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PBL-Based Science Learning on Living Things Interaction in Junior High School

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ABSTRACT

To obtain high learning outcomes, a teacher is required to teach students to use the right learning model. This study aims to analyze the effect of Problem Based Learning on the interaction of living things with their environment on learning outcomes in junior high schools. Experimental research with pretest posttest nonequivalent control group design. The object of this study is the results of student learning on the cognitive, affective, and psychomotor aspects. The sample used was two classes of students, as an experimental class and a control class and each of 28 students. Data collection techniques used were pretest-posttest, observation, and documentation. The research data were analyzed using the Independent Sample T-Test and the N-Gain test. The results showed that the average learning outcomes in the experimental class were higher than the average learning outcomes in the control class (N-gain 76>36.54); on Affective (73.21> 64.73) and Psychomotor (77.68> 65.62) aspects. Then analyzed using the Independent sample T-test. Based on the analysis of research results and discussion, it can be concluded that Problem Based Learning learning in the interaction of living things with their environment has an effective effect on junior high school student learning outcomes.

1. INTRODUCTION

Science learning will be more meaningful if it is designed to give students opportunities to find facts, construct concepts, and discover new values. Students as learning subjects in learning, as subjects of scientific work, not as spectators of teacher scientific work. Science learning in schools is expected to be a place for students to learn about the environment independently and apply it in everyday life. Through scientific learning, students receive direct information through observation, discussion and simple research (Noviyanti, E, Rusdi, Ristan, 2019)Science or Science is not only knowledge in the form of facts, concepts or principles, but also the process of discovery. Science learning emphasizes direct experience to develop skills in order to understand the natural environment through research and application, which helps students deepen their understanding (Bahtiar, Dukomalamo, 2019).

According to (Tayeb, 2017) the learning model is a conceptual framework that describes a structured approach to integrating learning experiences, achieving certain learning objectives and serving as a guide for teachers when preparing and carrying out learning activities. The things that must be considered by the teacher in choosing the model and method used in class are the characteristics of the material, student characteristics, facilities and infrastructure, and the teacher's ability to apply learning models and methods. The selected model and method must be adapted to the material, sometimes different materials must be delivered in different ways (Paradina, D. Connie, Medriati, 2019).

Problem based learning can accommodate students' knowledge in learning and improve the ability to solve mathematical problems encountered in everyday life. The philosophy underlying

PBL learning can be viewed as a collaborative, independent, collaborative and contextual activity. As an educational strategy that attracts many educators provide a guiding framework that supports active and group learning based on the belief that effective learning occurs when students construct ideas through social interaction and independent learning (Yew, E.H.J., Goh, 2016). According to (Phungsuk, R., Viriyavejakul, C., Ratanaolarn, 2017), PBL is active learning based on the use of unstructured problems as a learning stimulus that prioritizes problem solving or questions and focuses on interdisciplinary relationships, authentic research, collaboration and production. Also work or display of work and focused results.

According to (Saharsa, U., Qaddafi, M., 2018) the purpose of the PBL model is to master the concept of discovery learning and develop problem solving skills. With PBL students are trained to think, solve problems, find ideas and make decisions. Students become more understanding because they are directly involved in actively growing new knowledge, and become more aware of all concepts and principles. Using PBL means teaching students to face real life problems as a basis for learning or students learn through problems. This is corroborated by (Supiandi, M. I., & Julung, 2016) that consistently implementing PBL can improve students' ability to solve problems.

According to (Haryanti, Y.D. Febrianto, B., 2017) and (Tyas, 2017) the characteristics of PBL include: a. pose problems or questions that are relevant and personally meaningful to students because they reflect authentic real life, avoid easy answers, and allow multiple solutions to the situation; b. focus on interdisciplinary relationships; c. authentic research, students analyze and define problems, develop hypotheses and predictions, collect and analyze data, conduct experiments (if necessary), draw conclusions; and d. produce and display products or works. But there are also those who state that the characteristics of PBL (Cahyaningsih, U., & Ghufron, 2016) include: a. Learning; b. problem based; c. solution to problem; d. determine their own way to solve the problem; e. iterative, that is when students receive information, they bring it back to the problem at hand and solve it; f. cooperative; g. self reflection h. Self-monitoring: re-evaluating, observing again from the beginning to find out what progress and what has been achieved; and i. original. Therefore, the characteristics of PBL are student-centered learning, problem-oriented learning, where the problem is authentic and the teacher acts as a facilitator, and from this learning students can later find their own way to solve problems.

