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Application of the Problem Based Learning (PBL) Model on Environmental Pollution Materials to Increase Motivation and Learning Outcomes

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Abstract

Motivation to learn is an encouragement both from outside and from within a person to develop interest, desire, and ability to learn and acquire new knowledge. The existence of high motivation is very important to determine success in the learning process of students. This study aims to analyze the increase in motivation and learning outcomes in natural sciences on environmental pollution through the Problem Based Learning. Methods of data collection using questionnaires, interviews, observations and tests. Implementation of this research three cycles, each cycle of activities are: planning, implementation, observation, and reflection. The results of the action research cycle I average value of learning motivation included in the sufficient category. The results of the action research cycle II mean value of learning motivation included in the sufficient category. The final results of the action in the third cycle the average value of learning motivation included in the high category. These results have exceeded the indicators of success, students so that the application of the Problem Based Learning model for 3 cycles to the motivation and learning outcomes of students experienced increase.

Keywords: learning outcomes; motivation; problem based learning

INTRODUCTION

Education is the process of transmitting and receiving knowledge, skills, values and social norms from the older generation to the younger generation, with the aim of developing individual abilities and potential in achieving a better life (Yusuf, 2017; Sujana, 2019; Rahman *et al.*, 2022). Education has a very important role in the life of individuals and society. Education and learning have a very close relationship because learning is an important part of the educational process. Learning can be defined as a process by which individuals acquire knowledge, skills, and attitudes through experience or interaction with their environment (Rukiyati, 2019; Diantoro & Purwati, 2021; Rahman *et al*., 2022). This learning process can occur in various environments such as in the classroom, outside the classroom, at work, or at home. Education aims to develop the potential and abilities of individuals in achieving a better life. One way to achieve this goal is to help individuals acquire the necessary knowledge and skills through the learning process. In the context of formal education, learning usually occurs in the classroom and through specially designed programs (Sujana, 2019; Rahmah, 2018; Diantoro & Purwati, 2021). An effective learning process can help improve the quality of education, while quality education can create a better learning environment. In addition, education and learning are also interrelated in terms of methods, strategies and teaching techniques used to facilitate the learning process. Overall, education and learning

have a close relationship because learning is an integral part of the educational process. Effective learning can help achieve educational goals in developing individual potential and preparing them for a better life (Bahri *et al.*, 2017; Setyosari, 2017; Yusuf, 2017). Science learning is a science class, has special characteristics, namely studying factual natural phenomena, both in the form of facts or events and their causal relationships in the learning process. The science learning process consists of three stages, namely planning the learning process, implementing the learning process, and researching learning outcomes (Supriyono, 2018; Susanti *et al.*, 2021; Kanga *et al.*, 2022). Learning in natural sciences emphasizes providing direct experience to develop competence in order to scientifically explore and understand the natural surroundings contained in the learning process (Trianto, 2015; Hamdalia *et al*., 2018; Panggabean *et al.*, 2021).

A learning process is essentially not without motivation. Then motivation can be interpreted as a force, both from within and from outside that encourages a person to achieve certain predetermined goals (Therefore motivation to learn is the key to the success of students to achieve good learning (Sukmini *et al.*, 2016; Rahmah, 2018; Suminah *et al.*, 2018). Based on the results of observations and interviews with science teachers was obtained that motivation and learning outcomes in science were still low. The low motivation to learn can be seen when the learning process takes place, some students are sleepy, suddenly singing during the lesson, chatting with their classmates, running around, daydreaming when the teacher explains the material and learning seems monotonous so that students have difficulty and has an impact on the low learning outcomes of students.

