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The Effectiveness of Problem-Based Learning in Ecosystem Content on Critical Thinking Skills Reviewed from Students' Metacognitive Awareness

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Abstract

This study was conducted because most students at SMPN 43 Bandar Lampung have low critical thinking skills and not all students can use their metacognitive awareness well. This study aims to determine the effect of implementing the PBL model on student's critical thinking skills and describe students' critical thinking skills toward the interaction of living things with their environment in terms of metacognitive awareness. The design in this study was a quasi-experiment using the pretest-posttest control group design technique. Sampling used a purposive sampling technique with a research sample of 52 students. The instruments used were pretest and posttest questions, metacognitive awareness questionnaires, the application of the PBL model, and students' responses to the PBL model. The average n-gain value of the experimental class was 0.65 with the criteria of 'moderate'. The n-gain homogeneity test was sig. 0.250 > 0.05. Hypothesis test with a sig. (2-tailed) value of 0.00 < 0.05. The effect size result was 1.18 with criteria of 'large'. These results show that the use of the PBL model is effective in improving students' critical thinking skills in the interaction of living things with their environment. The results of the analysis between metacognitive awareness and essential skills of thinking descriptively show that more than half of the students who are at the 'developing' metacognition level consist of students who are in the moderate and high critical thinking categories.

Keywords: Critical Thinking, Metacognitive Awareness, PBL.

Efektivitas Pembelajaran Berbasis Masalah pada Konten Ekosistem terhadap Kemampuan Berpikir Kritis Ditinjau dari Kesadaran Metakognitif Siswa

Abstrak

Penelitian ini dilakukan karena sebagian besar siswa di SMPN 3 Bandar Lampung memiliki keterampilan berpikir kritis yang rendah dan tidak semua siswa mampu menggunakan kesadaran metakognitifnya dengan baik. Penelitian ini bertujuan untuk mengetahui pengaruh penerapan model PBL terhadap keterampilan berpikir kritis siswa dan mendeskripsikan keterampilan berpikir kritis siswa terhadap interaksi makhluk hidup dengan lingkungannya ditinjau dari kesadaran metakognitif. Desain dalam penelitian ini adalah quasi eksperimen dengan menggunakan teknik Pretest-Posttest Control Group Design. Pengambilan sampel menggunakan teknik purposive sampling dengan sampel penelitian sebanyak 52 siswa. Instrumen yang digunakan adalah soal pretest dan posttest, angket kesadaran metakognitif, penerapan model PBL dan respon siswa terhadap model PBL. Rata-rata nilai N-Gain kelas eksperimen sebesar 0,65 dengan kriteria "sedang". Uji homogenitas N-Gain adalah Sig.0,250 > 0,05. Uji hipotesis dengan nilai Sig. (2-tailed) 0,00 < 0,05. Hasil uji effect size sebesar 1,18 dengan kriteria "besar". Berdasarkan hasil tersebut menunjukkan bahwa penggunaan model PBL efektif dalam meningkatkan keterampilan berpikir kritis siswa dalam interaksi makhluk hidup dengan lingkungannya. Hasil analisis antara kesadaran metakognitif dengan keterampilan berpikir kritis secara deskriptif

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menunjukkan bahwa lebih dari separuh siswa yang berada pada level metakognisi ‘berkembang’ terdiri dari siswa yang berada pada kategori berpikir kritis sedang dan tinggi.

Kata kunci: Berpikir kritis, Kesadaran Metakognitif, PBL

INTRODUCTION

Critical thinking skills in the 21st century are very much needed for the current generation in facing various global problems and challenges along with the rapid development of science and technology. Critical thinking is the ability to determine a problem that produces interpretation, analysis, evaluation, and inference as well as the presentation of evidence, concepts, criteria, or contextual considerations that are the basis for making a decision (Halimatussa’diyah et al., 2023). Critical thinking skills are one of the skills that must be trained in students to solve problems related to concepts so students' critical thinking skills are critical in ensuring the success of learning (Ramdani et al., 2020). Students' critical thinking skills in science learning are very much needed in connecting and understanding the contents of science material that is microscopic or abstract so it requires good analysis, evaluation, and interpretation of students' thinking in teaching and learning activities (Vari & Bramastia, 2021).

Competencies that are by the 21st century, namely teacher competencies in pedagogical development related to good learning development, of course, cannot be separated from learning compiled by (Komalasari et al., 2019)teachers. Students' critical thinking skills can be improved by implementing innovative learning models such as PBL (Problem Based Learning). The application of the PBL model emphasizes the integration of everyday life problems in learning and directs students to formulate the best solutions (Sri Wahyuni et al., 2023). The main characteristics of PBL can be seen from the presentation of a problem at the beginning of the learning process. The problems presented can involve students directly and can stimulate curiosity so that students are active in the learning process.