One way to improve students' creative thinking skills in learning is to use appropriate learning models to achieve learning goals (Malasari, E. Y. U., Rasiman., 2018). In learning science in the 21st century, teachers are required to conduct learning that reflects the four skills known as the 4Cs, namely critical thinking, communication, collaboration, and creativity. As conveyed by (Paradina, D. Connie, Medriati, 2019), PBL learning is suitable for honing the competence of student learning outcomes and optimizing science learning.

This is in line with research results (Fauzan, M., Gani, A., & Syukri, 2017)that there is an increase in student learning outcomes in cognitive, affective, and psychomotor aspects by applying the PBL model to science learning. The advantage of PBL according to (Rosa, N. M., & Pujiati, 2016) is that in learning it shows students have the ability to think critically and creatively and helps students develop thinking skills and problem solving as independent learners. Supiandi, M. I., & Julung, (2016) also holds the same view, which claims that consistent PBL implementation has proven successful in improving student problem solving and learning with PBL consistently improving student learning outcomes (cognitive).

According to (Hartati, 2016) PBL makes a good contribution to the development of scientific literacy attitudes, it can even be used to train students to develop and investigate problems by raising awareness of different ways of thinking and solving problems (Baysal, 2017). Likewise according to (Baysal, 2017; (Bashith, A., & Amin, 2017), PBL can improve critical thinking as indicated by the active attitude of students in the class through discussions and questions with real problems. PBL also improves students' mind map placement skills at a fairly good level in all respects (Karyatin, 2016) as well as improves cognitive, affective, and psychomotor thinking skills (Fauzan, M., Gani, A., & Syukri, 2017) and (Amalia et al., 2017). The application of PBL is much

better than the traditional model and has a positive effect, and can create a fun learning environment and encourage optimal learning (Schettino, 2016). PBL allows students to carry out in-depth studies of material and problems, combine theory and practice, and apply various knowledge and skills to develop solutions to problems given by the teacher (Andini, S. A., Susanto, S., & Hobri, 2017).

According to (Tyas, 2017) PBL is not a learning model that is easy to implement, so teachers don't want to use it. One reason is that the teacher is not used to it, so the teacher's habits are still the same as traditional learning. The weaknesses of PBL are revealed in long and complex lessons that demand higher student activity and concentration, as well as results that depend on group abilities. Another weakness is that the problem solving process requires time and special attention (Maulidiyahwarti, G., Sumarmi., &Amirudin, 2016). The results of the study (Tyas, 2017) also show that teachers encounter obstacles, namely at the planning stage, it is difficult to determine the right problem to create and encourage a good atmosphere for discussion, as well as to stimulate students' intellectual development.

Long-term limitations in planning and implementing learning come from the teacher's lack of understanding of PBL learning. It is not easy for teachers to position themselves as trainers and mentors, deepen understanding and support student initiatives. Another weakness of applying the PBL model is that students who are not interested or do not believe that the problem being studied is difficult to solve, are reluctant to try it. Arousing students' interest in the problem-solving process is an important step in learning. Weaknesses in the application of PBL are certainly not a reason not to implement this model. PBL development that seeks a way out of these weaknesses must be carried out as an effort to further develop this learning model (Purwanto, W., Djatmika, E. T., 2016)

Student learning outcomes from the learning process at school, can be in the form of behavior, values, perceptions, attitudes, appreciation and skills. According to (Ilmiyah, N.H., & Sumbawati, 2019) learning outcomes are changes in students' knowledge, attitudes, skills and behavior as a result of experience. Learning outcomes can also be interpreted as the result of hard work and activities that are completed both individually and in groups after participating in the learning process (Komariyah, S., & Laili, 2018). Learning outcomes are nothing but changes in behavior after students learn which is an indication of student attitudes (Paradina, D. Connie, Medriati, 2019). Science learning in schools is expected to be a place for students to learn about the environment independently and apply it in everyday life. Through scientific learning, students receive direct information through observation, discussion and simple research (Noviyanti, E, Rusdi, Ristan, 2019).