Based on the results of data analysis from the non-cognitive diagnostic assessment, the learning motivation of students is quite high, both internal and external motivation. After getting information from the interview results that the problem in the learning process especially science subjects, is that the teacher in the learning process only uses the lecture method and does not use various learning models so that the learning process is not going well and effectively. students feel lazy and lack enthusiasm and even seem to pay less attention to the learning process so that it has an impact on the low learning outcomes of students. This becomes a demand for teachers to be able to choose an appropriate learning model so that the learning process is more interesting and enjoyable so that students have high motivation and learning outcomes in the learning process at school. So we need an interesting learning design for students in order to achieve good grades . One alternative learning design that must be applied in the next material is environmental pollution in order to increase motivation and student learning outcomes in this material the researcher chose to use the Problem Based Learning model. So we need an interesting learning design for students in order to achieve good grades.

The Problem Based Learning learning model was chosen because considering the material characteristics of environmental pollution it is considered suitable to use problem-based learning models so it is hoped that this model will provide meaningful and memorable learning for students, increase students joy and enthusiasm and can liven up the classroom atmosphere. Problem based learning has contributed to the development of students' creative thinking skills rather than using traditional teaching methods. The problem based learning learning model is a learning model based on many problems that require authentic investigation, namely investigations that require real solutions (Ersoy & Başer, 2014; Zulhanifah, 2015; Yulianti & Gunawan, 2019). This learning model involves students actively in the learning process. Students are given the freedom to think more and actively participate in developing their reasoning, recognizing the material being taught, and being able to use their reasoning in solving the problems they face in everyday life (Zulhanifah, 2015; Hotimah, 2020; Syawaly & Hayun, 2020). Among the biological materials, especially on the concept of pollution and environmental damage, it includes phenomena that exist in everyday life. Problem-based learning was developed to help students develop thinking skills, problem solving, investigative skills, role abilities to learn adult roles through involving students in real or simulated experiences and making students independent (Djonomiarjo, 2020; Hotimah, 2020; Syawaly & Hayun, 2020). There are six key elements to increase learning motivation in the classroom using the PBL model, namely course goals, student's personal goals, student's interest and background knowledge, relevant materials, skills of independent learning, and feedback (Harun *et al*., 2012; Sukmini *et al*., 2016; Susanti *et al*., 2021).

Learning using the Problem Based Learning model will foster enthusiasm for students and motivate students to learn so hopefully it will have a positive impact on the learning process. problem based learning model provides meaningful learning opportunities for students who can be actively involved in their learning. based on this background it is necessary to conduct classroom action research to prove that using the Problem Based Learning model can increase motivation and student learning outcomes in learning IPA.

METHOD

The material used in this study is environmental pollution. Researchers used tools such as learning implementation plans, cognitive test questions, teacher observation sheets and student learning motivation questionnaire sheets. This study uses three cycles, namely cycle I, cycle II and cycle III, each cycle through the stages of planning, implementing action, observing, and reflecting. Classroom action research is carried out during science class hours or according to the lesson schedule accompanied by a science teacher as an observer during the research process to find out deficiencies or weaknesses in each cycle.

In the first cycle, the first thing to do is to do the planning by compiling and preparing the Learning Implementation Plan, preparing student attendance, preparing tools and instruments to find out the results of motivation and learning outcomes in cycle I and preparing documentation tools. After that, the implementation of the action is carried out, namely the teaching and learning process using the problem based learning method with the stages opening activities, greeting and praying, checking attendance, conducting apperceptions, providing motivation about the benefits of learning to be carried out, conveying the objectives and learning models used; Core activities, Orient students to problems, organize students to learn, guide individual or group investigations, develop and present work results, analyze and evaluate problem-solving processes; and closing activities, the teacher asks the learning difficulties faced by students, the teacher and students conclude the lesson at the meeting, the teacher evaluates the achievement of learning outcomes by distributing questions. Observations were made during the learning process, the observations were assisted by observer teachers to find out deficiencies, motivation and student achievement from the application of the learning model studied. The last stage is reflection by processing data both observation and test data, matching the results of processing and data analysis with indicators of success, analyzing the causes of deficiencies in cycle I, and corrective action plans in the next cycle.

