*Original Research***Improving Literacy and Students Activities on Motion and Force Materials through Problem Based Learning Model**Refa Tri Ustati¹, Eka Cahya Prima^{1*}, Erni Yuliah Kosasih¹¹*Department of Science Education, Faculty of Mathematics and Science Education, Universitas Pendidikan Indonesia, Bandung 40154, Indonesia**Corresponding author: ekacahyaprima@upi.edu

Abstract. Current technological developments provide opportunities for every learner to express themselves creatively through digital media. However, the easy access to technology that can facilitate the learning process can make learners become complacent with the excitement of instant technology, so that the learning culture is reduced due to this convenience. The PISA 2018 results show that Indonesia occupies the bottom 10 positions out of 79 participating countries, even below the achievements of students in ASEAN countries. This is reflected in the observation results at SMPN 32 Bandung which has a low level of literacy skills, so that the learning process tends to be passive and only receives learning from the teacher. This can be seen from the percentage of passing the classical KKM learning that does not reach an average of 75%. Based on the above problems, it is necessary to increase the literacy and activity of students related to the Implementation of Straight Motion and Force in everyday life using the Problem Based Learning (PBL) learning model. This type of research is Classroom Action Research (PTK) with quantitative research methods and using post-test only instruments. The results of this study are the level of literacy skills of students with the application of Problem Based Learning on Straight Motion and Force material is still relatively low with the acquisition of the value $-t \text{ count} < -t \text{ table}$ or $-4.154 < -2.03011$ which results in H_0 rejected. The data results show that there is a significant difference between the average literacy skills of students against the given value of 70. Then the results of increasing student learning activities have increased to more than 70%.

Keywords: Problem Based Learning, Literacy, and Learning Activities**Introduction**

Education should always evolve according to the demands of the times. Currently, the development of Science and Technology (IPTEK) is unavoidable and has a great influence on several aspects, one of which is the aspect of the learning process. An extensive and easily accessible information system can facilitate an efficient learning process through various *online learning platforms* as a learning resource for students. This contributes to improving creativity, critical thinking and understanding in learning (Sholikha, 2015). Technology provides opportunities for every learner to express themselves creatively through digital media.

However, behind the easy access to technology, there are risks that need to be watched out for. This access can make students become complacent with the excitement of instant technology, so that the learning culture is reduced (Mulyani & Haliza, 2021). According to a survey conducted by the Education Research Center (Puspendik) of the Ministry of Education and Culture, only 6.06% of Indonesian students have reading skills in the good category, while 46.83% are in the less category and 47.11% are in the sufficient category (Kemdikbud, 2017).



The use of gadgets and social media can distract from activities that require deeper concentration, such as reading books. As a result, learning focus is reduced and time that should be allocated for learning activities is used for other activities. Research by Hastini, et al (2020) shows that learning using technology has not succeeded in improving literacy in generation Z. This generation tends to prefer instant communication through technology. This generation tends to prefer more instant communication through gadgets, which makes it difficult to communicate directly. Therefore, the balance between the use of technology and the establishment of a strong learning culture is very important.

According to the Programme for International Students Assessment (PISA) international survey organized by the Organization for Economic Co-Operation and Development (OECD), an international survey has been conducted to measure students' basic literacy levels such as reading, mathematics, and science at the age of 15 (Puspendik, 2019). The results of the 2018 PISA achievement survey showed that Indonesia ranked in the bottom 10 out of 79 participating countries, even below the achievements of students in ASEAN countries. In detail, Indonesia ranked literacy in reading at position 74 out of 79 countries, literacy in mathematics at position 73 and science literacy at position 71 (OECD, 2019).

The PISA results showing Indonesia's low literacy have serious implications for students. Learners with low literacy tend to have difficulty in solving problems, are less able to develop skills in applying knowledge in everyday life, and are slow in making decisions (Yusmar & Fadilah, 2023). This impact not only limits learners, but affects the future of learners in the world of work. As explained by Ajisoka, et al (2024) who stated that low literacy will hinder the ability of learners to compete in a job market that increasingly requires science, technology and problem-solving-based skills.