Research conducted by (Seibert,2021)concluded that the PBL model is an ideal strategy to engage Gen Z students in critical thinking such as asking, analyzing, interpreting, concluding, and applying. In addition, Cahyo & Murtiyasa (2023) Based on the results of their research, states that the use of PBL can improve students' self-discipline and critical thinking skills. Through problem-based learning, students can develop critical thinking skills which are very important to support learning. Other research results show that the application of PBL can improve students' critical thinking skills and student involvement in the learning process. Sri Wahyuni et al. (2023)It is stated that students

who can solve problems through active thinking, not only obtain information from several sources, but are actively involved in finding solutions, analyzing the information obtained, and actively involved in group discussions. Students can also reflect to experience learning during the learning process that has been carried out.

A person's knowledge of the thinking process and the results of his thinking is called metacognition (Ikhsan, Munazir & Fitria, 2017). Metacognition is the formation of awareness of cognition, how cognition works, how to organize it, and what the results are. Metacognitive awareness is an individual's awareness of using his mind to plan, control, and evaluate cognitive processes and strategies. Metacognition is very important in learning because knowledge of cognitive processes can guide students in developing and choosing strategies to improve cognitive performance so that learning is successful.

Metacognition is conscious control of knowledge, learning processes, affective and cognitive states of students, and self-regulation of students so that they can reflect on themselves (Esref & Cevat, 2021). Metacognition is closely related to learning achievement because learning achievement is the result of the cognitive process. The results of the study by Wiono & Dewi, 2023)showed that students with a "developed" level of metacognitive awareness were able to identify and revise concepts that developed in society related to the human reproductive system so that they were scientifically correct. Metacognitive awareness can significantly improve student learning achievement. This is evidenced by the fact that before learning using metacognitive strategies was given, the average student learning achievement was 54.85. After learning using metacognitive strategies was carried out at the first meeting, there was an increase to 58.18, then at the second meeting, the average student learning achievement increased again to 64.89 (Amanda et al., 2019). Metacognitive strategies are one strategy that can help students develop critical thinking skills.

The current claim of the independent curriculum is that teachers are given the freedom to choose appropriate subject matter to achieve learning objectives and students can explore their uniqueness so teachers need to explore the competencies possessed by students before the material is taught. The design of the independent curriculum essentially provides freedom of thought, planning, implementation, and assessment in learning. Both teachers and students have their freedom to get quality learning, but basically, even though the independent curriculum still plays an important role in the success and success of learning is determined again by the teacher. The findings of the

research conducted (Setiawan et al., 2020) state that the independent curriculum provides opportunities for teachers to create fun and supportive learning for students. The concept of active and innovative learning is not only based on problem-based learning models. However, the needs of students in the learning process must be considered to realize learning activities that are impartial to students. The material on ecosystems is a sub-material for science subjects for grade VII SMP in the independent curriculum which contains the reciprocal relationship between living things related to the food chain, food webs, and food pyramids. This will attract students' attention because the problems given will be related to everyday life. By including material about the interaction of living things with the environment in classroom learning, it can encourage students to develop curiosity, be honest, responsible, objective, highly critical thinking, and have an attitude of caring for the surrounding environment (Putri et al., 2017). Study This is different with other research, because in the research This participant was invited For fill in questionnaire awareness metacognition related himself each Then categorized based on the acquisition number from the results questionnaire . Next participants educate given treatment using a *problem-based learning* model so that participants educate with category awareness metacognition certain can known How level ability think critical.

SMP Negeri 43 Bandar Lampung shows that teachers still often use discussion and lecture methods in implementing learning. This results in knowledge not being fully accepted by students so that they cannot be aware of its use in solving everyday problems. This is supported by research (Hartatik, 2023) states that the quality of learning outcomes is influenced by the use of learning models used by teachers which tend to be less varied. The lecture method still dominates its use by teachers during the learning process in the classroom. Meanwhile, students still need time to adapt to the learning situation in the classroom during the implementation of the independent curriculum which still feels lacking for them. This condition is closely related to students' ability to use metacognitive awareness. This can be seen that they have not been able to choose the right strategy to achieve goals and evaluate the results of their thinking. This shows that students themselves have low critical thinking skills and have not been able to use metacognitive awareness properly.

Based on research that has been done by (Sonyinga et al., 2018) explains that in the class being taught with learning models inquiry guided who has mark results Study tall is participant students who have awareness metacognition tall whereas participant the

students who are taught using a learning model based on the problem that has mark results Study low is participant students who have awareness metacognition low. This shows that learning model inquiry guided with participant students who have awareness metacognition tall own mark results high learning also compared with students who give treatment with using other models and students with category awareness metacognition low. Next research conducted by (Ramadhani et al., 2020) mentions that that the average n-gain index of ability think-critical students who use the *problem-based learning* model based on metacognitive taller than average n-gain index capability think-critical students who use the *problem-based learning* model. The average n-gain index of the class experiment is 0.75 with the category high, while the average n-gain index of the class control is 0.69 with the category in progress. Reality show that in condition said, quality improvement ability think critically students whose learning using a PBL model based on metacognitive more good than students who learning using a problem-based learning model.