In the second cycle, all activities are in principle the same as in cycle one, the nature of repeating and improving the actions from the results of observations and reflections in cycle one. But the difference is in cycle 2 before starting the main activities the teacher does games so that the learning process becomes more interesting and fun. In the third cycle, all activities are in principle the same as cycles one and two, the nature of repeating and improving the actions of the results of observation and reflection in cycles one and two. But the difference is that in cycle 2 the teacher designed the student worksheets as attractive as possible and before starting the main activities the teacher did ice breaking so that the learning process became more effective. In this study, the indicator that guides success is an increase in student learning outcomes as seen from student test results through the application of the Problem Based Learning learning model. Indicators of success in this study are the results of the knowledge (cognitive) tests of students who have completed learning at least 85% completeness is measured from the minimum criteria completeness score of 80. To measure the percentage of student competence classically the following formula can be used:

$$P = \frac{\sum \boldsymbol{n1}}{\sum \boldsymbol{n}} \times 100\%$$

While indicators of success in measuring student motivation seen from the range of values can be analyzed with the following formula :

$$Score = \frac{Student\ score}{score\ max} \times 100\%$$

RESULTS AND DISCUSSION

At this stage the researcher has prepared learning tools and research instruments. The learning process is carried out in accordance with the Learning Implementation Plan that has been made previously and the learning model used is the Problem Based Learning model. In the learning process students learn to use discussion and presentation methods regarding the meaning of environmental pollution, types of environmental pollution, understanding of water pollution, factors causing water pollution, impacts of water pollution and ways to deal with water pollution.

Table 1. Percentage of Learning Motivation Questionnaire Results Cycle I

Cycle	Average	Category	Amount	Percentage
I	40,8	Very enough	8	32%
	(Enough)	Enough	17	68%
		Tall	0	0%
		Very high	0	0%

Based on the results of the data analysis of the learning motivation questionnaire presented in the table, it can be seen that the motivation to learn science in the first cycle of water pollution material which is classified in the very sufficient category is 8 people out of 25 students, so the number of students who have low learning motivation ranges from 32%. high category as much as 0 out of 25 people, very high category 0 out of 25 people. While the sufficient category is 17 people out of 25 students, so the number of students who have low learning motivation is around 68%. So that the average result of science learning motivation on water pollution has a value of 40.8 in the sufficient category. Actually when students are experiencing the real environment, it will be more effective. They will get both experience exploring mollusc, echinoderms in real habitat for example and a lot of knowledge (Ratih *et al*., 2021; Fatonah *et al*., 2023; Mufida *et al*., 2023).

Table 2. Percentage of Learning Outcomes Cycle I

Cycle	Category	Amount	Percentage
I	complete	9	36%
	Not Completed	16	64%

Based on the results of the analysis of science learning outcomes data on water pollution material presented in the table, it can be seen that 25 students who took the exam obtained learning outcomes in the complete category as many as 9 people or 36% and students who obtained learning outcomes in the incomplete category were 16 people or 64%. From the results of these data it can be concluded that students who have completed only 36% of the 85% that have been determined by the researcher means that class action research must be continued in the next cycle.

Table 3. Student worksheet Assessment Results Cycle I

Group	Category		Average
	Report	Presentation	
1	67	50	58.5
2	50	58	54
3	72	67	69.5
4	78	83	80.5
5	61	50	55.5
6	78	92	85
	Amount		403
	Average		67,2

Based on table 3, the average value of students seen from the report and presentation categories is still classified as unsatisfactory or lacking. The average value of each group's student work sheet has not reached <75

Table 4. Results of the Assessment of the Implementation of Cycle I Learning

Cycle	Average	Category	Total score	Percentage score
I	84	Very good	16	36%
		Good	21	48%
		Pretty good	0	0%
		Not good	0	0%

