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Problem Based Learning: Improve Critical Thinking Skills for Long Life Learning

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Abstract: This study aims to increase the students' critical thinking. The subjects of this study were 37 students of XI-Science E from Senior High School 2 Tuban, who used the Problem Based Learning (PBL) model. This research was a Class Action Research (CAR) used interviews with chemistry teachers at Senior High School 2 Tuban, the observation's instruments were used student activity sheet and posttest questions to measure the students' critical thinking skills. The research was conducted in two cycles with a total of four meetings. The data analyzed descriptively and obtained were learning using PBL between cycles 1 and 2 experienced increase in activity of paying attention to teacher explanations, giving opinions, investigating, analyzing solutions, and students' critical thinking skills increased based on the analysis of posttest scores in cycles 1 and 2. The mean value in cycle 1 of the interpretation indicator was 45 while in cycle 2 it went up to 97, in the inference indicator the average of cycle 1 was 58 while cycle 2 increased to 98 and the analysis indicator in cycle 1 had an average value of 53 while cycle 2 was 81. The completeness of students was seen by the percentage of students whose posttest scores in cycle 2 reached KKM, namely interpretation of 97% (35) of students complete, inference of 95% (35) students complete, and analysis as much as 86% (32) students completed.

Keywords: Critical thinking; Long life learning; Problem based learning; Sustainable development

Introduction

As the population grows, the ability of nature to produce something is decreases and human needs are increase, it is causing small actions that can damage the nature (Liobikiene & Poškus, 2019). Sustainable Development (SD) under the United Nations (UN) stated that environmental problems must be handled simultaneously with social and economic problems (Gericke et al., 2019; Sass et al., 2021). Sustainable Development Goals (SDGs) could be realized that humans changed their behavior (Sass et al., 2020). The SDGs indicator have Education for Sustainable Development (ESD) which is a lifelong learning process. ESD carried the concept of instilling human values in humans (Gericke, 2022). Through human values, it hopes that sustainable development will be created. In this case, there are three perspectives of sustainable development, namely the balance of social, environmental and economic life. ESD also emphasizes the education of knowledge, skills, values and insights which were one of the fundamental foundations of sustainable development (Mahat et al., 2020).

ESD is an educational idea that comes from the environment (Fibonacci et al., 2020). The issues that part of ESD had attachment to the global issues. With ESD, it is hopes that students would be aware of existing problems and produce social-cultural environmental preservation behavior (Olsson et al., 2020). From the explanation presented, an abstraction could be drawn that the purpose of ESD is indeed oriented towards developing values and skills so that they can take part in environmental preservation. ESD requires students to have five important abilities, one of which is Critical

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Thinking and Reflection, where students are expect to be able to develop critical thinking skills by taking into environmental, economic, social and cultural factors in the context of sustainable development (Mogren et al., 2019). Critical thinking skills are a component of high-level skills, namely reflective and logical thinking to make decisions and actions (Putri & Rusmini, 2021; Wartono et al., 2018). Critical thinking skills can also develop communication skills (Mataniari et al., 2020). Critical thinking skills are skills needed in facing the 21st century, because students able to make decisions and solve problems in the social and environmental sphere later (Irwanto et al., 2019; Mataniari et al., 2020). Critical thinking skills must be trained in learning the new paradigm. New paradigm learning is a learning practice that is centered on students and gives teachers the flexibility to formulate learning designs that suit the characteristics and needs of students (Sufyadi et al., 2021). Pancasila Student Profile (P3) had a role as a guide in learning a new paradigm which had 6 dimensions as a reference for competence and character that must be learned, that are faith, piety to God Almighty, and noble character, global Diversity, mutual Cooperation, independent, critical reasoning, and creative (Sufyadi et al., 2021). Based on interviews with chemistry teachers at Senior high School 2 Tuban, it was found that learning in class XI-Science E often used Student Worksheets (LKS) provided by the school so that students were not trained in advanced thinking skills for lifelong education, this was also seen based on the completeness of the results study on hydrolysis and buffer material which was still a lot incomplete. So that in collaborative PTK learning was designed which expected to be able to train critical thinking skills through the Problem Based Learning (PBL) model.

