# APPLICATION OF STEM-BASED WORKSHEETS TO INCREASE INTEREST AND LEARNING OUTCOMES OF 5TH GRADE STUDENTS IN CHANGING STATES OF MATTER

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| Article Info | Abstract |
|---|---|
| | This research aims to increase the interest and learning outcomes of 5th grade students at SDN Triwung Lor 2 by applying STEM-Based student worksheets on the material of changing state of matter. This research is a Classroom Action Research (CAR) conducted on 22 students of 5th grade at SDN Triwung Lor 2 Probolinggo City, consisting of 10 male and 12 female students. The data were collected through observation sheets, questionnaire sheets, pre-tests, and post-tests. The increase in student's interest and learning outcomes was calculated by N-gain. The results showed that STEM-based worksheets could increase student's interest and learning outcomes with the N-gain score on learning interest of cycle I and cycle II included with low criteria. While the learning outcomes experienced an insignificant increase because the learning outcomes in cycle I were included in the moderate criteria and cycle II were included in the low criteria. This research concludes that the application of STEM-based worksheets can increase student's interest and learning outcomes.<br><br>**Keywords:** Student Worksheets; Learning Interest; Learning Outcomes |

## A. Introduction

The Minister of Education and Culture issues Circular No. 3 of 2020 on Education Units and No. 36962/MPK.A/HK/2020 regarding the implementation of Education in the Covid-19 Emergency Period, teaching and learning activities are conducted online to prevent the spread of Covid-19 (Menteri Pendidikan, 2020).

The results of Yunitasari & Hanifah's research (2020) state that online education has a huge impact on students' learning interests, because various learning processes cause students to feel lazy or have no desire to take part in online learning that has been planned by the school due to reduced students' learning interests.

Based on the observation results by researchers while teaching at SDN Triwung Lor 2 Probolinggo City, found that students' learning outcomes from the results of the Mid-Semester Assessment (PTS) of science subjects from 5th grade students still did not fulfill the minimum completeness criteria, the use of student worksheets in this school is still not implemented, even the 5th grade teachers are not aware of the student worksheets existence that has been used by several schools in Indonesia, and students have no interest to participate in the learning. The not maximized use of learning media will cause learning not to run smoothly and makes students get bored quickly (Windiyani *et al.,* 2018: 92).

The cause of decreased students' interest in learning is the current implementation of online learning not all students can follow it because not all students have the means that can support online learning (Huzaimah & Amelia, 2021: 524).

The use of student worksheets in learning can be another method for teachers to concentrate the study or inform certain activities and as a learning tool that speeds up the time when delivering learning materials (Fithri, et al., 2021:556)

The student worksheet is one of the learning tools that aims to expand student learning activities, empower students to learn on their

own according to their capacities and interests in stimulating learning activities, and as a variety of learning methods that aim to prevent students from becoming tired when studying (Muthoharoh *et al.,* 2017: 14). Based on the interview results with one of the teachers at the school, the teacher was still unfamiliar with teaching materials or learning media in the form of STEM-based worksheets during the learning process, especially science learning.

Science learning should be attractive with the assumption that there is an increase in the learning outcomes, especially the consequences of capacity, ability, and mentality, which are evaluated with estimation results using tests that emphasize students' learning exercises (Jannah *et al.,* 2020). The purpose of science learning is a mode for students to be able to explore and digest the natural phenomena around them scientifically so it can assist students in gaining a deeper understanding (Laksita *et al.,* 2017: 33).

The worksheet combined with the STEM approach will bring more

information to students globally, connecting mathematics and various sciences, such as the research of Febriyanti & Maryani (2020) states that the STEM approach on the worksheets is in experimental material and practice.

Based on the pre-cycle results of $5^{th}$ grade students, it was found that the learning interests and learning outcomes of $5^{th}$ grade students were still relatively low. The limitations in the learning process have an impact on the quality of students' skills (Maulida *et al.,* 2021: 135). Thus, students need learning media innovations that can increase students interests and learning outcomes while carrying out online and offline learning. STEM-based worksheets are the latest learning media to be applied to students, so this research is very influential in increasing students' interest and learning outcomes.

Therefore, this research aims to examine the increase in students' learning interest and learning outcomes after using the STEM-based worksheets learning media in the material of changing states of

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matter in 5th grade of SDN Triwung        Lor 2 Probolinggo City.

