



**DEVELOPMENT OF STUDENT WORKSHEETS BASED ON PjBL USING
LIVEWORKSHEET ON TEMPERATURE AND HEAT MATERIALS TO INCREASE
STUDENT LEARNING OUTCOMES SMP NEGERI 29 MEDAN T.P 2023/2024**

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Abstract

This study aims to see the feasibility based on the assessment of material experts, language and learning experts, design experts, the responses of educators and students as well as the effectiveness of the Student Worksheets Based on PjBL Using Liveworksheet on Temperature and Heat Material to Increase Student Learning Outcomes at VII Junior High School students. The sample of this study was students of class VII-5, totaling 32 people. This type of research is Research and Development (R&D) using the ADDIE model. The instrument used in this study consisted of a material expert validation questionnaire, language and learning experts, design experts, a questionnaire for educators and students' responses. The test is in the form of an essay to measure the level of students' learning outcome on Temperature and Heat material. Based on the results of the study obtained data from material expert validation of 84%, validation of language and learning experts 97,33% and validation of design experts 82,66% with each in the strongly feasible category. The response of students with 32 people was 85,33% and teacher response was 92% in the strongly feasible category. So based on the results of the students' worksheet validation, this is suitable for use in the learning process. Students' worksheet which is designed effectively to increase students' learning outcomes, the results of students' learning outcomes are obtained with an average N-Gain value of 0.72 with high criteria.

Keywords: PjBL, Liveworksheet, Learning Outcomes.

Introduction

Science education in secondary schools is formulated not only as a standalone subject but also as an integrated science curriculum. Both educational approaches are perceived as means to cultivate thinking skills, learning proficiency, curiosity, compassionate attitudes, and a sense of responsibility toward the natural and social environment. Integrative science melds various components, including attitudes, knowledge, and skills. To facilitate fruitful science learning, the learning environment must vigilantly track advancements in science and technology. The caliber of the learning environment significantly shapes the quality of the employed learning outcomes (Handika, 2020).

Currently, science learning activities still minimally utilize teaching materials that keep pace with developments in science and technology. Based on research by Aisyah (2020), teaching materials have the potential to transform learning activities, making them more engaging. This transformation provides students with the opportunity to learn independently, reducing their reliance on the teacher's presence. Consequently, students find it easier to master each competency required. In reality, many teachers face challenges in comprehending teaching materials and exhibit limited creativity in their development. For instance, teachers persist in using traditional tools such as books and blackboards during the learning process.

One learning media that is considered effective is media that involves students directly (students become the center of the learning process/student center learning) especially in terms of increasing achievement (Dishinta, 2020). Media that allow it to be used include online-based worksheets.

Based on the results of observations and interviews conducted by researchers with science teachers at SMP Negeri 29 Medan, there are several obstacles, including: (1) emphasis on teachers being able to develop media or teaching materials that utilize technology so that students can learn by following technological developments, (2) teachers have not fully implemented Student-

Centered Learning (SCL), (3) teachers have never used Student Worksheets in teaching and learning activities in class due to a lack of understanding of how to create technology-based teaching materials, and (4) decreased student learning outcomes due to students' understanding of learning material is hampered.

From the obstacles above, researcher together with teacher looked for solutions to overcome these learning problems by developing Student Worksheets based on PjBL using Liveworksheets, Student Worksheets that are student-centered, technology-based, and can increase learning outcomes.

Research Method

This type of research is Research and Development (R&D) to develop Student Worksheet on Temperature and Heat material with ADDIE model. Research and Development is a method for developing and validating products that will be applied in learning. This research was carried out from Februari to March 2024 at SMP Negeri 29 Medan. The population in this research were students from class VII consisting of 160 students. The sample studied is representative of one class from the entire class VII population. The research sampling technique used was simple random sampling. Simple random sampling is a technique for sampling members of a population that is carried out randomly, without paying attention to the strata in the population (Hardani et al., 2020). There are 4 data collection techniques in this research, namely Observation, Interviews, questionnaire, and Test. The instruments used in this research consisted of: 1) validation of the material expert questionnaire, 2) validation of the language and learning expert questionnaire, 3) validation of the design expert questionnaire, 4) student and educator responses, and 5) test questions on student learning outcomes.