Not only does low literacy affect the future of learners, it also has consequences for the education system. A system that is unable to improve literacy will face challenges in improving the overall quality of education, thus impacting on economic and social development (Suryadarma & Jones, 2013). More broadly, failure to improve literacy can create social inequalities in society because of the imbalance due to the level of educational standards. According to Adhani, et al (2024) improving literacy across the board in communities can improve their quality of life through access to information and business opportunities, helping them to escape social inequality and poverty.

Based on the results of observations of interviews with SMPN 32 Bandung teachers on October 6, 2023, it was found that even though the school had implemented an independent curriculum, the classical KKM pass rate of students was still low, with an average percentage not reaching 75%. This is due to the low literacy skills of students, so that the learning process tends to be passive and less interactive.

Low literacy skills of students are influenced by several factors, such as the education system, curriculum, learning resources used, learning methods and models and learning tools that are less supportive in improving students' literacy skills (Kurnia et al., 2014). One solution that is considered effective to improve students' science literacy skills is through the application of problem-based learning models (Qomariyah et al., 2019).

Problem Based Learning (PBL) is a learning approach focused on problem solving. In PBL, learners are given real problems relevant to the learning objectives, which they then investigate with the help of a facilitator (teacher). This model allows learners to find solutions, present the results of the investigation, and be accountable for the information obtained (Wulandari & Sujono, 2013). PBL can be a solution because of contextual-based learning. Learners are faced with problems that are relevant to everyday life, so learning becomes more meaningful. When facing real problems, they must read, analyze and evaluate various sources

of information to find solutions. This process directly involves their literacy skills, such as reading, writing and critical thinking (Wijnia et al., 2024). In addition, PBL can increase learners' active engagement through cooperation and discussion among learners. In this process, they will share knowledge and opinions through critical thinking skills, thus helping them find the right solution to the problem at hand (Sipahutar, 2022).

In previous research conducted by Hartati, (2016) with the title "Improving the Attitude Aspects of Science Literacy of Junior High School Students through the Application of Problem Based Learning Model in Integrated Science Learning" showed that the N-gain value of experimental and control classes was in the moderate category (0.44 and 0.31). It can be concluded that the PBL model makes a good contribution to improving the attitudinal aspects of students' science literacy. Then Fauziah's research, et al (2019), showed that the average N-gain of science literacy was 0.55 in the moderate category. The results of this study indicate that there have been studies on improving literacy. However, improving students' literacy through literacy-based Learner Worksheets (LKPD) and according to PBL syntax has not been widely studied, so further research is needed on different materials.

Based on these problems, it is necessary to increase the literacy and activity of students to overcome the low involvement of students in learning. Therefore, this study aims to improve students' literacy and activity, especially in understanding the concepts of Straight Motion and Force. Through literacy-based assessment and the use of literacy-based LKPD according to the *Problem Based Learning* syntax, it is expected to significantly improve students' literacy skills and learning activities.

Methods

The research method used is descriptive quantitative with the type of Classroom Action Research (PTK). This research was conducted based on the problems faced by students during the learning process (Widyati, 2008). The location of this research was at SMPN 32 Bandung, with the research subject being students of class VII-I with a total of 36 people. The sample selection used a convenience *sampling* technique, namely sampling from the class taught by the student teacher. However, this technique has weaknesses, namely less representative and can cause selection bias because it has the potential to have different characteristics from unreachable groups (Firmansyah, 2022).

This research design uses a *post-test only* design. The advantage of this design is that it does not require a *pretest* or measurement before the intervention, making it more time efficient. In addition, this design reduces the risk of participants remembering questions from the *pretest* that may affect the results. Thus, this design allows for a purer evaluation of the direct effect of the intervention on the variable being measured (Marsden & Torgerson, 2012).