Based on table 4 regarding the results of the assessment of the implementation of learning cycle I, it can be obtained that 16 points out of 4 points get a score of 4 (very good) and 21 points out of 7 points get a score of 3 (good). So if the total becomes 37 points or in percentage 84% with good qualifications. Based on the results of data analysis in cycle I, student learning motivation is still quite sufficient with an average score of 40.8. The data obtained in cycle I activities were 8 students (32%) who had a very sufficient category and 17 students (68%) who had a sufficient category. The data shows that the motivation to learn science in the subject of water pollution is still low. Based on observations made by teachers and students during the implementation of class action research cycle I that researchers found many obstacles and challenges that became obstacles during the learning process. Constraints or deficiencies experienced by researchers in the learning process do not only come from students, but these obstacles come from teachers or researchers who carry out the learning process. In the implementation of cycle I, it was seen that students were still not familiar with the Problem Based Learning model so that the learning process was not conducive. This is because the previous science learning process still used the lecture method so that student learning activities in class still looked passive. In addition, the low motivation of student learning can be seen from the students who pay less attention to the teacher when explaining the material, often chatting with their desk mates, running around, the classroom is not clean, the uniform is not neat and some are even being rude to the teacher. Of course this is a challenge for researchers in carrying out classroom action research with the problem based learning model so that improvements need to be made for the next learning process, namely cycle II. Seemingly we need more excited learning media or challenging subject delivery like problem based leraning and project based learning (Marhamah, 2021; Hannifa *et al.*, 2022).

After the learning evaluation was carried out in cycle IIn the stage of implementing class action research cycle II the learning process is carried out in accordance with the learning implementation Plan that has been made previously and the learning model used is the problem based learning model. In the learning process the researcher focused on the question and answer method from the video shown by the teacher, the method of discussion and presentation regarding the meaning of air pollution, types of air pollution, factors that cause air pollution, the impact of air pollution and how to deal with air pollution. In addition, researchers also focus on interactive learning media such as PPT and quizizz. The observation results obtained in the implementation of cycle II are as follows:

Table 5. Percentage of Learning Motivation Questionnaire Results Cycle II

Cycle	Average	Category	Amount	Percentage
II	47,16	Very enough	3	12%
	(Enough)	Enough	12	48%
		Tall	10	40%
		Very high	0	0%

Based on the results of the data analysis of the learning motivation questionnaire presented in the table, it can be seen that the motivation to learn science in the second cycle of air pollution material is classified in the very sufficient category as many as 3 out of 25 people with a percentage of 12%, very

high as many as 0 out of 25 students. If calculated as a percentage, the number of students who have very high motivation to learn science is around 0%. As for the sufficient category, there were 12 out of 25 people with a percentage of around 48%. And the number of students who have high motivation is 10 out of 25 people with a percentage of 40%.

Table 4.6. Percentage of Cycle II Learning Outcomes

Cycle	Category	Amount	Percentage
II	complete	13	52%
	Not Completed	12	48%

Based on table 6 it can be seen that 25 students who took the exam obtained learning outcomes in the complete category of 13 people with a percentage of 52% and students who obtained learning outcomes in the incomplete category were 12 people with a percentage of 48%. From the results of these data it can be concluded that students who have completed only 52% of the 85% .

Table 7. Student worksheets Assessment Results Cycle II

	Report	Presentation	Product	
1	78	75	78	77
2	78	75	75	76
3	78	75	75	76
4	89	100	85	91
5	89	75	80	81
6	78	100	75	84
	Amount			485
	Average			81

Based on table 7, the average score of students seen from the categories of reports, presentations and products is still not satisfactory or sufficient.