This matter shows that students who are taught using a PBL model based on metacognitive ability think highly critically compared to students who are taught only using a PBL model without know level of awareness metacognition in each student. Therefore, researcher is interested For do a study with using a PBL model in class experiments and discovery learning models in the classroom control that on each student Already known moreover formerly level awareness metacognition then it will be analyzed how ability think critical after given treatment. This has not yet once conducted in previous research There is previously. The purpose of this study was to determine the effectiveness of PBL learning on students' critical thinking skills on the material of interactions between living things and the environment and to describe students' critical thinking skills on the material of interactions between living things and the environment in terms of metacognitive awareness.

RESEARCH METHODS

This study used a quasi-*experimental method* with a *non-equivalent control group type*. The determination of the research design was based on the difference in the number of group members in the study. The independent research variable is a problem-based learning model, while critical thinking skills are dependent variables, and metacognitive awareness is a moderating variable. The data were processed using *Microsoft Office Excel*

and SPSS applications using *Pearson Product Moment Correlation – Bivariate* . The research design is presented in Table 1.

Table 1. 2x2 Factorial Study Design

Learning Model (A)	Metacognitive Awareness (B)	
	Developed (B_1)	*Poo* r (B_2)
PBL (A_1)	A_1B_1	A_1B_2
Discovery learning (A_2)	A_2B_1	A_2B_2

Table 1 is the process of coding research samples based on differences in metacognitive awareness levels. This research was conducted at SMPN 43 Bandar Lampung City. The research population was the number of grade VII students divided into 5 classes. The research sample was determined using *purposive sampling* and selected Class VII.1 as the experimental group and Class VII.2 as the control group.

The instruments used to collect research data were metacognitive awareness questionnaires and critical thinking ability tests. The statements in the questionnaire consisted of 52 items, filled in by students according to their experiences and referring to the *Guttman scale* (yes or no). Indicators of awareness metacognition contained in the questionnaire is cognitive knowledge and cognitive regulation. Cognitive knowledge includes indicators of procedural, declarative, and conditional knowledge. While indicators of cognitive regulation include information management strategies, planning, monitoring understanding, debugging strategies, and evaluation. Indicators' ability think critically of research This developed based on the Ennis benchmark (in Supriyadi, 2018) which includes indicators 1) basic clarification, 2) basic support, 3) inference, 4) further clarification, and 5) strategies and tactics. The instrument used to determine students' critical thinking skills is to use *pretest-posttest questions* in the form of essays.

The study began by mapping the level of metacognitive awareness of experimental and control class students, followed by conducting *a pretest* of critical thinking skills. Furthermore, experimental class students applied PBL while the control class applied the *discovery learning model*. The learning material is the interaction of living things with their environment. Critical thinking ability data were then processed using normality and homogeneity tests, then continued with an *independent sample t-test*. The normality test used *the Kolmogorov-Smirnov one-sample test and* the homogeneity test used the Levene of equality test with a significance level of 5% each. Data processing was carried out with the help of the SPSS Windows version 23 program.

RESULTS AND DISCUSSION

Learning by implementing PBL in class experiments begins by directing students to conduct investigations of real authentic and formulaic problems. Furthermore, students are directed to formulate hypotheses, collect information, and formulate conclusions as solutions to problems raised at the beginning of learning. (Hartatik, 2023). Based on the research results, it can be concluded that PBL can invite students to develop a creative spirit, work together, think metacognitively, develop critical thinking skills, and increase independence.

Based on the activities of students in the experimental class, the following are the *pretest* and *posttest data* in Table 2 which describe the development of critical thinking skills before and after treatment was given.

Table 2. Statistical Test Results of *Pretest* and *Posttest Values*

	Class	x̄ ±Sd	Normality Test	Homogeneity Test	T-test
Pretest	E	41.48 ± 6.45	Sig. 0.200 > 0.05	Sig.0.421 > 0.05	*Sig.* (2-tailed) 0 < 0.000
	K	33.04 ± 5.52	Sig. 0.068> 0.05		
Posttest t	E	79.48 ± 4.64	Sig. 0.200 > 0.05	Sig.0.096> 0.05	
	K	65.12 ± 6.25	Sig. 0.200 > 0.05		
N- Gain	E	0.65± 0.07	Sig. 0.069 > 0.05	Sig.0.250> 0.05	
	K	0.48± 0.06	Sig. 0.200 > 0.05		

The description in Table 2 shows that each pretest and posttest score from the experimental and control classes is normally distributed. This can be seen from the significance value which is greater than 0.05. Furthermore, a homogeneity test was carried out which showed that the sample came from a homogeneous population. This is indicated by a significance number greater than 0.05. Based on the results of the normality and homogeneity tests, it was continued with a t-test with a significance result of less than 0.05 which indicated that the independent variable had a significant effect on the dependent variable. This is by the results of the study (Wiono & Dewi, 2023)which stated that the results of the normality and homogeneity tests were continued with a t-test with a significance result of less than 0.05 which means that the independent variable had a significant effect on the dependent variable. So it can be said that PBL has a significant effect on students' critical thinking skills.