The test instruments used for data collection include content aspects by giving questions containing discourse text related to motion and force. Then students are also given literacy-based LKPD according to PBL syntax which includes cognitive and psychomotor aspects. The assessment criteria in the literacy-based LKPD have been adjusted to the learning objectives on the material taught as in Table 1 and Table 2. The implementation of this research was carried out according to the stages in class action research as shown in Chart 1.

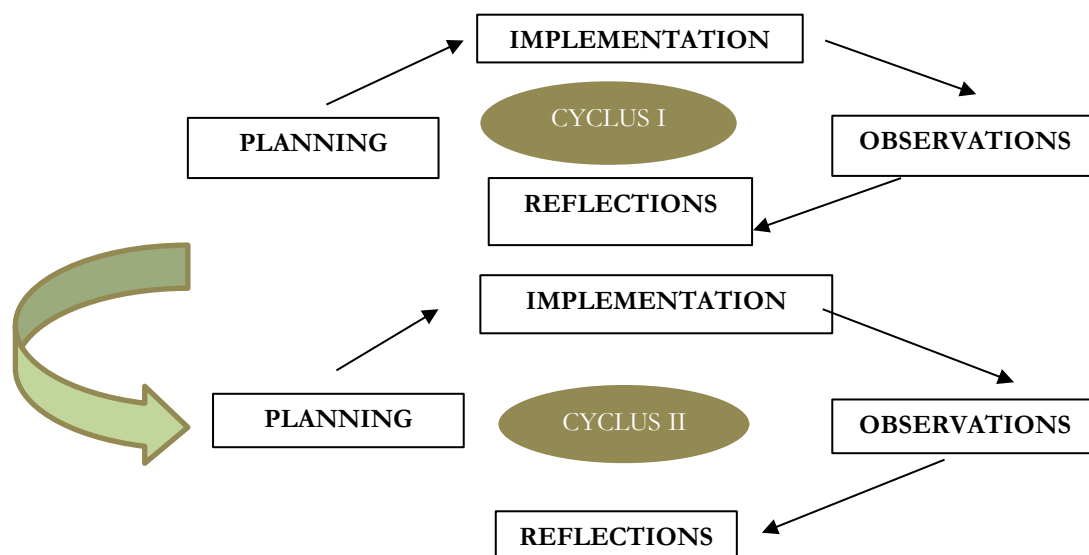


Chart 1. Stages of Classroom Action Research

a. Planning

Planning is done to analyze the needs of learning devices. This stage aims to support the learning process in order to produce research data that can solve problems. The devices needed are as follows:

- 1) Learner background observation analysis
- 2) Material analysis
- 3) Develop teaching modules
- 4) Learning media that will be used
- 5) Determination of simple practicum related to the material
- 6) Developing literacy-based and syntax-compliant LKPDs
- 7) Making literacy-based questions
- 8) Make an assessment rubric
- 9) Validating literacy-based questions with student teachers and supervisors

b. Implementation (Action Strategy)

Research action is a form of implementation of the planning that has been designed. This study aims to determine the level of literacy of students through the *Problem Based Learning* model. The learning process not only follows the syntax of the model, but is also supported by LKPD which is developed based on literacy and in accordance with the syntax. During implementation, learning support facilities such as media, practicum tools, and other learning needs are also prepared.

c. Observation

The observation implementation stage is an observation activity carried out by the observer to obtain data according to the required indicators. This observation is carried out to determine the level of learning activity of students during the learning process. This stage is carried out taking data on the activities of students in accordance with the aspects set out in the assessment rubric as in Table 5. This stage is carried out with 2 cycles consisting of 2 meetings where 1 meeting is 2 x 40 minutes.

d. Reflection

Reflection is an overall evaluation stage in the learning process that has been carried out to find out the shortcomings that need to be corrected. Reflection is a step to improve

previous activities so that the implementation in the next cycle will be better (Prihantoro & Hidayat, 2019).

Deficiencies in the learning process that have been recorded and analyzed become the basis for planning the next cycle. Therefore, PTK is not only carried out in one cycle, but can be carried out in several cycles as shown in Chart 1. This research was carried out until cycle II because there were deficiencies in the learning process in cycle I. Thus, it is necessary to repeat the cycle as before, which includes the planning stage, the implementation stage in the form of action strategies, observation during the learning process and reflection.