The results of the site survey showed that students had difficulty solving scientific problems. Students are also difficult to ask questions based on the problems presented, and students often wait for the teacher to explain rather than find out for themselves. This happens, one of the reasons is that the teacher has not aroused students' creative thinking and activity. Learning is still teacher-centered, so students are less actively involved in learning and problem solving. In connection with these problems, teachers must develop innovative learning models such as PBL. With PBL learning it is hoped that good communication will be established between students. Students exchange thoughts and opinions, discuss existing problems among themselves, making it easier for them to find and present ideas or solutions to solve existing problems. In addition, students can be actively involved in the learning process and acquire critical thinking to achieve the best possible learning outcomes.

Based on various research results, it was concluded that PBL can improve the quality of learning in high schools (Andini, S. A., Susanto, S., & Hobri, 2017; Karyatin, 2016). This is in accordance with research (Wulandari, N. I., Wijayanti, A., & Budhi, 2018) which shows that there are significant differences in the learning outcomes of 7th grade students of SMP Negeri 11 Yogyakarta in the 2016/2017 academic year between PBL and traditional learning models according to ability student communication. Likewise with the results of the study (Saharsa, U.,

Qaddafi, M., 2018) which showed that the application of PBL had a positive influence on the conceptual understanding of class VIII students of SMPN 19 Bulukumba in science learning as evidenced by the high average results of participants' understanding of the concept.

Previous research on problem-based learning in class VIII students of SMP Negeri 1 Tasikmadu at SMP Negeri 1 Tasikmadu for the 2018/2019 academic year on learning showed that there was a significant influence on student learning outcomes in science learning. Learning-based learning has never been applied to the material interactions of living things with their environment. With this background, a problem-based learning research was carried out on the material interaction of living things with their environment at SMP Negeri 1 Tasikmadu. Based on the description presented, it is important to study science learning based on PBL on the interaction of living things and their environment on student learning outcomes at SMP Negeri 1 Tasikmadu semester 2021/2022. The results of this study can be used to provide input in learning similar material and allied classes in learning using Problem Based Learning, as well as input for prospective teachers in preparing PBL-based learning.

2. MATERIALS AND METHODS

2.1. Types and Research Design

This research is an experimental research with pretest posttest nonequivalent control group design. This study involved two classes, namely the experimental class and the control class. These two classes were given different treatment. The experimental class was used as the treatment class, namely the implementation of learning using the PBL model while the control class used a non-PBL learning model (Table 1.).

Table 1. Pretest Posttest Nonequivalent Control Group Design

Pretest	Treatment	Posttest
O_1	PBL	O_2
O_3	Non PBL/Control	O_4

Note:
O1 = Pretest experimental class
O2 = Posttest experimental class
O3 = Pretes control class
O4 = Posttest control class

2.2. Population, sample and research sampling

This research was conducted at SMPN 1 Tasikmadu which is located at Buran Village, Tasikmadu, Kranggan, Buran, Tasikmadu District, Karanganyar Regency, Central Java during the even semester of the 2021/2022 school year. The population used in this study were all class VII students of SMPN 1 Tasikmadu which consisted of 8 classes. The research samples were students in class VII A, totaling 28 students as the experimental class and class VII D, totaling 28 students as the control class. Determination of the sample by random sampling. The data used in this study are the learning outcomes of class VII students at SMP Negeri 1 Tasikmadu even semester for the 2021/2022 academic year with the application of Problem Based Learning on the interaction of living things with their environment (Table 2).

Table 2. Data Sources, Data Collection Techniques, Instruments

Aspects of learning outcomes	Data Sources	Data Collection Techniques	Instruments
Cognitive	Student	Pretest and posttest	Multiple choice questions
Affective	Student	Observation : Discussion	Observation sheet

Aspects of learning outcomes	Data Sources	Data Collection Techniques	Instruments
		Observation Cooperation Summing up the learning outcomes	
Psychomotor	Student	Presentation observation	Presentation observation sheet

2.3. Research Procedures

Beginning with the preparation of lesson plans using PBL and not PBL and its tools for learning material on the interaction of living things with their environment, accompanied by teaching materials according to the material, determining learning media that are appropriate to the material, LKPD, and learning outcomes assessment instruments including cognitive assessment instruments (pretest and posttest questions), affective assessment, and psychomotor assessment. Trials of research instruments and instrument validation were carried out to obtain valid and reliable measuring instruments.