Result and Discussion

a. Analysis Stage

1. Analysis of Student Needs

Researchers carried out an analysis of student needs to determine the needs of each student regarding Student Worksheets in science learning. Table 1 below is the result of the analysis of student needs.

Table 1. Results of the Analysis of the Students Needs

No	Question Criteria	Score	Category
1	Do teachers use learning media in implementing science learning?	44.4%	Low
2	Is the applied science learning easy to understand without learning media?	55.5%	Low
3	Do teachers use teaching strategies that involve students in teaching science?	44.4%	Low
4	Does the teacher present Student Worksheets in the science learning process?	33.3%	Low
5	Is the implementation of the activities in the Student Worksheet given by the teacher technology-based?	77.7%	Low
6	Does the teacher involve students a lot in learning?	55.5%	Low
7	Are the Student Worksheets given by the teacher presented in an attractive and innovative appearance?	44.4%	Low
8	Can teachers create a creative and enjoyable science learning process without technology-based Student Worksheets?	55.5%	Low
9	Are you satisfied with the current	55.5%	Low

	implementation of science learning using Student Worksheet?		
10	Is implementing science learning in class without Student Worksheet media able to improve your learning outcomes?	44.4%	Low

Based on Table 1, it can be concluded that students need Student Worksheets in learning science. This is evidenced by the lack of teachers presenting Student Worksheet in science learning at 33.3%.

2. Analysis of Student Characteristics

Analysis of student characteristics was carried out by researchers to determine the characteristics of each student regarding the required Student Worksheet. Table 2 below is the result of the analysis of student characteristics

Table 2. Results of the Analysis of the Students Characteristics

No	Question Criteria	Score	Category
1	It is easier for me to understand learning after using electronic teaching materials	66.6%	High
2	I felt tense and afraid while participating in science learning activities	33.3%	Low
3	I am more enthusiastic about taking science lessons that use electronic learning media	77.7%	High
4	I am more enthusiastic about learning science with innovative methods	55.5%	High
5	I am more enthusiastic about using the student-	44.4%	High

	centered Electronic Student Worksheet		
6	I feel bored if teaching and learning activities do not use the Electronic Student Worksheet	44.4%	High
7	I find it difficult to use the Electronic Student Worksheet during science learning activities	44.4%	Low

Based on Table 2, it can be concluded that students need an Electronic Student Worksheet and student-centered activities. This is supported by the results of the analysis which states that students are more enthusiastic about taking science lessons that use electronic learning media by 77.7%.

3. Analysis of Teachers' need

The teacher needs analysis aims to identify products that are suitable for use in learning activities based on teacher needs regarding Student Worksheets. The results of the teacher needs analysis can be seen in Table 3 below.

Table 3. Results of the Analysis of the Students Characteristics

No	Problems and Needs of Teacher
1	The limited ability of teachers to create learning media that is able to involve student activities
2	Teachers need learning media that can improve student learning outcomes
3	Teachers need technology-based, innovative and interesting learning media

Based on Table 3, the results of interviews conducted by researchers with class VIII science teachers at SMP Negeri 29 Medan, the researchers concluded that the learning media used by students did not match the characteristics and needs of students so that students were less active in carrying out learning using existing learning media. Learning media such as the Electronic

Student Worksheet used have not been able to improve student learning outcomes. Therefore, it is necessary to develop a Student Worksheet based on PjBL using Liveworksheet.

b. Design Stage

1. Cover

The Student Worksheet cover is created using Microsoft Word. The images used are adapted to the material theme, namely temperature and heat, plus images of substances, wax and hot steam. The colors used are blue and white for the personal identity column on the bottom right, containing name, class and class as in Figure 1.

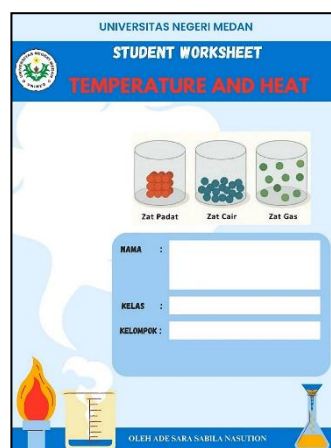


Figure 1. Cover of worksheet

2. Contents

The content of the material in the developed LKPD is in the form of a table of contents, instructions for using the LKPD, concept map, activity title, KI, KD, achievement indicators, learning objectives, materials, activity procedures, observation tables, questions and conclusions, final evaluation, colored images as in Figure 2.