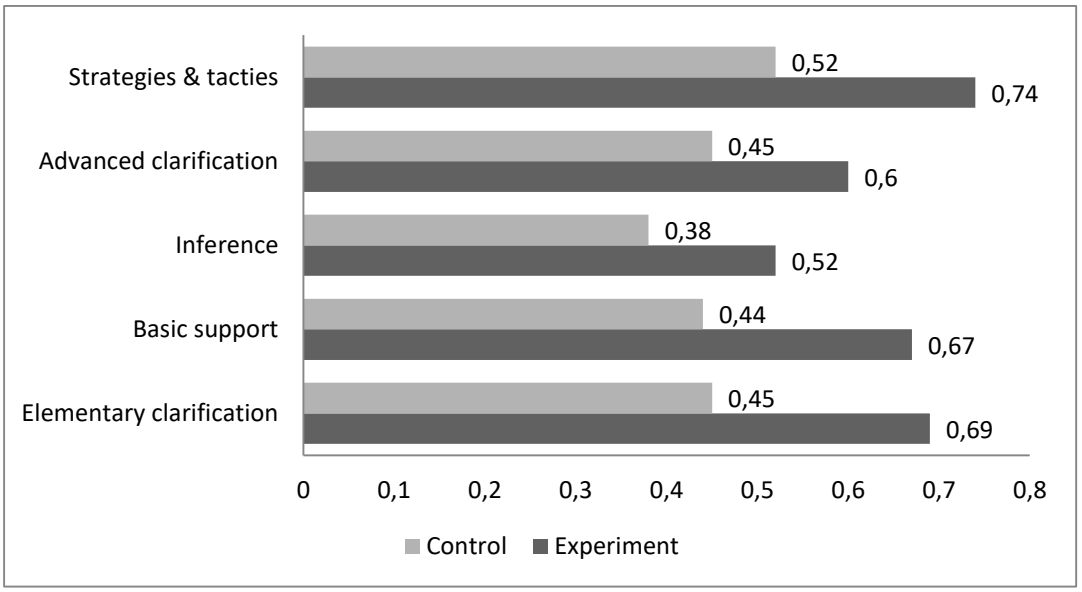


Figure 1. Results of Representation of Students' Critical Thinking Skills

Based on Figure 1, it can be seen that the largest score change in the experimental class is in the indicator of providing a simple explanation, which is 0.74 and the lowest score is in the indicator of drawing conclusions. While in the control class the highest score is 0.52 and the lowest score is 0.38. The data above directly shows that students in the experimental class have higher critical thinking representation abilities compared to the control class.

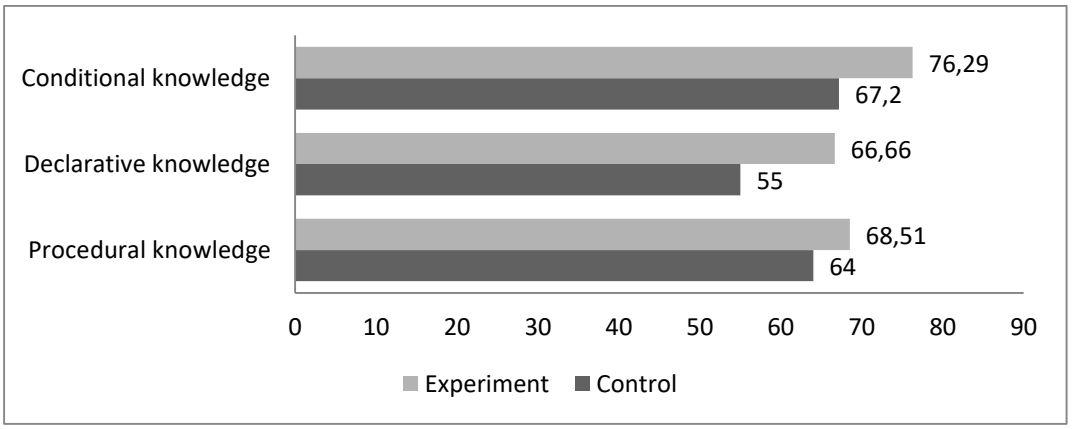


Figure 2. Level of Awareness of Metacognitive Aspects of Metacognitive Knowledge

Metacognitive awareness can influence students in receiving and managing the information they obtain so that it will influence students in improving their learning outcomes. Metacognition itself plays a role in the learning process, especially in problem-solving. Students will be aware of their thinking process and evaluate it

themselves regarding the results of their thinking process. Students in the experimental class are aware of their thinking methods so that students can plan, organize, and evaluate the learning process. The following is the level of metacognitive awareness based on indicators of knowledge and metacognitive regulation in the experimental and control classes.