The implementation of learning begins with giving pretests to the two research classes, then learning is carried out according to the planned lesson plans. In the Experiment class, using PBL, the class is grouped into five groups, studying with the LKPD guide according to the material on the interaction of living things with their environment. Classes run according to the planned lesson plans. During the learning activities, an assessment of the observation of the interaction of living things with their environment is carried out when activities outside the classroom use LKPD, the location of the observations according to the agreement of each group. Then an assessment of the discussion of the results of observations, together with an assessment of cooperation during group activities, and an assessment of the presentation of the results of observations and group discussions. Learning to complete the material: 1. Patterns of interaction of living things, 2. Food chains and food webs, 3. Symbiosis, 4. Role of living things in the environment, carried out in 2 meetings. At the second meeting, at the final meeting a post test was carried out. The same learning steps are carried out in the control class, the difference is that they are not problem-based but use other learning. The six assessments were carried out to obtain research data. The data collection technique used was a test (Pre and Post test) for cognitive learning outcomes data, affective and psychomotor learning outcomes were carried out by observation. All data obtained were analyzed using hypothesis testing using the Independent Sample T-Test (Figure 1).

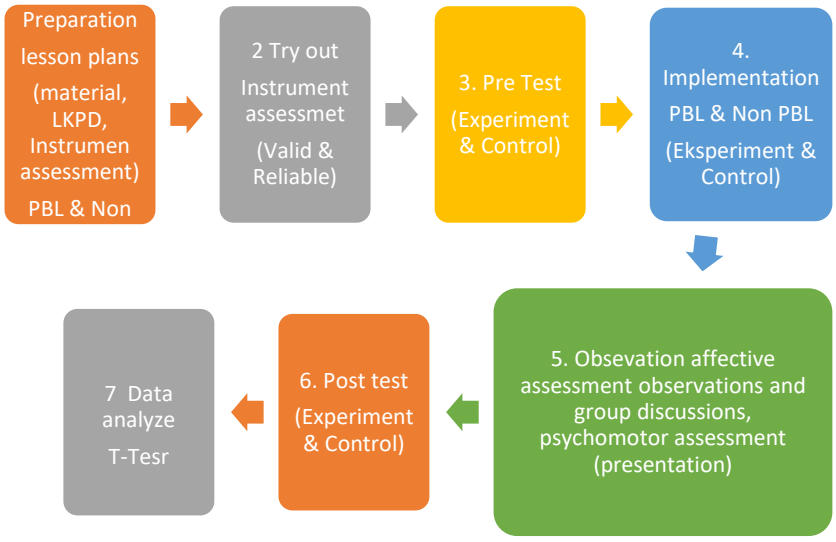

Fig. 1. Research Procedures

3. RESULTS AND DISCUSSION

3.1. Result

The research data is in the form of student learning outcomes after completing learning with PBL learning models and without PBL. Learning outcomes are based on students' ability to complete cognitive pre- and post-test assessments, observation of students' attitudes during learning as an affective assessment, and the ability to present the results of observations as a psychomotor assessment (Table 3).

Table 3. Learning Outcomes of Pre and Post tests, Affective and Psychomotor using PBL on Living Things Interaction Material.

Learning outcomes	*Problem Based Learning*					Without Problem Based Learning				
	Pre	Post	Ngain (%)	Affec	Psycho	Pre	Post	Ngain (%)	Affect	Psycho
Max	80	100	100	100	100	80	90	75	87.50	87.50
Min	40	70	40	50	50	40	50	16,67	37.50	37.50
Mo	70	90	66.67	75	75	60	80	33,33	62.50	62.50
Me	60	90	75	75	75	60	70	33,33	62.50	62.50
Mean	58.57	88.93	76 (Ef)	73.21 (G)	77.68 (G)	57.86	72.86	36.54 (IE)	64.73 (E)	65.62 (E)

Note :

Category Interpretation of Effectiveness N-Gain (%)
<40 = Ineffective (I)
40-55 = Less effective (LE)
56-75 = Effective enough (EE)
>76 = Effective (Ef)
(Nurhayati, 2021)

Affective and Psychomotor Score Criteria
80-100 = Very good (VG)
70-79 = Good (G)
60-69 = Enough (E)
< 60 = Less (L)
(Amyani, 2018)

Based on Table 3, it can be seen that learning using PBL shows higher post-test learning outcomes than learning outcomes using learning models without PBL (88.93> 72.86), as evidenced by greater N-gain results (76%/Ef > 36.54 %/IE) which means learning using PBL effectively improves learning outcomes in the cognitive domain. In the affective domain, the learning outcomes obtained show that the average affective learning result using PBL is higher than not using PBL (73.21/G> 64.73/E), which means that learning using PBL is better than not using PBL which is shown to be sufficient criteria. Likewise shown in the psychomotor aspects, the average shows higher results than not using PBL, namely 77.68/G> 65.62/E, which means that learning using PBL gives higher results on psychomotor aspects as explained in Figure 2.