PBL is a learning model with a design that provides problems in everyday life that involve students' critical thinking skills and the process of analyzing students (Ningsih & Cintamulya, 2018; Yulianti & Gunawan, 2019). PBL in chemistry provided opportunities for students to integrate science with the environment, social and society in the context of long-life learning for a sustainable life. The problems presented in PBL were realistic, and emphasize the used of communication, collaboration, and existing resources to formulate ideas and develop reasoning skills (Okafor, 2019). PBL could improve student learning outcomes in the cognitive, affective and psychomotor aspects supported by previous research which stated that the application of the PBL model could improve students' critical thinking skills (Akhdinirwanto et al., 2020; Marnita et al., 2020). By used PBL it was hoped that students would learn according to learning outcomes through learning that integrates science with the environment, economy, social and culture in the context of sustainable development using the problems of water and air pollution in Tuban which Colloid material, chemistry subjects to be aware of the problems that exists and produces social-cultural environmental preservation behavior and able to improve critical and reflective thinking skills for life-long learning of class XI-Science E of Senior High School 2 Tuban.

Method

This study used quantitative and qualitative research with a Classroom Action Research (CAR)/Classroom Action Research design which was an observation of changed in students used various techniques and strategies in a teaching activity (Ali et al., 2023). PTK was carried out collaboratively between PPG students, lecturers and chemistry teachers at Senior High School 2 Tuban to improve conditions in a better direction. The research subjects were 37 XI-Science E students. The research procedured in Figure 1 refered to the Kemmis and Taggart design which consisted of two cycles for each cycle consists of 4 aspects, that are planning, implementation, observation, reflection (Rifanty, 2019). Cycle one aimed to determine students' initial abilities in receiving learning with the Problem Based Learning (PBL) model to train critical thinking skills and the second cycle aimed to make improvements in the first cycle (Masruri, 2023).

Planning

The researcher determined the learning objectives, namely when given students' problem, students were able to provide solutions used the concept of colloidal separation critically with the PBL learning model for long life learning, then instruments were arranged to monitor the implementation of learning, students' critical thinking activities, and posttest questions in each cycle as the success reflection material.

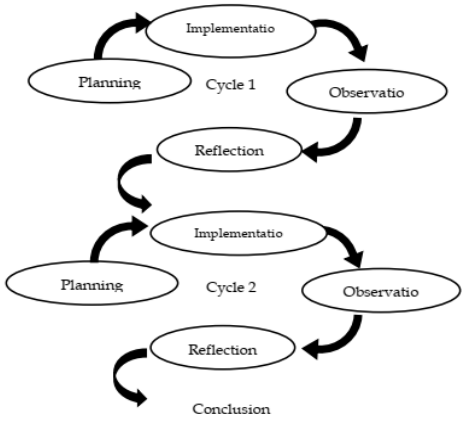

Figure 1. Kemmis and Mc Tagart action research (1988)

Implementation

The implementation in Figure 2. was carried out by Pre-service PPG students which consisted of 2 cycles with each cycle consisting of 2 meetings, at the end of the cycle there was a posttest as a measurement as well as a reflection of learning activities to be improved in the next cycle. Implementation was carried out by applying the PBL model to train students' critical thinking skills for long life learning.

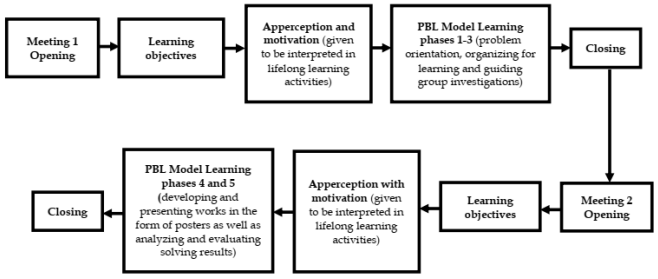

Figure 2. Diagram of learning implementation in each cycle

Observation

Researchers with the help of 2 researchers observed the implementation of learning and critical thinking activities at each meeting and through the posttest completeness given in each cycle. If students who had scores above the average are 85% of the total number, they were said to be classically complete. If students had not achieved classical mastery, then the research was carried out again in cycles.