## B. Research Methodology

Based on the research objectives to increase elementary school students learning interest and learning outcomes by applying the STEM-based worksheets learning media, the suitable type of research is classroom action research. Sanjaya (2016) suggests that classroom action research is defined as an assessment that concentrates on learning problems in students' study rooms through self-reflection with the ultimate goal of solving problems through ways to conduct arranged activities in real situations and investigate any effects of that treatment.

This CAR is conducted collaboratively and participative, where collaborative means that researchers work together with the class teachers, and participative means that researchers are assisted by their colleagues who are called observers (Rahayu *et al.,* 2018).

The subjects in this research were the 22 students of 5th grade at SDN Triwung Lor 2 Probolinggo City in the 2021/2022 academic year,

consisting of 10 male and 12 female students. This classroom action research was conducted from November to December 2021, consisting of two action cycles. Action research has an iterative work process or often referred to as a cycle.
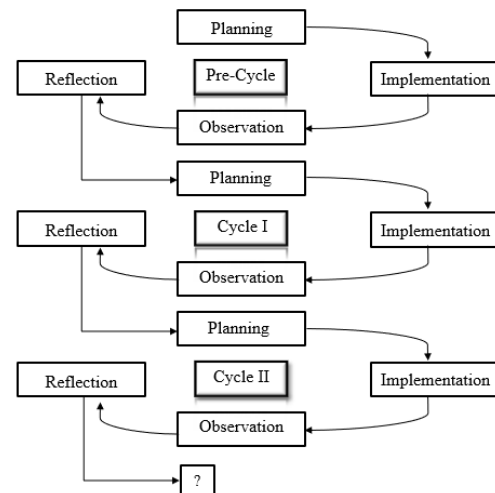


**Figure 1. Classroom Action Research Cycle (Arikunto, 2015)**

This research was conducted in three cycles as shown in Figure 1, where each cycle consists of planning, action implementation, observation, and reflection. To obtain data on student's interests and learning outcomes in this research, the instrument used are: 1) Student questionnaire instrument is used to

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measure students' learning interest in the science learning process using STEM-Based worksheets media; 2) cognitive tests in the form of pre-test in the pre-cycle and post-test in cycle I and cycle II. The cognitive tests are used to determine students' learning outcomes during the science learning process using STEM-Based worksheets media.

While the data analysis used in this research is quantitative data analysis. Quantitative data were obtained from the results of students' learning interest questionnaires, observations of student interests, and cognitive tests.

Based on the calculation results of the percentage score, the obtained qualitative criteria of students' learning interests can be seen in table 1 below (Anggraeni *et al.,* 2021).

**Table 1**
**Learning Interests Criteria**

| Percentage (%) | Criteria |
|---|---|
| $81,25 <$ Score $\leq 100$ | Very Good |
| $62,50 <$ Score $\leq 81,25$ | Good |
| $43,75 <$ Score $\leq 62,50$ | Fair |
| $0 \leq$ Score $\leq 43,75$ | Poor |

The success of STEM-Based LKPD implementation is also supported by students' learning

outcomes through the given cognitive tests to students at the end of each cycle. The data analysis is conducted to determine students' learning outcomes individually and classically, especially for students who can be said to be complete in learning if they have achieved a score of $\geq 70$ from the highest score of 100.

Students learning outcomes criteria after conducting the learning process according to Masyhud (2014: 204), can be seen in table 2 below.

**Table 2**
**Learning Outcomes Criteria**

| Score Range | Criteria |
|---|---|
| 80 – 100 | Very Good |
| 70 – 79 | Good |
| 60 – 69 | Fair |
| 40 – 59 | Poor |
| 0 – 39 | Very Poor |

In this case, the data of students' learning interests and learning outcomes were analyzed using the average normalized N-gain score to calculate the increase in students' learning interest and cognitive learning outcomes before and after learning science using STEM-based worksheets learning media.

After obtaining the results from the N-gain score formula on the assessment results of students'

learning outcomes from the final test of each cycle, the N-gain classification can be inspected in table 3 below (Wijaya *et al.,* 2021: 40).