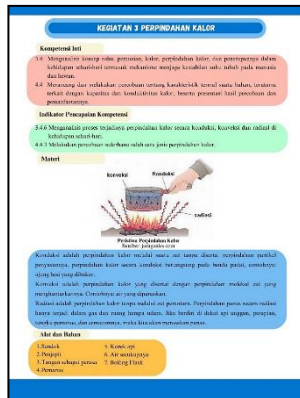


Figure 2. Contents of worksheet

c. Development Stage

1. Material Expert Validation

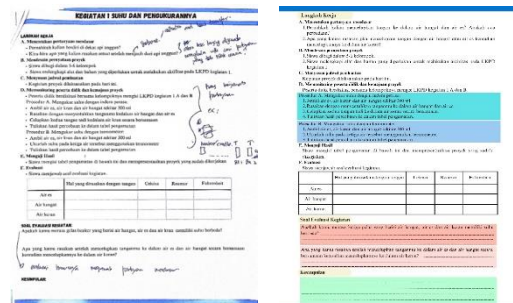
Validation of material on Student Worksheet is carried out to determine expert assessments in improving the quality of the material. The results of validations from material experts can be seen in Table 4.

Table 4. Material Expert Validation Results

No	Indicator	Score
1	Supporting the competency achievement indicators in accordance with the Indicator Criteria in the Independent Curriculum	3
2	Suitability of Basic Competencies with learning objectives	4
3	Suitability of material to learning objectives	4
4	The truth of the concept in Temperature and Heat material	4
5	Suitability of learning material objectives with usefulness for students	4
6	Presentation of material related to life	5
7	The presentation of the material is presented coherently and systematically	4
8	The presentation of the material is presented systematically	5
9	The presentation of the material content can be understood easily	5
10	The presentation of the material is supported by picture illustrations	4
11	Conformity of material with facts	4
12	The suitability of the material presented to a problem	5

13	The activity procedures in the Worksheet are in accordance with the Project Based Learning (PjBl) syntax	4
14	Use straightforward, communicative and clear language in delivering Worksheet material and activities	4
15	Use standard, clear sentences that do not contain double meanings in delivering Worksheet material and activities	4
Total Score		63
Average Percentage		84%
Category: Strongly feasible		

Based on Table 4, the Student Worksheet based on PjBL using Liveworksheet is declared very suitable for use without revision. The total score given by material experts to the indicators presented is 63 out of 75. So the percentage of material expert assessments is 84% and this assessment is included in the strongly feasible category. The Student Worksheet can be said to be appropriate because the topic presentation is based on real problems. The topics raised in the Student Worksheet must be related to facts or occur in real life so that students can more easily understand the meaning of the problem and students can get used to practicing interpreting various problems or information obtained (Zahroh and Yuliani, 2021).



a). Before

b). After

Figure 3. Material Expert Revision

2. Language and Learning Expert Validation

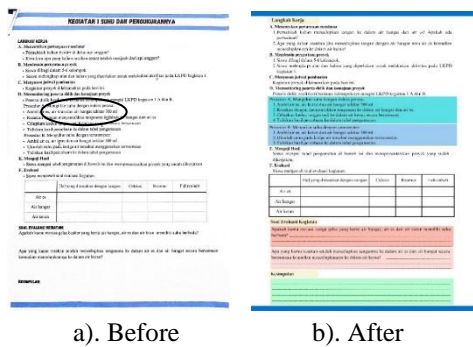
Validation of language and learning experts on student worksheet is carried out to determine expert assessments in improving the quality of language and learning. The results of validation from material experts can be seen in Table 5.

Table 5. Language and Learning Expert Validation Results

No	Indicator	Score
1	Suitability of Worksheet with the Project Based Learning (PjBL) learning model	5
2	The language presented in the Worksheet is communicative	5
3	In its presentation it does not contain double (ambiguous) meanings.	5
4	The writing of foreign words (use of foreign language) is in accordance with PUEBI	5
5	Accurate use of terms and symbols in presenting Worksheet	3
6	Ease of understanding the flow of material through the use of language	5
7	The sentence structure used is in accordance with EYD	5
8	Phenomenon cases give rise to activities that involve the active participation of students and teachers	5
9	Evaluation questions can encourage students to find solutions	5
10	The ability of Worksheet to help students understand the concept/material of Temperature and Heat	5
11	The activities presented direct students to build their knowledge independently	5
12	Providing a column for conclusions and student evaluation of learning activities that have taken place	5