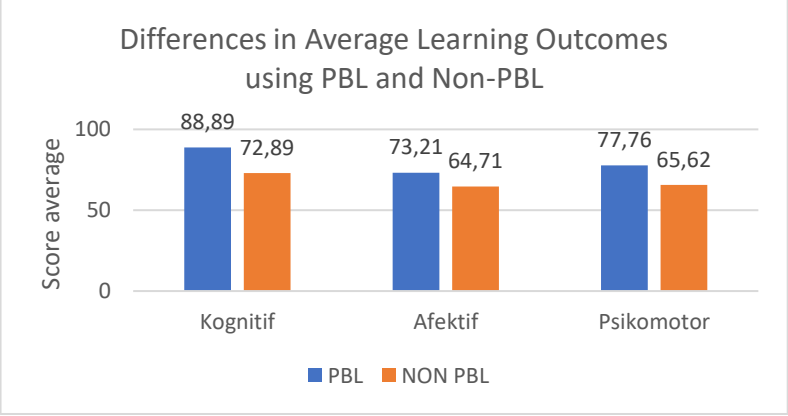

Fig. 2. Analysis of the average results of learning outcomes on cognitive, affective and psychomotor aspects

3.2. Normality and Homogeneity Prerequisite Test

Testing the learning outcomes data using the Kolmogorov-Smirnov test, shown in table 4.

Table 4. The results of testing the normality of learning outcomes for junior high school students using PBL

Aspect	Class	Significance Setting	Significance	Decision
Cognitive	Experiment	0,05	0,16	Normal
	Control	0,05	0,07	Normal
Affective	Experiment	0,05	0,97	Normal
	Control	0,05	0,52	Normal
Psychomotor	Experiment	0,05	0,10	Normal
	Control	0,05	0,12	Normal

Based on Table 4. It shows the results of the normality test of the three learning outcomes with PBL learning including normal distribution (significance value is greater than the significance constant). Likewise for the next prerequisite test, namely the homogeneity test (Table 5), all three showed normal results (the significance value was greater than the significance constant).

Table 5. The results of testing the Homogeneity of Junior High School Students' Learning Outcomes using PBL

Learning outcomes	Significance Setting	Significance	Decision
Cognitive	0,05	0,16	Homogeneous
Affective	0,05	0,88	Homogeneous
Psychomotor	0,05	0,87	Homogeneous

3.3. *Test Independent Sample T-Test*

Subsequent analysis with the Independent Sample T-Test, comparison of the probability value of Sig. (2-tailed) that is, if the probability (sig.) > 0.05, then H0 is accepted, and if the probability (sig.) < 0.05, then H0 is rejected. From the three learning outcomes data (Cognitive, Affective and Psychomotor) it shows that learning outcomes at thit > ttab, which means that student learning outcomes on cognitive, affective and Psychomotor show differences with higher results, which means the hypothesis that learning using PBL affects learning outcomes studied in junior high school students on science material (Table 6).

Table 6. Test Independent Sample T-Test Student Learning Outcomes using PBL

Learning outcomes	Class	N	Mean	t_{hit}	t_{tab}	*Sig. (2-tailed)*	Conclusion
Cognitive	Experiment	28	88,93	5,78	2,005	0,00	Differences
	Control	28	72,86				
Affective	Experiment	28	73,21	2,85	2,005	0,006	Differences
	Control	28	64,73				
Psychomotor	Experiment	28	77,68	2,74	2,005	0,008	Differences
	Control	28	65,62				

3.4. N-Gain Test

There is an increase in students' learning comprehension abilities using PBL learning, a normalized gain analysis (N-Gain) is carried out, while the results are in Table 7.