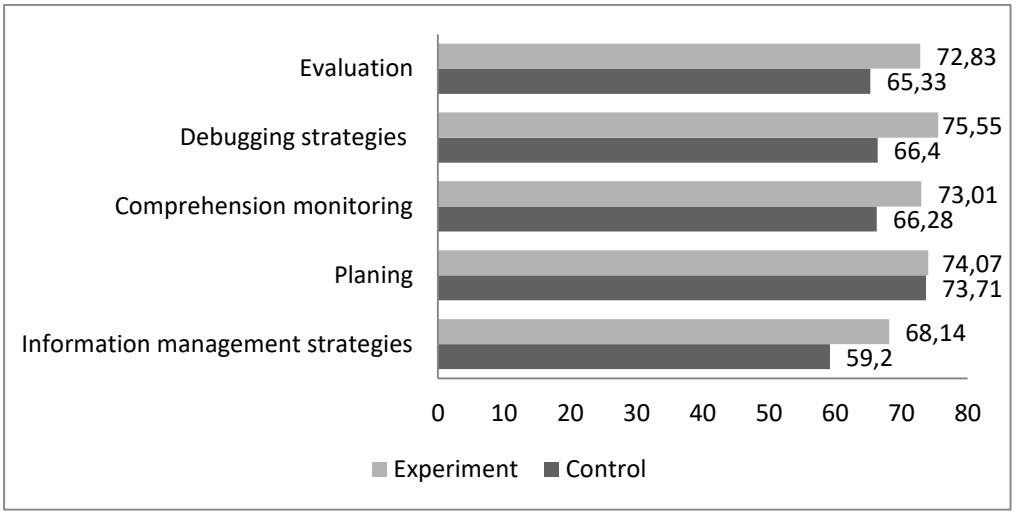


Figure 3. Level of Metacognitive Awareness of Aspect Arrangement Cognition

Based on Figure 3, it can be seen that the level of metacognitive awareness in the experimental class and the control class is different. This is indicated by the average value for each indicator of knowledge about metacognition and cognitive regulation in the experimental class being higher than in the control class. The indicator of knowledge about cognition in the experimental class has an average value (70.48) in the developing category and an average value of cognitive regulation (72.72) in the high category, while in the control class the average value of knowledge about cognition (62.06) in the developing category and the average value of cognitive regulation (65.87) in the developing category. The sub-indicator of the level of metacognitive awareness developing has reached the awareness of thinking for oneself but needs to be stimulated. The dominance of the "developing" level of junior high school students is in line with learning outcomes (Wiono & Dewi, 2023). This shows that the average value for each indicator of metacognitive awareness which includes knowledge about cognition and cognitive regulation is higher in the experimental class. The average value of the cognitive regulation indicator is in the high category. The sub-indicator of information management and evaluation strategies is in the developing category. Students in the experimental class

already have several problem-solving methods, can monitor their understanding independently, and reread the reading when confused. Planning activities such as showing objectives and analyzing tasks help activate relevant knowledge so that students can easily understand the learning material. There is a relationship between metacognitive awareness and students' critical thinking skills about the interaction of living things with their environment. The following is an explanation of critical thinking skills from metacognitive awareness.