Table 8 Results of Assessment of Implementation of Cycle II Learning

Cycle	Average	Category	Total score	Percentage score
II	93	Very good	32	73%
	(Very good)	Good	9	20%
		Pretty good	0	0%
		Not good	0	0%

Based on table 8 regarding the results of the assessment of the implementation of learning cycle II, it can be obtained that 32 points out of 8 points get a score of 4 (very good) and 9 points out of 3 points get a score of 3 (good). So if the total becomes 41 points or in percentage 93% with very good qualifications. There were improvements in cycle II so There were improvements in cycle II so that the learning process became more effective, student activities became more active, increased motivation and science learning outcomes on environmental pollution material became better. Class action research cycle II was carried out as a form of improvement from cycle I because the research results had not yet reached the indicators of success that had been determined by the researcher. Of the various aspects that were improved through reflection activities carried out by teachers and researchers, by focusing on things that became improvements in cycle I, such as teachers having to guide and direct students in each learning activity, especially during group discussions, teachers had to be more assertive advising students when the class atmosphere is not conducive or by doing ice breaking, the teacher must be more assertive in limiting time so that the learning process is more efficient, the teacher must be more assertive to students who are difficult to arrange in the preparation of group friends.

Based on the results of data analysis in cycle II, students' learning motivation has increased even though it is still classified as sufficient with an average score of 47.16. The data obtained in cycle II activities contained 3 students (12%) who had a very sufficient category, 12 students (48%) had an adequate category and 10 students (40%) had a high category. The data shows that the motivation to learn science on air pollution is still low. The low motivation to learn in cycle II is because students are still adapting to the problem based learning model seen during the learning process students are still indifferent to their friends who are presenting so discussion activities are still passive. There are still many students who do not have a high sense of responsibility for the tasks given by the teacher where male students still rely on female students in carrying out their assignments, causing group discussion activities to not run effectively and conducively. In addition, students are still not able to optimize the time in the discussion process with group mates. If seen from table 7, the student worksheets observation sheet for each group is still classified as sufficient or not satisfactory. This shows that the learning process in cycle II requires an improvement so that the next learning process becomes better and the motivation and learning outcomes of students can experience a significant increase.

After evaluating the learning cycle II followed by research cycle III. At the implementation stage of the class action research cycle III, it was held for 2 meetings. The learning process is carried out in accordance with the Learning Implementation Plan that has been made previously and the learning model used is the Problem Based Learning model. In the learning process the researcher focuses on the question and answer method from the video shown by the teacher, ice breaking at the beginning of learning, designing and making projects, discussion methods, and presentations. The observation results obtained in the implementation of cycle III are as follows:

Table 9. Percentage of Learning Motivation Questionnaire Results Cycle III

Cycle	Average	Category	Amount	Percentage
III	67,36	Very enough	0	0%
	(very high)	Enough	0	0%
		Tall	5	20%
		Very high	20	80%

In cycle II there was an increase so that students' learning motivation could experience a significant increase so that the learning process in cycle III was carried out as well as possible such as the teacher had to be more assertive towards students who had a low desire to do groups. assignments, better guiding and directing students during group activities, being more assertive about time limits and doing ice breaking at the beginning of learning so that the learning process is more conducive. In addition, in cycle III the researcher maximized learning media such as power points and student worksheets which were designed as attractive as possible so that students were more interested in doing assignments with a group of friends. The data obtained in cycle III activities showed that 5 students (20%) had a high category and 20 students (80%) had a very high category. The results of student learning motivation achieved in cycle III have achieved classical success indicators namely the average score is included in the high category (> 50) (Hamdalia *et al.*, 2018; Bragaswangga *et al*., 2019; Djonomiarjo, 2020; Wini *et al*., 2022).

Table 10. Percentage of Learning Outcomes Cycle III

Cycle	Category	Amount	Percentage
III	complete	23	92%
	Not Completed	2	8%

Based on diagram 10 it can be seen that 25 students who took the exam obtained learning outcomes in the complete category of 23 people with a percentage of 92% and students who obtained learning outcomes in the incomplete category were 2 people with a percentage of 8%. The highest score obtained from the test results is 100 and the lowest score is 70.

Table 11. Student worksheets Assessment Results Cycle III

Group	Category			Average
	Report	**Presentation**	**Product**	
1	100	90	88	93
2	95	83	88	89
3	100	92	95	94
4	100	100	95	98
5	95	83	90	89
6	100	92	90	94
	Amount			557
	Average			93

Based on table 11, the average value of students seen from the categories of reports, presentations and products is classified as very satisfying or very high, with an average value of 93.