Research Results

Activity Implementation

a. Cycle I

Implementation of cycle I applies learning in accordance with the design of the teaching module and applies the *Problem Based Learning* model on Straight Motion material. Students are given *treatment* in accordance with the syntax of the model for 2JP (2 x 40 minutes). The activity plan in this cycle is to carry out Straight Motion practicum in groups with the aim of practicum to calculate the speed of a runner. Students measure the length of the runner's trajectory in the school field, then calculate the time taken using a *Stopwatch* as shown in Figure 1.

During the learning process, observations were made by observers to analyze the learning activities of students according to the rubric that had been prepared. This aims to determine the level of student activity during the learning process. Based on the observation results in cycle I, the average percentage of learning activities was 52%. The assessment aspects include visual, oral, emotional, writing and listening activities. The results of the data analysis of students' learning activities are shown in Table 5.

In addition to observation, students were given literacy-based LKPD and according to the syntax of the PBL model, which had been validated. Then, students' answers were analyzed to determine their literacy level. In cycle I, the results of data analysis showed that 16% of students had high literacy skills, 68% of students had moderate literacy skills and 16% of students had low literacy skills. Learners conduct data analysis based on the results of field investigations as shown in Figure 1, then the data obtained is analyzed and written on the LKPD as shown in Figure 2.



Figure 1. Learners timing a runner



Figure 2. Students Analyzing LKPD Data

In the reflection activity, there were several things that needed to be improved because they did not meet the research needs. Therefore, re-planning was carried out for cycle II. The reflection results from cycle I showed that the time allocation in one of the learning activities was less precise, which had an impact on the time allocation for data analysis in the field. This occurred due to the limitations of practicum tools, so that the data search process took longer. To overcome this, improvements were made to the practicum activities so that the learning time could be carried out according to the lesson plan. The improvement steps include the provision of learning media that involve students more and the use of language that is easier to understand in LKPD, adapted to the cognitive level of junior high school students.

b. Cycle II

The implementation of cycle II is a form of improvement from the previous cycle, so as to maximize further learning activities through learning improvements and refinements (Afandi, 2014). The activity plan in this cycle includes the preparation of learning tools, refining the practicum LKPD and improving the language used adapted to the cognitive level of grade 7. In this cycle, students measure the force on three loads with different masses using a dynamometer.

After conducting a simple practicum, learners analyze the data based on the results of the investigation as shown in Figure 3, then write the results on the LKPD (Figure 4). The results of the analysis of students' answers on LKPD during the implementation of cycle II showed that 50% of students had high literacy skills, 16% of students had moderate literacy skills and 34% of students had low literacy skills.



Figure 3. Students Carrying out the Force Practicum



Figure 4. Students Analyzing LKPD Data

During the learning process, observation of learners' learning activities is still carried out to obtain optimal results. The interaction of the learning process increased compared to the previous cycle, characterized by the enthusiasm of students during the learning process, especially during practicum activities. Based on the results of observations in cycle II, the average percentage of students' learning activities increased to 70.23%, up from 52% in cycle I. This shows an increase in learning activities over the previous cycle. This shows an increase in learning activities of more than 18% as shown in Figure 1.

At the end of the lesson, a literacy-based summative assessment was conducted for the learners and the results of the assessment were further analyzed. Learners were given 10 validated questions to determine their literacy skills. However, the average result of the literacy-based assessment was still relatively low at 57.22 below the expected average score of 70 (see Table 4). To overcome this, efforts need to be made to improve their literacy skills. In addition to the application of supportive learning models and methods, literacy-based learning habituation should also be applied so as to improve their reading skills.