From table 7, learning science on the interaction of living things using PBL shows an increase in understanding from pre-test to posttest by 75. 83% which is included in the effective category to improve learning outcomes, even though the increase is only 0.83 from the effective limit. In contrast to learning science with the same material but not using PBL learning, the increase in students' learning understanding only increased by 36.54%, which means it was not effective/Ineffective.

Table 7. N-Gain Test Pretest and Posttest student learning outcomes using PBL on the Interaction of Living Things

Class	N-gain (%)	Category
Experiment	75.83	EE
Control	36.54	IE

Note :

Category Interpretation of Effectiveness N-Gain (%) (Nurhayati, 2021)

<40 = Ineffective (I) 56-75 = Effective enough (EE)
40-55 = Less effective (LE) >76 = Effective (Ef)

3.5. Cognitive Learning Outcomes of Junior High School Students using PBL on the Interaction of Living Things

Science learning about the interaction of living things in high school using PBL shows an effective increase in understanding. According to (Hartati, 2016), PBL contributes to increasing science literacy, training to develop and investigate problems by encouraging different ways of thinking when solving problems (Baysal, 2017). Also emphasized by (Astuti, 2019), that learning science using PBL helps students process information and gather their knowledge about nature and the surrounding environment. This statement is relevant to this research which also studies the interaction of living things with their environment. In fact, according to (Afni et al., 2018), the habit of applying problem-based learning models and their impact on increasing mastery of biology concepts for high school students indicates that the application of PBL which is carried out on an ongoing basis can have a positive impact on student learning outcomes.

In contrast to the results of the study (Warabula, M; Papilaya, P.M., Rumahlatu, 2020), which found that the discovery learning learning model and video-assisted PBL learning model did not affect motivation but did affect cognitive learning outcomes. Similarly, according to (Anggraini et al., 2020) it was concluded that the PBL model can improve cognitive biology learning outcomes. Almost the same as stated by (Kasuga et al., 2022), PBL-based learning on the development of science process skills on the topic of safety in our environment in secondary schools in Tanzania, proved to have no statistically significant difference in achievement by gender compared to the method traditional. This study recommends the continued use of learner-centred approaches such as PBL in science teaching and learning.

As stated by (Kasuga et al., 2022), students' critical and creative thinking skills are honed better when learning uses PBL. Gradually assisting students in cultivating thinking competence and skills in solving problems in everyday life which makes students independent learners, in line with today's independent learning. This is also supported by (Supiandi, M. I., & Julung, 2016), who argues that science learning using PBL consistently proves its success and improves students' cognitive abilities. This is shown from the results of the post test scores

of students who are higher than those who do not use PBL (90> 70). Similar to the results of research (Karan, E. Brown, 2022), that there is a significant average difference in solving problems before and after using PBL and students get higher scores compared to students in the control group.

3.6. Affective Learning Outcomes of Junior High School Students using PBL on the Interaction of Living Things

The affective domain is a domain related to attitudes (Karan, E. Brown, 2022). In the affective domain, the learning outcomes of students using the PBL model are higher than those of the non-PBL model. Student learning outcomes improve because PBL encourages the application of student knowledge to real-world situations. Learning using PBL affects students' affective learning outcomes because this learning model has steps that involve students to be actively involved in the process of solving real problems in their environment. Besides that, it can increase students' curiosity about science learning material. They are passionate about learning, thus affecting student learning outcomes. The steps of the problem-based learning model are: a. orient students to problems, b. organize students to study, c. guiding individual and group research, d. develop and present works, e. analyze and evaluate the problem solving process (Paradina, D. Connie, Medriati, 2019) In fact, according to (Maulidya et al., 2021) suggests that the syntax of the PBL learning model that can improve students' analytical abilities includes orienting students to problems, helping students to investigate independently and in groups, analyze and evaluate processes. Likewise according to (Ati, A.F.S. Biato, M.A. Aprillya, 2022), found that PBL supported by AR is more effective than only PBL and the teaching methods currently used in terms of increasing reflective thinking skills towards problem solving and decision making abilities, as well as achievement persistence academic in learning science.

Based on research (Ati, A.F.S. Biato, M.A. Aprillya, 2022) it was stated that learning using PBL can improve critical thinking as indicated by the active attitude of students in the class. Students become active during the learning process through discussions and questions based on real problems. PBL can create a fun learning environment and encourage optimal learning (Schettino, 2016) Likewise, according to (Fitriyyah et al., 2019), it was concluded that the PBL learning model had an effect on the critical thinking skills of Kragan 3 Public Middle School students on global warming material. Likewise, what was stated by (Dewi et al., 2019) stated that the application of the PBL model could increase student learning activities and student learning outcomes in biology on Environmental Pollution Material for Class X Students of SMA Negeri 1 Jatisrono.