Reflection

Reflection was applied to look back at the learning cycle that had been done. Researchers and chemistry teachers at Senior High School 2 Tuban were did the reflection together on changed that occurred in the classroom so that conclusions were drawn to be used in determining steps towards the next cycle. The indicator of success that became a benchmark in CAR was when the learning outcomes of students' critical thinking skills reached KKM with a minimum of 85% of students in the class.

Result and Discussion

The research model used was Class Action Research (CAR) from Kemmis and Mc Taagart which consisted of planning, implementing, observing and reflecting. This research was conducted because there were problems in class XI-Science E, named learning in class was not related to daily life and tended to follow worksheets contained practice questions which caused students to not be trained in critical thinking skills and had an impact on grades. Researchers collaborated with collaborators, whose were chemistry teachers at Senior High School 2 Tuban. Collaborators assisted in observing and reflecting on learning in class. PTK was carried out in class XI-Science E on colloid material, separation sub-material and colloid properties used the PBL model which consisted of 2 cycles with a total of 4 meetings and was carried out from 16 May 2023 to 24 May 2023. In line with previous research that the used of the PBL model was able to improve problem-solving thinking skills critically because students were integrated knowledge to find solutions to their problems (Samsudin et al., 2020).

The implementation of PTK used the PBL model in the colloid separation sub-material in cycle 1 and the properties of colloids in cycle 2. PBL learning consisted of 5 phases, that are organizing students into problems, organizing students to learn, assisting independent and group investigations, developing and presenting works and exhibitions, analyzing and evaluating the problem-solving process (Wahdaniyah & Agustini, 2023). Students were given problems regarding pollution of fish processing waste on the North Sea coast of Tuban in cycle 1 and air pollution by PT. SWJ in Tuban in cycle 2, students were then divided into 6 groups and given Student Worksheets (LKPD) which had PBL stages and critical thinking indicators. At the end of each cycle there was a posttest which refers to three indicators of critical thinking, namely: 1) interpretation; 2) inference; and 3) analysis (Facione, 2020). Critical thinking skills were trained because those were the key to a science education that serves to prepare the younger generation to understand the influence of science and the environment along with its impacts (Eska et al., 2023; Ilkorucu et al., 2022).

Table 1. Students' Activities Percentages in Every Cycle

Indicator	Percentage	
	Cycle 1	Cycle 2
Noticed teacher explanation	12%	13%
Given opinion	12%	14%
Involved in formulate problem	15%	13%
Did investigation / inquiry	21%	25%
Did analysis proposed solution	13%	14%
Communicate results self-evaluation to process and results-think	12%	12%
Activity that was not relevant	15%	9%
Total Activity	100%	100%

Data on students' activity in conducting PBL-critical thinking was in table 1. Based on table 1, the percentage of total activity in each cycle that occurs was 100%. In cycle 1 the percentage of irrelevant activities was 15% while in cycle 2 it was 9% this had an impact on other activities such as when students carried out investigations in cycle 1 only had a percentage of 21% while cycle 2 rose to 25%, in cycle 2 students were also more active in asking the teacher because there was an

increasing in the percentage of activity from 12% in cycle 1 to 14% in cycle 2. It could be concluded that there was an increase in student activity between cycle 1 and cycle 2 in terms of paying attention to the teacher's explanation of opinions, investigation and when analyzing solutions in PBL to improve critical thinking skills. The PBL model had characteristics that involved students in solving problems so as to stimulate students to be more active, critical and creative in learning (Hidayah et al., 2021).