Literacy Outcome Analysis

The results of the level of literacy skills of students are obtained through analyzing the answers to literacy-based LKPDs that are done in groups and literacy assessments that are done individually. The results that have been obtained during *treatment* are analyzed according to the type of data. The following are the results of data analysis based on LKPD answers consisting of 2 cycles and literacy assessment data analysis:

a. LKPD

The results of the analysis of LKPD answers are categorized into 3 levels, namely high, medium and low levels. The assessment of LKPD answers is analyzed based on the predetermined assessment rubric as in Tables 1 and 2.

Table 1. Criteria for Students' Literacy Skills Cycle I

Learner Literacy Level		
High	Medium	Low
16% of learners have a high level of literacy skills	68% of learners have a high level of literacy skills	16% of learners have a low level of literacy skills
• Learners are able to formulate related problems appropriately. • Students are able to explain the concept of straight	• Learners are able to formulate problems, but not yet related to the material.	• Learners have not been able to formulate related problems appropriately. • Students have not been able to explain the concept of

Learner Literacy Level		
High	Medium	Low
motion, know the difference between distance and displacement, and know the difference between speed, velocity and acceleration correctly and completely. • Learners are able to collect data completely and thoroughly • Learners are able to process data according to the formula correctly • Learners are able to solve all the questions on the LKPD and make conclusions related to the appropriate	• Learners are able to explain the concept of straight motion, know the difference between distance and displacement, and know the difference between speed, velocity and acceleration. But incomplete • Learners are able to take complete data, but are less thorough • Students are able to process data according to the formula but still not correct • Learners have not been able to solve all the questions on the LKPD but the conclusions are not related and appropriate.	straight motion, know the difference between distance and displacement, and know the difference between speed, velocity and acceleration correctly and completely. • Learners are not yet able to collect data completely and thoroughly. • Students have not been able to process data according to the formula correctly • Learners have not been able to solve all the questions on the LKPD and make conclusions related to them appropriately.

Table 2. Criteria for Literacy Skills of Students in Cycle II

Learner Literacy Level		
High	Medium	Low
50% of learners have a high level of literacy skills • Learners are able to formulate related problems appropriately. • Learners are able to explain the concept of force, know the relationship between mass and force correctly and completely and know examples of force in everyday life. • Learners are able to collect data completely and thoroughly • Learners are able to determine the largest force in the experiment and know the effect of mass and force. • Learners are able to solve all the questions on the LKPD and make conclusions related to the appropriate	16% of learners have a low level of literacy skills • Learners are able to formulate problems but not yet related to the material. • Learners are able to explain the concept of force, know the relationship between mass and force and know examples of force in everyday life, but there is still something that needs to be improved. • Learners are able to take complete data, but still not thorough. • Learners are able to determine the largest force in the experiment, but do not know the effect of mass and force. • Learners have not been able to solve all the questions on the LKPD but the conclusions are not related and appropriate.	34% of learners have a high level of literacy skills • Learners have not been able to formulate related problems appropriately. • Learners are not yet able to explain the concept of force, know the relationship between mass and force correctly and completely and know examples of force in everyday life. • Learners are not yet able to collect data completely and thoroughly. • Learners are not yet able to determine the largest force in the experiment and know the effect of mass and force. • Learners have not been able to solve all the questions on the LKPD and make conclusions related to them appropriately.

$$\text{Literacy Percentage} = \frac{\text{Total number of students according to category}}{\text{Total number of students}} \times 100\%$$

Based on the data that has been analyzed, it shows that there is a change in the literacy level of students in one class (36 students). In LKPD I there was one group with high literacy skills, four groups with moderate literacy skills and one group with low literacy skills (each group consisted of 6 students). Meanwhile, the results of LKPD II data analysis showed an increase, with three groups having high literacy skills, one group with moderate literacy skills and two groups with low literacy skills. The increase in learner literacy can be seen from the results of LKPD cycle I which increased to 50% in cycle II.

b. Literacy Assessment

The instrument used in the assessment is *post-test only*. The results of students' answers were tested with normality test and hypothesis test. The assessment used for data collection is literacy-based with the aim of knowing the literacy skills of learners. The results of the analysis of assessment data that has been done by learners are presented with a statistical system (Nasution, 2017). The results of the data analysis of the normality test of students' literacy skills are sig 0.203 which indicates that the data is normally distributed. The data from the normality test results of the based assessment are shown in Table 3.