**Table 3**
**N-gain Classification**

| N-gain Score | Criteria |
|---|---|
| N-gain $\geq 0,70$ | High |
| $0,30 \leq$ N-gain $< 0,70$ | Medium |
| N-gain $< 0,30$ | Low |

## C. Result and Discussion

The research begins with conducting initial observations or pre-cycle implementation. Before starting the learning process with STEM-based worksheets, the practice questions and questionnaires of learning interests were filled out as a pre-test score using the designed pre-test instruments to test students' learning outcomes and learning interests in the pre-cycle.

Furthermore, the results of the pre-test data were analyzed, and then the obtained pre-test scores as an initial benchmark to conclude the improvement of students' learning outcomes and learning interest after applying STEM-based worksheet learning media. After analyzing the interests and learning outcomes in the pre-cycle, an action is taken with a continuous learning cycle. Each cycle consists of several stages, namely planning, action, observation, and reflection, which will bring improvement for the next cycle.

In pre-cycle activities, observation aims to see the teachers' and students' activities and to observe students' learning interest during the learning process. In this activity, the researcher plays the role of a teacher. In the implementation of pre-cycle observations, the researcher was assisted by 2 observers (research colleagues).

On the observation results of the pre-cycle, the learning process carried out by the teacher and the student's learning interests were quite good, but several aspects were not seen during the learning process namely, students were still shy to ask questions about material that had not been understood, and the classroom atmosphere was often not conducive because students talk to themselves and tend not to pay attention when the teacher explains the material in front of the class.

The assessment of student learning interest is seen from the

average results of observations and questionnaire sheets used to determine an increase in students' learning interest using the commonly used media in learning by teachers, the real/direct media with the STEM-based worksheets media. The percentage results of students' learning interest criteria in the pre-cycle can be seen in table 4 below.

**Table 4**
**Percentage of Students' Learning Interest Criteria in Pre-Cycle**

| Criteria | Frequency (students) | Percentage % |
|---|---|---|
| Very Good | 7 | 32 |
| Good | 15 | 68 |
| Fair | 6 | 0 |
| Poor | 0 | 0 |
| **Total** | **22** | **100** |

Based on the percentage data of students' learning interests criteria in the pre-cycle above, there were only 7 students who get very good scores criteria and 15 students who get good scores criteria. There are no students who get fair and poor scores criteria.

While the data of learning outcomes taken in the pre-cycle implementation are the final test scores that have been carried out by students at the end of the learning. The data analysis of learning outcomes can be seen in table 5 below.

**Table 5**
**Students' Learning Outcomes in Pre-Cycle**

| Criteria | Frequency (students) | Percentage % |
|---|---|---|
| Very Good | 0 | 0 |
| Good | 0 | 0 |
| Fair | 5 | 23 |
| Poor | 8 | 36 |
| Very Poor | 9 | 41 |
| **Total** | **22** | **100** |

In pre-cycle activities, students' learning outcomes obtained a total score of 978 from a maximum score of 2200. The highest score was 66, the lowest score was 20, and the average class score was 44.45%. Learning outcomes in the pre-cycle show that there are no students whose grades are complete or reach the minimum completeness criteria; in detail, there are 5 students who get a score of 60-69, 8 students get a score of 40-59, and 9 students get a score of 0-39.

Based on data from students' learning outcomes in the pre-cycle, it shows that students' thinking skills are still low, this possibility can occur because the methods and learning media applied are not varied and unattractive, so the scores of all students have not reached the minimum completeness criteria of 70.

After the evaluation, it turns out

that the selection of less attractive learning media is one of the contributing factors. The teacher only uses the blackboard media in the classroom to carry out the learning process. To overcome this, researchers need to apply a learning media that can increase learning interest and learning outcomes for $5^{th}$ grade students in the material of changing state of matter.

Based on the pre-cycle results that the student's learning interest and learning outcomes were low, the researchers continued to make learning improvements in cycle I. In this cycle, researchers used scientific methods and STEM-based worksheets media that had been made previously.

Cycle I learning was conducted by researchers who acted as teachers by applying the STEM-based worksheets learning media through offline learning in the classroom. The learning materials in cycle I are the various changes in the state of matter and its examples in everyday life. The classroom action research in cycle I was conducted in four stages, planning, action, observation, and reflection.

At the action implementation stage of cycle I, the learning process activities are conducted according to the lesson plan in one meeting on Thursday, November 25, 2021. The learning in cycle I discussed the changing state of matter using STEM-based student worksheets learning media that had been printed and also displayed on the LCD projector. This learning occurred for 2 hours of lessons (2 x 60 minutes) with the lecture method.