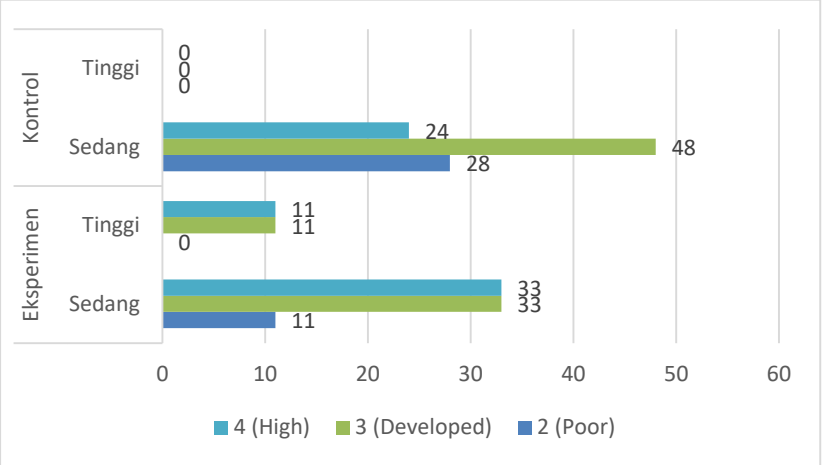


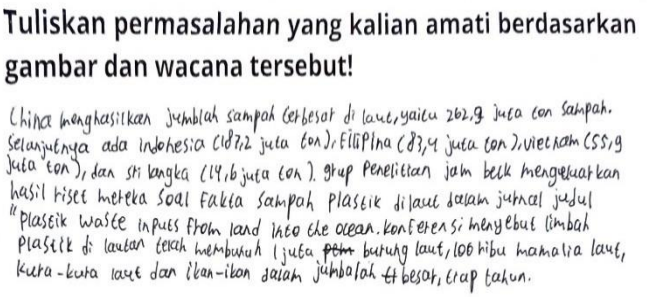
Figure 4. Percentage of Critical Thinking Ability to Metacognitive Awareness

Based on Figure 4, it can be seen that as many as 44% of experimental class students with a high metacognitive awareness category have N-Gain scores in the medium (33%) and high (11%) categories compared to 24% of control class students with a high metacognitive awareness category. Experimental class students with high metacognitive awareness have medium (24%) and high (0%) critical thinking skills. This shows that experimental class students with high metacognitive awareness are higher than the control class who are aware of their thoughts both in metacognitive knowledge and metacognitive regulation. In addition to critical thinking skills, metacognitive awareness is based on (Wiono & Meriza, 2022)one's findings related to high-level thinking skills. Students with high metacognitive awareness can plan what to learn and assess what has been learned. Students with high metacognitive awareness can plan what to learn and assess what they have learned (Sonyinga, Danial & Herawato, 2018). Students who have critical thinking skills need to have metacognitive awareness such as monitoring the thinking process, checking whether the strategy used leads to the right goal or not, ensuring accuracy, and making decisions (Sadeghi, Hassani & Rahmatkhah 2014).

In the *pretest* and *posttest questions* given, the indicator of providing a simple

explanation obtained the highest average N-Gain with a score of 0.74. Furthermore, after learning was carried out using the PBL model, the average *posttest score* increased because students were required to be able to identify problems, analyze arguments, and answer clarifying questions so that students were able to provide correct answers. The first syntax of the PBL model is problem orientation. The critical thinking indicator of the aspect of providing a simple explanation was higher in the experimental class using LKPD PBL compared to the control class with the percentage of indicators in the experimental class being 26.67% compared to the control class being 25%. In the first syntax, the teacher conveys objective learning, presents a problem, and motivates students to participate in problem-solving activities. Through the problems given, students can provide simple explanations.

Giving students a problem can train them to know their strengths and weaknesses and know what they need to master. This is included in the sub-indicator of the declarative knowledge aspect, where the knowledge that students must know about what, who, when, and where is used to achieve learning goals. Someone knows cognitive strengths or weaknesses, for example knowing that I have difficulty solving problems, I will answer the problems that I consider important first and save the difficult problems to answer last. The application of a problem-based learning model with the sub-indicator aspect of students' declarative knowledge will help direct the syntax of the problem-based learning model so that it can train students' critical thinking skills with indicators that provide simple explanations. These steps are in line with what students do, where students together with their groups read the problem carefully, and then students can identify the problem and write their arguments on the worksheet.

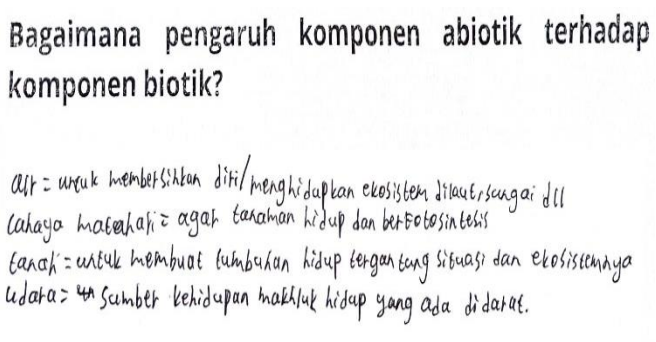

Tuliskan permasalahan yang kalian amati berdasarkan gambar dan wacana tersebut!

China menghasilkan jumblah sampah terbesar di laut, yaitu 262,9 juta ton sampah. Selanjutnya ada Indonesia (187,2 juta ton), Filipina (83,4 juta ton), Vietnam (55,9 juta ton), dan sri langka (14,6 juta ton). grup penelitian jam beck menggunakan hasil riset meteka soal fakta sampah plastik dilaut dalam jurnal judul "Plastik waste inputs from land into the ocean. konferensi menyebut limbah plastik di lautan telah membunuh (juta ~~pun~~ burung laut, 100 ribu mamalia laut, kura-kura laut dan ikan-ikan dalam jumblah ~~ti~~ besar, tiap tahun.