Table 2. Data of the Critical Thinking

Aspect	Cycle 1			Cycle 2		
	Interpretation	Inference	Analysis	interpretation	Inference	Analysis
Average	45	58	53	97	98	81
Top- Rated	100	100	93	100	100	100
Lowest-Value	10	0	23	20	40	40

Data on student learning outcomes that were analyzed were the acquisition of posttest scores. The questions given in the posttest questions were of the same type as the questions in the LKPD. The questions in the posttest also contained three indicators of critical thinking skills, namely interpretation, inference and analysis. In table 2 it could be seen that the average value in cycle 1 was still low compared to the average cycle 2. The average value in cycle 1 was the interpretation indicator which was 45 while cycle 2 goes up to 97, in the inference indicator the average cycle 1 was 58 while cycle 1 was 2 increases to 98 and in the analysis indicator cycle 1 had an average value of 53, while cycle 2 is 81.

Table 3. Post-test Completeness Percentage in every Cycle

Post-test	Interpretation (%)	Inference (%)	Analysis (%)
Cycle 1	30	57	38
Cycle 2	95	95	86

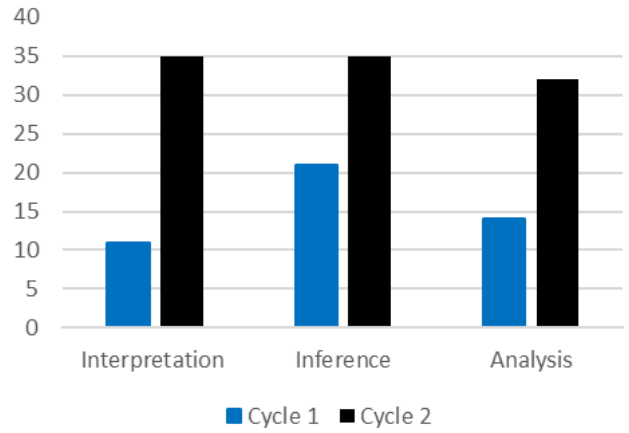

Figure 3. The graph of the student's critical thinking completeness

Based on the post-test completeness percentage data for each cycle in Table 3, it showed that there was an increase in students' critical thinking completeness during cycle 1 and cycle 2 in the three indicators. The completeness of students is seen by the value of students who achieved KKM could be seen in Figure 3 with a description 97% (35) students completing in interpretation, 95% (35) students completing in inference, 86% (32) students completing in analysis.

Critical thinking was a thinking process in which missed conceptualization, applying, analyzing, synthesizing, and evaluating information collected was based on observation, experience to guide students' beliefs (Ibrahim et al., 2023). So that the PBL model applied in XI-Science E was able to improve critical thinking skills. This was supported by research showing that PBL was also able to improve critical thinking skills from cycle 1 by 79.42% to 82.29 in cycle 2 (Rosy & Pahlevi, 2015).

Conclusion

Based on the research that has been applied. it could be concluded that used Problem Based Learning (PBL) in material separation and colloidal properties can be improved the critical thinking skills of students in class XI-Science E because it linked science with the environment, social, culture for long life learning in sustainable life. The critical thinking skills of students in cycle 2 on interpretation indicators obtained mastery of 95% (35) of students, inference of 95% (35) of students and analysis of 86% (32) of students. The success indicator that became the benchmark in this CAR was when the learning outcomes of students' critical thinking skills reached KKM with a minimum number of 85% of students in the class, it can be concluded that problem-based learning was applied in class XI-Science E to improve critical thinking skills succeed.

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Author Contributions
The contribution of the authors are equal. Dinda Karunia Putri did Conceptualization, investigation, analyses data and writing draft; Rusly Hidayah, S.Si., M.Pd did validation and

writing-review draft ; and Drs. Yohanan Didik Yuwono did supervision and reflection.

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Conflicts of Interest
The authors declare no conflicts of interest.

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