In this cycle I, the STEM-based worksheets media was used to explaining the material start of various changes of state matter to some examples of events that experienced changes in the state of matter that occurred in everyday life. The teacher slowly explains the material of changing state of matter to increase students' learning interest in the learning process using STEM-based worksheets media.

Next is the evaluation stage, the cycle I post-test is carried out after the learning is finished. Then the observations results of cycle I show that the learning process conducted by the teacher and students is good. In the

cycle I learning using STEM-based worksheets, the total student test scores were 1347, with the highest score of 87 achieved by Nindi, the lowest score of 21 achieved by Wahyudi, and the average class score is 61.23. Students who have reached the minimum completeness criteria are 10 or 45% of the total students in 5th grade.

Based on the percentage data of students' learning interest criteria in cycle I, 6 students earned very good scores, and 15 students earned good scores. Meanwhile, some students get fair scores, and there are no students who get poor scores. For more details, the percentage data of students' learning interests criteria in cycle I can be seen in table 6 below.

**Table 6**
**Percentage of Students' Learning Interest Criteria in Cycle I**

| Criteria | Frequency (students) | Percentage % |
|---|---|---|
| Very Good | 6 | 27 |
| Good | 15 | 68 |
| Fair | 1 | 5 |
| Poor | 0 | 0 |
| **Total** | **22** | **100** |

While the analysis of the learning outcomes criteria can be seen in table 7 below.

**Table 7**
**Students' Learning Outcomes in Cycle I**

| Criteria | Frequency (students) | Percentage % |
|---|---|---|
| Very Good | 3 | 14 |
| Good | 7 | 32 |
| Fair | 4 | 18 |
| Poor | 5 | 23 |
| Very Poor | 3 | 14 |
| **Total** | **22** | **100** |

Based on table 7, can be obtained information that there is an increase in the learning outcomes obtained by students in cycle I because there are 3 students who get very good scores criteria and 7 students who get good scores criteria. Meanwhile, 4 students scored fair, 5 students scored poor, and 3 students scored very poor.

Based on the test results, the results of the learning interest questionnaire, and observations on cycle I, several deficiencies still need to be corrected in the next cycle, namely: 1) Students do not understand the meaning of the questions in the worksheets given by the teacher. 2) Students' understanding of several concepts in the material of changing state of matter is still low. 3) Students' learning interest has increased but is still in the low category because some students easily forget the explained

material, and some students are also more interested in reading other books than books related to science learning. 4) Students are unfamiliar with description questions that require students to answer with more than one word, or the answers must be complete according to students' understanding.

Based on the reflection of the cycle I implementation, which had several deficiencies in the ongoing learning process, the researchers revised the planning for the next cycle, cycle II. This cycle also occurs in several stages, namely planning, action, observation, and reflection.

Cycle II implementation is almost the same as cycle I, only the added material explanation of the cause of changes in the state of matter that occurs in everyday life with the implementation of simple experiments by all students who have been divided into five groups. The learning process in cycle II is carried out in one meeting, on Wednesday, December 15, 2021, in lessons hours 1 and 2. This learning is conducted for two hours (2 x 60 minutes) by applying STEM-based worksheet learning media.

In cycle II learning using STEM-based worksheets, the total students' test scores were 1468, with the highest score of 96 achieved by Nadya, the lowest score of 29 achieved by Aprilia, and the average class score of 66.73. Students who complete the minimum completeness criteria are 10 or 45% of the total $5^{th}$ grade students.

As seen from the percentage data of students' learning interest criteria in cycle II, 7 students earned very good scores, and 15 students earned good scores. Meanwhile, there are no students who earned fair and poor scores. For more details, the percentage data of students' learning interests criteria in cycle II can be seen in table 8 below.

**Table 8**
**Percentage of Students' Learning Interest Criteria in Cycle II**

| Criteria | Frequency (students) | Percentage % |
|---|---|---|
| Very Good | 7 | 32 |
| Good | 15 | 68 |
| Fair | 0 | 0 |
| Poor | 0 | 0 |
| **Total** | **22** | **100** |

The data percentage comparison of students' learning interest criteria in each cycle obtained an increase in the criteria of good and

very good, while the percentage data of fair criteria is decreasing. For more details, the percentage data of students' learning interest criteria in each cycles seen in table 9 below.