Picture 5. Orientation Problem on Sheet Work

The syntax of PBL is organizing students to learn, students are formed into a group consisting of several heterogeneous students. The formation of this group can make it

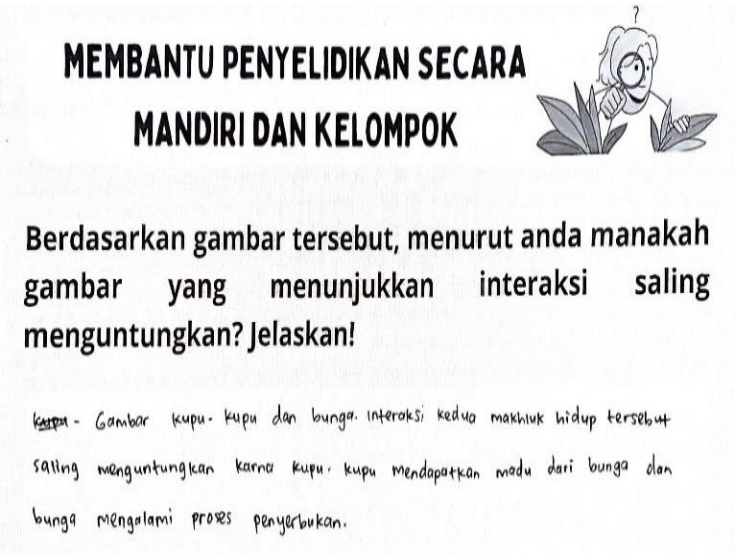
easier for students to work together in completing the tasks given. Students can discuss with each other in expressing group ideas on the worksheets that have been given. This is by research conducted by (2003) (Lestari, Ansori & Karyadi, 2017)that group work carried out by students can provide opportunities for other students to express opinions, collect information related to problems, and participate in discussions. Students in the experimental class with the understanding monitoring sub-indicator have an average score percentage of 73.01 (High). The understanding monitoring sub-indicator requires students to be able to monitor their understanding and the learning process. This is by the theory put forward by (2003) Schraw (1998)that monitoring refers to awareness in completing tasks. The problem-solving process carried out by students is also monitored by their knowledge so that the problem-solving used is appropriate. After reflection, the percentage of the skill-base building indicator increased by 70% with good criteria, this indicates an increase in student skills by answering critical thinking questions and making conclusions based on data and activity objectives (Lestari, Ansori & Karyadi, 2017). In this problem-based syntax learning, the teacher helps students determine and design tasks related to the problems that have been given. Through planning in solving problems, students can build a skill base.



Picture 6. Organize Participants Educate on a sheet Work

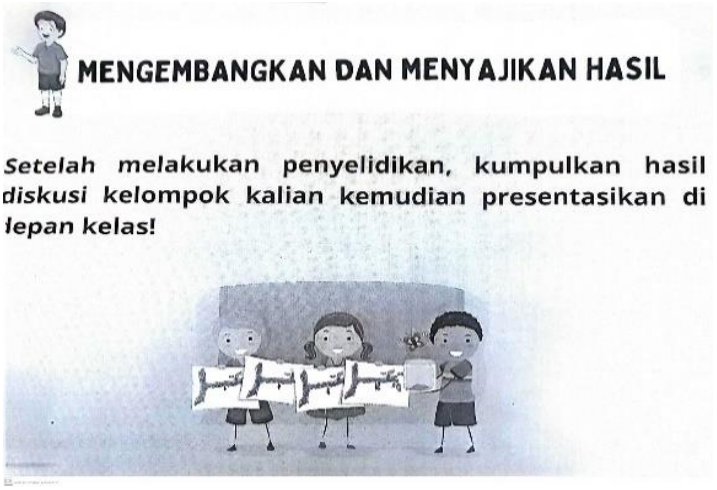
Next, students will conduct investigations in groups according to the groups that have been formed. Students follow up on problems by collecting relevant information and analyzing data. Students who have their aspects, namely the sub-indicator of metacognitive awareness, namely procedural knowledge, namely about how to apply learning procedures, where students are required to use strategies to find out how far the learning process has taken place and when to implement the process in various situations that can be obtained through discovery activities, problem-solving and cooperative learning. (Handayani et al., 2021). It is stated that the ability to develop strategies and

tactics can also be stated as Good because as many as 93% of students master the ability to be said to be Good. This step is in line with what students do, where students can collect information in groups to determine a picture of the interaction of living things that are included in the interaction of living things that are mutually beneficial. In this syntax, students practice managing strategies and tactics.



