD 2	Shows the accuracy of the measuring indicator items	47.0	ST
	Shows clarity of language used	43.3	J
	Shows the quality of graphic components	43.3	B
LKPD 3	Shows the accuracy of the measuring indicator items	46.0	ST
	Shows clarity of language used	42.3	J
	Shows the quality of graphic components	43.7	B
LKPD 4	Shows the accuracy of the measuring indicator items	45.0	T
	Shows clarity of language used	44.3	J
	Shows the quality of graphic components	45.7	SB
LKPD 5	Shows the accuracy of the measuring indicator items	45.0	T
	Shows clarity of language used	45.0	J
	Shows the quality of graphic components	45.0	B

(2) Results of face validation of student and practitioner response questionnaires

The results of the face validation analysis of student and practitioner response questionnaires can be presented in Table 5 below:

Table 5. Results of Face Validation Questionnaire student responses

Rated aspect		Average	Status
Student response questionnaire	Shows the accuracy of the measuring indicator items	45.2	ST
	Shows clarity of language used	45.5	SJ
	Shows the quality of graphic components	45.5	SB
Practitioner response questionnaire	Shows the accuracy of the measuring indicator items	45.1	ST
	Shows clarity of language used	44.6	J
	Shows the quality of graphic components	44.8	B

The face validation analysis that has been carried out is shown in tables 4 and 5 which state that the LKPD for Environment-Based Physics Learning with a STEM Approach is declared feasible to continue to the next stage. The LKPD for Environment-Based Physics Learning with a STEM Approach was declared suitable for use in three aspects of assessment, namely the accuracy of items measuring indicators, clarity of the language used and graphic components.

b. The results of the development analysis are viewed from the perspective of expert validity

(1) Expert validation results of physics learning LKPD

The results of the content validity test were analyzed using the Aiken's V index.

Table 6. Content Validity Analysis Test of Environment-Based Physics Learning LKPD Using a STEM Approach with the Aiken'V Index

LKPD	Aspect	Number of Validity Item Scores	V	Category
LKPD 1	Content Eligibility	15.11	0.69	Valid
	Feasibility of Presentation	10.78	0.67	Valid
	Language Eligibility	11.44	0.64	Valid
	Graphic Eligibility	10.89	0.68	Valid
LKPD 2	Content Eligibility	15.00	0.68	Valid
	Feasibility of Presentation	10.67	0.67	Valid
	Language Eligibility	11.89	0.63	Valid
	Graphic Eligibility	10.89	0.68	Valid
LKPD 3	Content Eligibility	15.11	0.69	Valid
	Feasibility of Presentation	10.78	0.67	Valid

	Language Eligibility	12.00	0.63	Valid
	Graphic Eligibility	10.89	0.68	Valid
LKPD 4	Content Eligibility	15.11	0.69	Valid
	Feasibility of Presentation	10.78	0.67	Valid
	Language Eligibility	12.00	0.63	Valid
	Graphic Eligibility	16.22	1.01	Valid
LKPD 5	Content Eligibility	15.11	0.69	Valid
	Feasibility of Presentation	10.78	0.67	Valid
	Language Eligibility	11.44	0.64	Valid
	Graphic Eligibility	10.89	0.68	Valid

(2) Expert validation results of the Practitioner Response Questionnaire

The results of the content validity analysis test of the expert agreement index for each component are tabulated in table 7 below.

Table 7. Content Validity Analysis Test of the Practitioner Response Questionnaire with the Aiken'V Index

No.	Aspect	Number of Validity Item Scores	V	Category
1.	Instructions for Completing the Questionnaire	4.11	0.69	Valid
2.	Content Eligibility	8,11	0.68	Valid
3.	Feasibility of Presentation	4.33	0.72	Valid
4.	Language Eligibility	4.11	0.69	Valid
5.	Graphic Eligibility	6.44	0.64	Valid

(3) Expert validation results of the Student Response Questionnaire

The results of the content validity analysis test of the expert agreement index for each component are tabulated in table 8 below.

Table 8. Content Validity Analysis Test of Student Response Questionnaire with the Aiken'V Index

No.	Aspect	Number of Validity Item Scores	V	Category
1.	Instructions for Completing the Questionnaire	4.33	0.72	Valid
2.	Content Eligibility	7.67	0.77	Valid
3.	Feasibility of Presentation	5.44	0.78	Valid
4.	Language Eligibility	3.44	0.69	Valid
5.	Graphic Eligibility	7.89	0.72	Valid

The results of expert validation which have been analyzed using Aiken'V theory show that each instrument developed has a V value for each instrument as low as 0.63. Based on Aiken'V theory in Chapter III, if expert justification produces a V value > 0.4 for each instrument developed, then all instruments are valid. So, it can be concluded that all instruments developed in terms of expert validity with a validity index (V) are suitable for use in the research process.