Table 3. Normality Test Results

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
VAR00002	.117	36	.200*	.959	36	.203

Based on the results of the normality test in Table 3, the results show that the data is normally distributed. Furthermore, parametric tests were carried out by conducting hypothesis testing using a *one sample t-test* which is used to test significance in one sample group (Mustafidah et al., 2020). The results of the *one sample t-test* hypothesis test analysis are shown in Table 4.

Table 4. One Sample t-test Hypothesis Results

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Value	36	57.2222	18.45630	3.07605

One-Sample Test

Test Value = 70

t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
				Lower	Upper

One-Sample Test						
Value	-4.154	35	.000	-12.77778	-19.0225	-6.5331

Data needs are used the results of literacy-based assessment assessments or *post-tests* that are done individually to determine the level of literacy skills of students. Data analysis of hypothesis testing using *one sample t-test* is as follows:

- a. **Null hypothesis (H_0)** = 'There is no significant difference between the average literacy skills of learners against the given score of 70
- b. **Alternative Hypothesis (H_a)** = 'There is a significant difference between the average literacy skills of students against the given score of 70

Basis for Hypothesis Test Decision Making

- 1) If $-t \text{ count} < -t \text{ table}$, then H_0 is rejected.
- 2) If $-t \text{ table} < -t \text{ count}$, then H_0 is accepted.

Basis for Decision Making Based on Sig Value.

- 1) If the sig value (2-tailed) < 0.05 , then H_0 is rejected (Influential)
- 2) If the sig value (2-tailed) > 0.05 , then H_0 is accepted (No Effect)

Decision Making

Based on the results of hypothesis data analysis from the *post-test* using *one sample t-test*, the value of $t \text{ count} = -4.154$ and $t \text{ table}$ obtained with $df \ 35$, sig 5% (2-tailed) = 2.03011. This can be interpreted that the hypothesis results affect the literacy skills of students because it shows $-t \text{ count} < -t \text{ table}$ or $-4.154 < -2.03011$. Then in the acquisition of the sig value. (2-tailed) of 0.00 or if it is related to the basis for decision making, then the sig value of 0.00 < 0.05 which results in H_0 being rejected (Latief, et al 2019). The data results show that there is a significant difference between the average literacy skills of students and the given value of 70. This is in accordance with the average results of the literacy-based assessment of students, which is 57.22 with a sample of 36 students.

Learning Activity Analysis

The results of the analysis of student learning activities were obtained through observation during the learning process carried out by the observer by referring to the rubric of the student learning activity observation sheet. The observation process is carried out by paying attention to each individual student, either when the teacher explains the material or during the process of carrying out the practicum in groups. However, the assessment is in accordance with individual activities when working with group friends. The following are the results of data analysis based on the rubric of the student learning activity observation sheet:

Table 5. Activity Data Assessment Aspect

Aspects of learning activity	Cycle		Average
	1	2	
A. Visual activities			
Learners who pay attention to the educator's explanation	85.19%	89.82%	87.5%
B. Oral Activities			
Learners who ask questions	21.30%	36.11%	28.7%
Learners who express an opinion	22.22%	38.90%	30.6%
C. Emotional activities			
Enthusiastic learners in learning	66.67%	84.26%	75.5%

Aspects of learning activity	Cycle		Average
	1	2	
D. Writing activities			
Learners who write or take notes	50.00%	67.00%	58.5%
E. Listening to Friends' Opinions			
Learners who listen in learning	66.67%	100.00%	83.3%
Percentage (%)	52%	70.23%	