**Table 9**
**Comparison of the Students'**
**Learning Interest Criteria**

| Category | Pre-cycle (%) | Cycle I (%) | Cycle II (%) |
|---|---|---|---|
| Very Good | 32 | 27 | 32 |
| Good | 68 | 68 | 68 |
| Fair | 0 | 5 | 0 |
| Poor | 0 | 0 | 0 |

Based on table 9 shows that students' learning interest seen from the percentage criteria in the pre-cycle to cycle I of very good criteria decreased by 5% from (32% to 27%), while in cycle I to cycle II increased by 5% (from 27 % to 32%). It is because learning using STEM-based worksheets can make students like science learning and not easily bored when taking class lessons. The results of Safitri's research (2020) conclude that STEM-based physics worksheets are included in the category of very practical so they can be used in the learning process. Students learning interests can be grown by providing engaging learning, so students are more active and think about something

new (Anggraini, 2020).

Furthermore, for the analysis results of the students learning outcomes criteria in cycle II, each standard has a different number of students and percentages seen in table 10 below.

**Table 10**
**Students' Learning Outcomes in**
**Cycle II**

| Criteria | Frequency (students) | Percentage % |
|---|---|---|
| Very Good | 6 | 27 |
| Good | 5 | 23 |
| Fair | 5 | 23 |
| Poor | 4 | 18 |
| Very Poor | 2 | 9 |

Based on table 10, it can be obtained that students learning outcomes in cycle II also increased because 6 students got very good scores and 5 students got good scores. Comparative analysis of students learning outcomes in the pre-cycle, cycle I, and cycle II with students learning outcomes criteria for each category can be seen in table 11 below.

**Table 11**
**Comparison of Students' Learning**
**Outcomes in Cycle I and Cycle II**

| Category | Pre-cycle (%) | Cycle I (%) | Cycle II (%) |
|---|---|---|---|
| Very Good | 0 | 14 | 27 |
| Good | 0 | 32 | 23 |
| Fair | 23 | 18 | 23 |
| Poor | 36 | 23 | 18 |

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| | | | |
|---|---|---|---|
| Very Poor | 41 | 14 | 9 |
| **Total** | **100** | **100** | **100** |

Based on table 11 shows that students learning outcomes in pre-cycle to cycle I on the criteria of very good have increased by 14% from 0% to 14%, while in cycle I to cycle II increased by 13% from 14% to 27%. Therefore, the results of the research indicate that there is a significant increase in student learning outcomes based on the criteria of very good. It is because students have started to understand the concept well and are accustomed to answering the description questions with more than one word or long answers.

Based on previous research (Febriyanti & Maryani, 2020), states that STEM-based worksheets affect science learning outcomes in elementary school students. Khaerunnisa, et al. (2019) stated that thematic student worksheets are able to improve student learning outcomes.

Based on the results of the research reveal that students' learning outcomes in cycle I and II have increased because the average N-gain score of cycle I on student learning outcomes is 0.30, and cycle II is 0.10.

Students learning outcomes in each cycle have increased but included in the different criteria, the N-gain score of cycle I obtained the moderate criteria and the N-gain score of cycle II in the low criteria. The increase in students' learning outcomes can be seen in table 13 below.

**Table 13**
**Increasing in Students' Learning Outcomes**

| Cycle | Average Score of N-gain | N-gain Criteria |
|---|---|---|
| Cycle I | 0,30 | Medium |
| Cycle II | 0,10 | Low |

## D. Conclusion

The application of STEM-based worksheets can increase students' interest and learning outcomes, where the N-gain score on learning interest in cycle I and cycle II includes low criteria. While the learning outcomes have an insignificant increase because the learning outcomes of the cycle I were in the moderate criteria, and cycle II was in the low criteria.

BerBased on the description of the results and discussion, it can be concluded that the application of STEM-based worksheets media can increase learning interest and learning outcomes of 5th grade students at SDN Triwung Lor 2 Probolinggo City. So it is better if the STEM-based worksheets can be applied to students on other STEM-related materials, for example, some of the material contained in science subjects.

This STEM-based worksheet can be developed and applied to a STEM-based e-worksheet, an electronic student worksheet that can be used by students anywhere and anytime.

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