13	Instructions for carrying out assignments in the worksheets are understandable	5
14	Use standard, clear sentences and do not contain double meanings in conveying the contents of the Worksheet	5
15	Suitability of Worksheet with the Project Based Learning (PjBL) learning model	5
Total Score		73
Average Percentage		97,33%
Category: Strongly feasible		

Based on Table 5, the PjBL-based Student Worksheet using the Liveworksheet developed is declared very suitable for use and needs to be revised. The total score given by language and learning experts to the indicators presented is 73 out of 75. So the percentage of language and learning experts' assessment is 97.33% and this assessment is included in the strongly feasible category. The Student Worksheet needs improvement in the use of terms and symbols. Based on research by Fadhillah et al., (2020), the language assessment component uses eight indicators, namely 1) The language used is appropriate to the students' level of thinking, 2) The language used in the worksheet has polite (ethical) values, 3) The language used in the worksheet has aesthetic value so that students enjoy reading it (aesthetic), 4) The language used is communicative and informative so that the message conveyed is easy to understand (educational), 5) The language used does not have double meaning, 6) The terms used are in accordance with the technical terms of scientific knowledge. agreed, 7) The language used is in accordance with the rules of good and correct Indonesian grammar, 8) The spelling used refers to EYD.



a). Before b). After
Figure 4. Language and Learning Expert Revision

3. Design Expert Validation

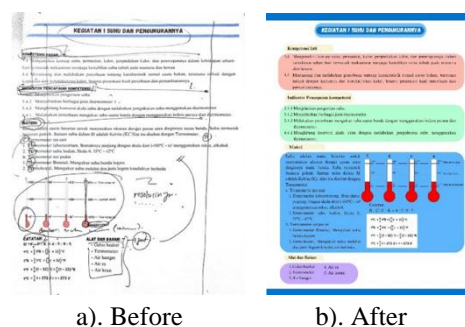
Design validation on Student Worksheet is carried out to determine expert assessments in improving design quality. The results of revisions from design experts can be seen in Table 6.

Table 6. Design Expert Validation Results

No	Indicator	Score
1	Worksheet size in accordance with ISO standard A4 (210 x 297 mm), Font 12, Times New Roman, 1.5 spacing.	5
2	Writing titles is clear, consistent and proportional	4
3	Proportional margin field	4
4	Appearance for layout on cover	4
5	Accurate use of color elements	4
6	The letter size of the Worksheet title is more dominant and proportional	5
7	The font size and type are easy to read	4
8	The cover and physical appearance of the Worksheet attract students' attention	4
9	The placement of layout elements is consistent	4
10	The separation between paragraphs is clear	5
11	Presentation of clear image quality	3
12	The use of images supports the content of the material	4

13	Conformity of language with good and correct Indonesian language rules	4
14	Suitability of evaluation questions with the material presented	4
15	Availability of conclusion column	4
Total Score		62
Average Percentage		82,66%
Category: Strongly feasible		

Based on Table 4.9, the Student Worksheet based on PjBL using Liveworksheet is declared very suitable for use and needs to be revised. The total score given by Design experts to the indicators presented is 62 out of 75. So the percentage of Design experts' assessment is 82.66% and this assessment is included in the strongly feasible category. The Student Worksheet needs improvement in image quality. Based on research by Utami, (2020), images are a medium that has the function of conveying messages through the sense of sight. Pictures can help teachers explain material or other things that cannot be reached or seen directly so that they can help students understand the material being presented.



a). Before b). After
Figure 5. Design Expert Revision

d. Implementation Stage

1. Student Responses

At this stage the researcher conducted a limited group trial with a total of 32 students to determine the effectiveness of the LKPD in improving student learning outcomes. Student responses can be seen in Table 7 below.