In fact, according to (Herlina et al., 2020) that the PBL model uses audio-visual media has an effect on student interest and learning outcomes. PBL encourages teachers to always train students to think logically and analytically to solve problems according to the structure of the subjects being taught. In PBL, the teacher creates learning situations that are challenging and arouse students' curiosity to find answers (Karyatin, 2016) also allows students to carry out in-depth studies of material and problems, combine theory and practice, and apply various knowledge and skills to develop solutions to problems given by the teacher (Amalia et al., 2017) Strengthened (Webster et al., 2022) which conveys that for those who wish to implement PBL and other complex learning approaches in a way that is responsive to the learner's life experiences needs to be done.

3.7. Psychomotor Learning Outcomes of Junior High School Students using PBL on the Interaction of Living Things

The psychomotor domain refers to a person's skill or ability to act in learning (Webster et al., 2022), psychomotor learning outcomes are manifested in the form of individual skills and abilities. Research shows that learning using PBL has an influence on students' psychomotor

learning outcomes, namely actively developing basic problem-solving skills and acquiring knowledge through interaction with others (Phungsuk, R., Viriyavejakul, C., Ratanaolarn, 2017)). PBL improves students' ability to place mind maps at a fairly good level in all (Karyatin, 2016) and improves cognitive, affective and psychomotor thinking skills (Fauzan, M., Gani, A., & Syukri, 2017). Learning using PBL has an impact on learning outcomes because PBL offers the following advantages: a. meaningful student learning processes where students learn to solve problems through the application of their knowledge; b. students simultaneously integrate knowledge and skills and apply them in relevant contexts; c. improve critical thinking, encourage student initiative at work, internal motivation to learn, and be able to develop interpersonal relationships in group work (Fauzan, M., Gani, A., & Syukri, 2017). Based on various research results (Andini, S. A., Susanto, S., & Hobri, 2017) and (Karyatin, 2016) it is concluded that PBL can improve the quality of learning in secondary schools. This is in line with research (Wulandari, N. I., Wijayanti, A., & Budhi, 2018), which shows that there are significant differences in the learning outcomes of 7th grade students of SMP Negeri 11 Yogyakarta in the 2016/2017 academic year between problem-based learning and traditional learning. Likewise, the results of the study (Saharsa, U., Qaddafi, M., 2018) show that the problem-based learning model has a positive effect on students' conceptual understanding of SMPN 19 Bulukumba Class VIII in science learning as evidenced by the high average of the study.

There are obstacles in this study, namely learning according to PBL which requires a longer time. The same thing happened in research (Tyas, 2017) which showed that teachers faced obstacles in implementing PBL, namely at the planning stage, it was difficult to determine the right problem to create a good atmosphere so that discussions could run well and could encourage students' intellectual development. Long-term limitations in planning and delivering lessons stem from teachers' unfamiliarity with PBL learning. It is not easy for teachers to position themselves as trainers and mentors, deepen understanding and support student initiatives.

Also added by (Tyas, 2017), PBL is not a learning model that is easy to apply, so teachers don't want to use it. This is due to several factors, one of which is not being willing to implement it so that the teacher's habits are still the same as traditional learning. Weaknesses of problem-based learning are revealed in long and complex lessons that demand a higher level of student activity and concentration, as well as results that depend on the ability of the group. Another weakness is that the problem solving process requires time and special attention (Maulidiyahwarti, G., Sumarmi., &Amirudin, 2016). Another weakness of PBL is that students are not interested or unsure that the problem to be studied is difficult to solve, so they are reluctant to try it. However, learning using PBL according to research (Hartati, 2016)shows student responses that fall under very high criteria. From this it can be argued that arousing students' interest in PBL is an important step in learning. Weaknesses in the application of PBL learning are certainly not a reason not to apply this model. The development of the PBL model that seeks a way out of these weaknesses must be carried out as an effort to further develop this learning model in everyday learning.

4. CONCLUSIONS

Based on the research and discussion, the conclusion is that science learning based on PBL on the interaction of living things with their environment has an effective effect on the learning outcomes of junior high school students.

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