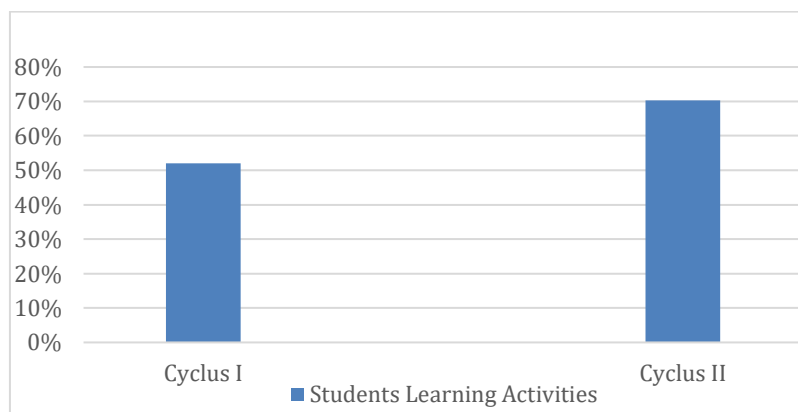


Figure 1. Figure of students learning activities

Based on the results of data analysis from cycle I and cycle II, it shows an increase in student learning activities. In Table 5, it can be seen that cycle I obtained an average percentage of 52% of students' learning activities, while in cycle II an average percentage of more than 70% was obtained. It can be concluded that the increase in learner activity in cycle I and cycle II increased by 18%. The most significant increase was when students listened to the teacher in the learning process, including in this case listening to friends who gave other people's opinions, did not cut the conversation and the eyes were on friends who argued.

The strength of the research that has been carried out based on the results of data analysis is the successful implementation of *Problem Based Learning* to improve students' literacy through literacy-based LKPD and according to PBL syntax. It is proven that in cycle I the level of literacy in the high category of 16% of the population of 36 students increased to 50% in the implementation of cycle II. This research supports Fadhila's research (2022), which states that *Problem Based Learning-based* LKPD can improve students' literacy skills by obtaining an *N-gain* score of 0.36 in the medium category. Another supporting research is Aulia's research (2021), which concluded that PBL-based LKPD has more effect than conventional LKPD because the presentation of the problem is more structured in accordance with the PBL syntax.

Then another advantage is that the results of the analysis of student learning activities from cycle I and cycle II show an increase in student learning activities with an average percentage of 52% to more than 70%. The results of the analysis of student learning activities were obtained through observations made by observers by referring to the rubric of the student learning activity observation sheet. The results of this study support Agustin's research (2013), with the acquisition of a percentage of 66.28% in cycle I to 76.50% after the implementation of cycle II.

The weakness of this study is that the level of literacy of students through summative assessment is still relatively low, namely 57.22. Evidently the results of data analysis sig value $0.00 < 0.05$ which results in H_0 rejected. The results of this study are not in accordance with the research of Tabun, et al (2020) in their research which states that the literacy skills of students in classes that get *Problem Based Learning* model learning are better than classes that do not get the model. Then these results are not in accordance with research conducted by Widiana, et al (2020), the application of PBL can improve students' science literacy skills in high school students.

Some of the factors that cause low literacy scores are the use of ineffective learning methods, non-contextualized learning, low interest in reading and lack of resources that support literacy. As a result, students are not accustomed to reading, analyzing and drawing conclusions from the information obtained. Solutions to overcome these challenges can be done through literacy habituation, improving teacher competence, improving assessments to be literacy-based, utilizing digital platforms and selecting the right textbooks (Suparya et al., 2022).

The percentage of students' learning activity level is good, but there are still 30% of students who are not active in the learning process. This is because the available practicum equipment is still limited, so the use of tools takes turns and makes students bored. Then the limited time allocation makes students rush in the process, so that things that are not understood are not asked to the teacher concerned.

Conclusion

Based on the results of class action research conducted at SMPN 32 Bandung in class 7, it can be concluded that the level of literacy skills of students with the application of *Problem Based Learning* on Straight Motion and Force material is still relatively low with the acquisition of the value $-t \text{ count} < -t \text{ table}$ or $-4.154 < -2.03011$ which results in H_0 rejected. The data results show that there is a significant difference between the average literacy skills of students against the given value of 70. Then the results of increasing student learning activities have increased to more than 70%.

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