2. Analysis of Learning results tests

a. Expert Validity Analysis

The learning outcome test instrument was validated by three experts. Based on the results of the validation analysis of the questions, the results of the content validity of the learning outcomes test items that will be tested in this research obtained a mean (V) of 0.70 and are in the valid category.

b. Field test

(1) Item Validity Analysis

Based on the results of the validity analysis of the question items, 17 valid question items were obtained with a point biserial coefficient value greater than r table = 0.276 with a significance value of 0.05.

(2) Reliability

Based on the results of the analysis of the learning outcomes test instrument, it has a reliability of 0.75, which means it is reliable. This shows that 75% of the variations in learning outcomes tests consist of elements that contain truth and the remaining 25%

contain elements of error. Theoretically, an instrument is declared reliable if the reliability coefficient is at least 0.6 (Sugiono, 2019). So the instrument is said to be good and suitable for use as an assessment instrument.

3. Logical Validity (Logic Validity)

Based on the learning outcome test instrument grid before and after the trial, it appears that all aspects or indicators after the trial, both theoretically and empirically, are in accordance or represented on the grid before the trial. This shows that all instruments have met the elements of logical validity.

4. Results of Analysis of Student Responses to LKPD for environment-based physics learning with a STEM approach

Limited trial of environment-based Physics learning LKPD with a STEM approach on research subjects, namely 31 students in class XI Science. Based on the results of limited trials, student responses to the LKPD were obtained in Table 9.

Table 9. Results of Student Response Questionnaire Analysis

Interval Class	Frequency	Percentage (%)	Category
119 – 139	4	12.9	Very Good
98 – 118	25	80.6	Good
77 – 97	2	6	Fair
56 – 76	0	0	Less
35 – 55	0	0	Very Less
Amount	31	100	

Overall, based on the results of the descriptive analysis of students' response scores to the LKPD, the average score was 109.4, in the interval class 98-118 and in the good criteria.

5. Results of Analysis of Practitioner Responses to LKPD for environment-based physics learning with a STEM approach

The results of the analysis based on the assessment of practitioners' responses to the Physics LKPD developed are shown in Table 10

Table 10. Results of Questionnaire Analysis of Practitioner Responses to LKPD

Interval Class	Frequency	Percentage (%)	Category
136 – 159	4	66.67	Very Good
112-135	2	33.33	Good
88 – 111	0	0	Fair
64 – 87	0	0	Less
40 – 63	0	0	Very Less
Amount	6	100	

Practitioner responses to the physics learning LKPD were obtained from 6 practitioners, 3 of whom were physics teachers at SMAN 1 Sendana. The response given by practitioners to the Physics LKPD that was developed was good, where the average score was 139.5 which was in the very good category. In line with the research results of Ramli, Yohandri, Sari & Selisme (2020), it is stated that STEM-based Physics LKPD has practical criteria consisting of ease, practicality and attractiveness. Research conducted by Mahjatia, Susilowari, & Miriam (2020), also shows that STEM-based LKPD is in the practical category.

6**. Results of analysis of the effectiveness of environment-based physics learning LKPD using a STEM approach**

(a) Descriptive Analysis

Table 11. Categorization of Student Learning Outcome Scores

Interval Class	Category
16 – 19	Very high
12 – 15	Tall
8 – 11	Currently
4 – 7	Low
0 – 4	Very Low

The posttest results from the experimental class and control class are as follows

Table 12. Learning outcome scores for experimental and control classes

Statistics	**Statistical Score**	
	Experiment	**Control**
Sample Size	31	28
Highest Score	17	17
Lowest Score	0	0
Empirical Highest Score	17	15
Empirical Lowest Score	7	5
Empirical Score Range	10	10
Average Score	12,355	9,643
Standard Deviation	3,050	3,021
Variance	9,303	9,127

Based on Tables 11 and 12, it can be seen that the average score obtained by students who were taught using the Environment-Based Physics Learning LKPD with a STEM Approach was 12.355 in the class interval 12-15, which means they were in the high category with the highest score being 17 and the lowest score 7 and the standard deviation obtained is 3.050 with a variance of 9.303. Meanwhile, the average score obtained by students who were taught using conventional methods was 9.643 in the 8-11 interval class, which means they were in the medium category with the highest score of 15 and the lowest score of 5 and the standard deviation was 3.021 with a variance of 9.127.