Table 7. Results of Student Responses

No	Indicator	Score
1	Clarity of learning objectives to be achieved in the worksheet	140
2	Clarity of the font and type of writing presented in the worksheet	126
3	Conformity of the images presented with the Temperature and Heat material	120
4	The use of sentences in the worksheet is easy to understand	152
5	Accuracy of color selection on the worksheet	134
6	Worksheets make it easier for students to understand the material	136
7	Worksheets motivate students to express their opinions	112
8	worksheets help students apply material in everyday life	144
9	The worksheet helps students in implementing projects on material	142
10	worksheets help students gather information about the material	128
11	The language used in the worksheets is simple and straightforward	128
12	The type and size of the font on the worksheet becomes more attractive	136
13	Instructions for using the worksheet are easy to understand	128
14	The display on the worksheet is interesting to read	138
15	Presenting the questions on the worksheet helps students understand the material	136
Total Score		2000
Average Percentage		83,33%
Category: Strongly feasible		

Based on Table 4.7, the PjBL-based Student Worksheet using the developed Liveworksheet is declared very suitable for use without revision. The total score given from 32 responses to the indicators presented is 2000 out of 2400. So the percentage of

student response assessments is 83.33% and this assessment is included in the strongly feasible category.

2. Teacher Responses

The results of the science teacher responses can be seen in Table 4.8 below.

Table 7. Results of Teacher Responses

No	Indicator	Score
1	Presenting Worksheet can encourage students' curiosity	4
2	Worksheet presentation provides examples of case related to life	5
3	Presenting Worksheet can trigger students to play an active role when learning	5
4	Presentation of Worksheet in accordance with Basic Competencies	5
5	Presenting Worksheet can trigger students to play an active role when learning	5
6	Illustrations on worksheets can motivate students to understand the material	4
7	Presenting questions in worksheets can improve student learning outcomes	5
8	Suitability of language to the level of development of students	5
9	The language on the worksheet is in accordance with Indonesian language rules	4
10	The language used in the Worksheet is understandable	5
11	The language used in Worksheets is simple and straightforward	5
12	The type and size of the font (letters) on the worksheet becomes more attractive	4
13	Instructions for using LKPD are clear and easy to understand	4
14	The display on the LKPD is interesting to read	4
15	The presentation of questions on the LKPD helps students understand the material	5
Total Score		69
Average Percentage		92%

Category: Strongly feasible

Based on Table 4.8, the PjBL-based Student Worksheet using the developed Liveworksheet is declared very suitable for use and needs to be revised. The total score given by the science teacher to the indicators presented is 69 out of 75. So the percentage of student response assessments is 92% and this assessment is included in the strongly feasible category.

e. Evaluation Stage

At this stage the researcher gave the students a final test in the form of a post-test. After that, an N-Gain Test was carried out to get an increase in student learning outcomes. Data obtained from N-Gain calculations related to increasing student learning outcomes calculations are presented in Table 4.9 below.

Table 9. Calculation Results of N-Gain

Class	Score Average			Criteria
	Pre-Test	Post-Test	N-Gain	
VII-5	36	83	0,72	High

Based on Table 4.9, the increase in student learning outcomes above shows an N-Gain value of 0.72 and is included in the high criteria.

Conclusion

Based on the results of the research and discussion on the development of Student Worksheet based on PjBL using Liveworksheet on Temperature and Heat material in class VII which has been stated previously, the following conclusions can be drawn:

a. Student Worksheet based on PjBL using Liveworksheet which was developed using the ADDIE method on Temperature and Heat material was declared valid after being validated by material experts and obtained an average percentage of 84%, with the strongly feasible category.

b. Student Worksheet based on PjBL using Liveworksheet which was developed using the ADDIE method on Temperature and Heat material was declared valid after being validated by language and learning experts and obtained an average percentage of 97.33% with the strongly feasible category.

c. Student Worksheet based on PjBL using Liveworksheet which was developed using the ADDIE method on Temperature and Heat material was declared valid after being validated by design experts and obtained an average percentage of 82.66% in the strongly feasible category.

d. The Student Worksheet based on PjBL using Liveworksheet which was developed is suitable for use in learning by students, this can be seen from the results obtained from student responses of 83.33% with the strongly feasible category.

e. The Student Worksheet based on PjBL using Liveworksheet which was developed is suitable for use in learning by educators, this can be seen from the results obtained from the educator response of 92% with the strongly feasible category.

f. Student Worksheet based on PjBL using Liveworksheet which was developed effectively to improve student learning outcomes in Temperature and Heat material. The percentage results obtained with an average pretest score of 36 and posttest 83 and N-Gain of 0.72.

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