Table 12. Results of Assessment of Cycle III Learning Implementation

Cycle	Average	Category	Total score	Percentage score
III	95	Very good	36	82%
	(Very good)	Good	6	13%
		Pretty good	0	0%
		Not good	0	0%

Based on table 12 regarding the results of the assessment of the implementation of learning cycle III, it can be obtained that 36 points out of 9 items get a score of 4 (very good) and 6 points out of 2 items get a score of 3 (good). So that if the total becomes 42 points or in a percentage of 95% with very good qualifications.

Table 13. Comparison of Learning Outcomes and Motivation in Cycle I, Cycle II, and Cycle III

No.	Aspect	Action	Percentage	Information
1	Learning outcomes	Cycle 1	36%	Not yet reached
		Cycle 2	52%	Not yet reached
		Cycle 3	92%	achieved
2	Motivation to learn	Cycle 1	40.8%	Not yet reached
		Cycle 2	47.16%	Not yet reached
		Cycle 3		achieved

Based on table 13, it can be seen that there is an increase in science learning outcomes in each cycle. This is evidence of success in the learning process using the Problem Based Learning model. The increase in student motivation after applying the Problem Based Learning model of 67.36% is inseparable from good cooperation between researchers, teachers and supervisors in designing more mature learning activities. Researchers succeeded in increasing motivation to learn science on environmental pollution material because researchers could be more assertive about the stages or syntax of problem-based learning models through power point media and student worksheets, motivating students more with expressions or advice as well as touches such as guiding and directing. In addition, the teacher also makes students more enthusiastic and confident when participating in the learning process, especially when students complete project assignments given by the teacher. So that students are able to show visible progress in almost all attention. As for the improvement from cycle I, there were 36% of students who completed, cycle II 52% of students completed and cycle III 92% of students completed. This means that the ability of students to participate in the learning process can be said to be very good from the beginning to the end of learning on environmental pollution material so that the learning outcomes of participants can reach the indicators of success that have been determined by previous researchers. This is because researchers have carried

out learning using problem based learning models well and students already understand and are accustomed to using problem based learning learning models in science learning. So that the research can be said to be successful and stop in cycle III.

Based on the data collected in research on environmental pollution through the Problem Based Learning model, it can increase motivation and science learning outcomes so that the Problem Based Learning model can be said to have a positive impact on the learning process. Learning using the problem based learning model can improve science learning outcomes higher than using other learning models (Bragaswangga *et al.*, 2019; Yulianti & Gunawan, 2019; Meilasari *et al.*, 2020). Stating that the benefits of problem-based learning include increasing problem-solving abilities, easier to remember and understand the material being taught, increasing focus on relevant knowledge, encouraging students to think, building skills. leadership and teamwork as well as social skills, build learning skills (life long learning skills) and motivate learning (Sukmini *et al*., 2016; Tyas, 2017; Susanti *et al*., 2021).

CONCLUSION

Based on classroom action research that has been carried out in 4 stages, namely planning, action, observation, and reflection in natural sciences subject matter of environmental pollution. through the Problem Based Learning model which hasOrientation of students to problems,Organizing students to learn,Guiding individual or group investigations,Develop and present the work, Analyze and evaluate the problem-solving processit can be concluded that The application of the Problem Based Learning model can increase motivation to learn natural science on environmental pollution. This can be proven by increasing the average student motivation in each cycle, namely 40.8% in cycle I to 47.16% in cycle II and experiencing a significant increase of 67.36% in cycle III resulting in an increase of 26.56%. The application of the Problem Based Learning model can improve natural science learning outcomes on environmental pollution this is shown by the increasing percentage of the value of cycle I (36%), cycle II (52%) and cycle III (92%) so that there is an increase of up to 40%. According to these data it can be said that learning natural sciences on environmental pollution using the Problem Based Learning model can be said to have been successful.

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