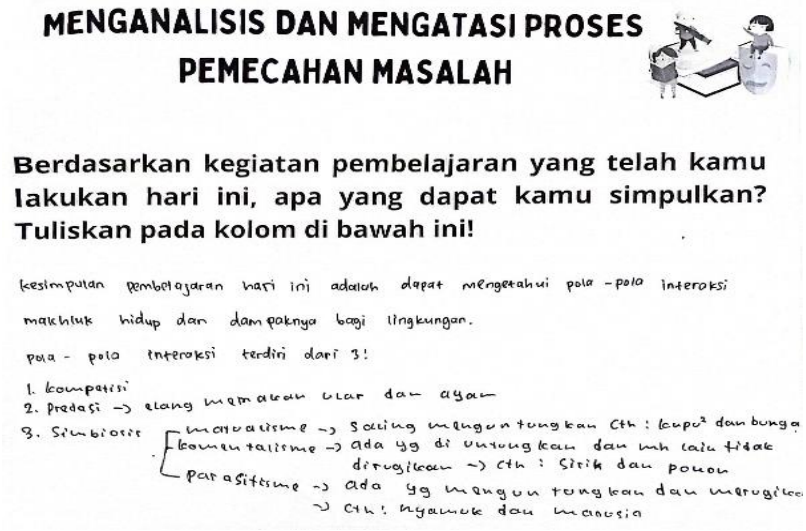
Picture 7. Help Investigation Generally Independent And Group on Worksheet

After students organize data from group discussion activities, students can develop and present the results of the information written on the worksheet in front of the class. The results of the work done by students on the worksheet require students to know and use learning strategies in every condition. This is included in one aspect of metacognitive awareness of conditional knowledge. Students must consider the relevant concepts and data to use but they will also think about processing and presenting data to obtain certain knowledge. In learning syntax, developing and presenting the results of the information that has been obtained can train students to provide further explanations. The ability to provide further explanations is the ability of students to provide appropriate explanations related to solving a problem. This can be seen when students in groups carry out presentations in front of the class and present good results accompanied by reasons. Research Ramdani et al. (2020) state that making further explanations gets the highest score because this question is often presented by teachers during learning. Thus, students can be said to be accustomed to receiving repeated information related to the question, so that it can trigger students' memory. Remember the students are quite tall.



Picture 8 . Develop And Presenting Results on Worksheet

Students are assisted by teachers to evaluate the results of student investigations and the processes they have used and can draw conclusions. Students who can conclude already have awareness in evaluating the learning process where students can ask themselves whether they have fully understood the learning process they have done or not. The awareness possessed by students is expressed in the evaluation sub-indicator. Evaluation is used to assess whether the strategy implemented is by students' metacognitive awareness (Jagals & Van Der Walt, 2016). Through this syntax, teachers can find out how students think in producing solutions to a problem and train students in making conclusions. Concluding is one indicator of critical thinking skills that must be based on analysis, observation and then continued by drawing realistic conclusions based on facts (Anggraeni, Tin & Yona, 2022). The indicator of concluding is an indicator with a low percentage compared to other critical thinking indicators. This is supported by research (Bahri et al., 2018)which states that the percentage of indicators for developing solutions and drawing conclusions is in the low category among the four indicators, due to the lack of student understanding in determining problem-solving solutions and drawing conclusions. Students can provide conclusions related to the learning that has been done and can provide solutions related to a problem that can be seen in the worksheet image below.



Picture 9 . Analyze And Overcoming the Process Solution Problems with Worksheet

Learning using the PBL model has a very positive response for both class VII 1 students as an experimental class where when students are given a problem they can hone, test, and develop their thinking skills. This indicates that the learning process in the experimental class using the PBL model has been carried out in an effective and good way. Based on the things that have been described above, it is obtained that the application of the PBL model can provide an increase in students' critical thinking skills in terms of metacognitive awareness. Effective management of the learning process in the classroom is the first step in creating success in final learning and improving student learning achievement (Purwati, 2022). Application of PBL with argumentation scaffolding was effective in increasing the critical thinking of prospective teachers from the criteria of "less critical" to "critical enough" and the n-gain results were categorized as moderate when viewed from the aspect of personality type. and gender (Cahyono, et al, 2021). PBL with scaffolding helps achieve independence and effectiveness to support metacognitive awareness in learning to improve critical thinking skills (Dagoc & Tan, 2018), Problem-based learning is a good solution to enhance critical thinking skills (Aini et al., 2019).

CONCLUSION

Learning using the PBL model is effective in improving students' critical thinking skills in ecosystem material. The results of the representation of critical thinking skills indicators provide a simple explanation to be the highest category in the experimental class of 0.74 compared to the control class of 0.52. The indicator of knowledge about cognition in the experimental class has an average value of 70.48 and an average value of

cognitive regulation of 72.72, while in the control class, the average value of knowledge about cognition is 62.06 and the average value of cognitive regulation is 65.87. There are 3 levels of metacognitive awareness with different average categories of critical thinking ability N-Gain. At different levels of metacognitive awareness, namely poor overall has an average of moderate N-Gain, the level of developing metacognitive awareness overall has an average of moderate and high N-Gain and the level of high metacognitive awareness overall has an average of moderate and high N-Gain.

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