(b) Inferential Statistical Analysis

1) Normality Test Results

The results of the normality test calculations in this study are as follows:

Table 13. Normality Test Results of Physics Learning Outcomes Scores for Experiment Class and Control Class

Data	**eriment**	**trol**	**ision**
			mally Distributed Data
L^2_{hitung}	2	6	
L^2_{tabel}	5	7	

2) Homogeneity Test Results

The results of the homogeneity test calculations in this study are as follows:

Table 14. Homogeneity Test Results of Physics Learning Outcomes Scores for Experiment Class and Control Class

Data	**Experiment**	**Control**
Variance	9,303	9,127
X^2_{hitung}	0.0026	
X^2_{tabel}	0.455	

3) Mann Whiteney U

To get these results, researchers used Microsoft Excel with analysis for the Mann Whitney U test to test the hypothesis, it can be seen from the table by comparing the 5% significance value, namely 0.05, with the p value = 0.0007 obtained from the probability table relating to the price Z = -3.19. So, the result is 0.0007 < 0.05, proving that H0 is rejected. So, it can be concluded that the average physics learning outcomes for classes that use Environmentally Based Physics Learning LKPD with a STEM Approach are higher than the average physics learning outcomes for classes that do not use Environmentally Based Physics Learning LKPD with a STEM Approach. Further differences can be seen from the descriptive analysis of the experimental class and control class. Based on the results of the descriptive analysis, the average value for the experimental class was 12.355, while the average value for the control class was 9.643, the standard deviation for the experimental class was 3.050, while the standard deviation for the control class was 3.021 and the variance for the experimental class was 9.303, while the variance for the control class was 9.127. From the results of the descriptive analysis of the two classes, it can be concluded that the experimental class has a higher score than the control class. So by using environment-based LKPD with a STEM approach, it is effective for learning physics. This is in line with research conducted by Artiani (2020) and Samal (2021) that the application of STEM-based LKPD is effective in improving student learning outcomes. In research conducted by Widyasari (2019), the development of local wisdom-based LKPD can improve students' mastery of science concepts and process skills.

CONCLUSIONS

Based on the results of the research and discussion, it can be concluded that: the results of the development of Environment-Based Physics Learning Worksheets with a STEM Approach are reviewed theoretically and empirically as follows: a) Theoretically: Based on face validation from 10 respondents, it shows that the accuracy of the items measuring indicators, the clarity of the language used, the graphic components for all instruments used are feasible and can be used in research.Based on expert validation from 3 physics lecturers, it shows that all the instruments used are valid and can be used for field trials and are effective. its implementation. b) Empirically: based on the results of the analysis of the questions, 17 of the 40 question items were valid and could be used as a learning outcomes test instrument with a reliability of 17 which means reliable. Reliability 0.75. c) Logical validity shows that the learning outcome test instrument grid before and after the trial shows that all aspects or indicators after the trial both theoretically and empirically are in accordance or represented on the grid before the trial. This shows that all instruments have met the elements of logical validity. The average physics learning outcomes for classes that use Environmentally Based Physics Learning LKPD with a STEM Approach are higher (effective) than the average physics learning outcomes for classes that do not use Environmentally Based Physics Learning LKPD with a STEM Approach.

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REFERENCES

1) Arikunto, S. 2010. Research Procedures, a Practical Approach. Jakarta: Rineka Cipta
2) Artiani, L. 2020. Development of Student Worksheets (LKPD) Using a Picture-Based Science, Technology, Engineering, and Mathematics (STEM) Approach. Lampung: Raden Intan State University
3) Azwar, S. 2012. Reliability and Validity. Yogyakarta: Student Library
4) Kadir. 2015. Applied Statistics (Concepts, Examples and Data Analysis with the SPSS/Lisrel Program in Research. Jakarta: PT Raja Grafindo
5) Mahjatia, N., Susilowati, E., & Miriam, S. 2021. Development of STEM-based LKPD to train students' science process skills through guided inquiry. Scientific Journal of Physics Education, 4(3), Article 3.
6) Ramli, R., Yohandri, Sari, YS, Selisne, M. 2020. Development of Physics Student Worksheets Based on Science, Technology, Engineering, and Mathematics Approaches to Improve Students' Critical Thinking. Journal of Educational Exacts
7) Samal, N., Ramlawati & Rusli, MA 2021. Application of STEM-based LKPD to improve the learning outcomes of Class VII students at SMPN 8 Makassar (Studies on Solar System Material). Proceedings of the National Science Education Seminar II
8) Sudjana. 2005. Statistical Methods. Bandung: Tarsito
9) Sugiono. 2019. Research and Development Methods. Bandung: Alphabeta.
10) Sukma & Mairi. 2018. The influence of the STEM (Science, Technology, Engineering and Mathematics) approach on knowledge, attitudes and beliefs. Proceedings of the National Seminar on MIPA IV
11) Utama, NG, Rahmatan, H., Azhar. 2019. Implementation of LKPD Based on Learning Cycle 5E Integrated with Islamic Values on Student Learning Outcomes in Middle Schools. Indonesian Journal of Science Education 7(1), 47-54
12) Widiyasari, AK 2019. Development of LKS (Student Worksheets) for Physics Based on Local Life to Improve Students' Mastery of Concepts and Science Process