

Implementation of Socio Scientific Issues Oriented Problem Based Learning Model in Improving Critical Thinking

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Abstract— Natural science subjects in elementary schools are adapted based on student growth so that the students create their own knowledge and concepts through everything that they learn in nature. The study aimed to describe the steps of problem based learning based socio-scientific issues, analyse the improvement of critical thinking, and examine student responses in natural science. It was classroom action research. The results indicated that the teacher performance in problem based learning based socio-scientific issues reached 91% of research performance indicator which the minimum indicator was 80%, the improvement of critical thinking achieved 89%, and student responses reached 89%. It concludes that problem based learning based socio-scientific issues improves critical thinking if it is implemented correctly.

Keywords— problem based learning, socio-scientific issues, critical thinking, student response and teacher performance.

I. INTRODUCTION

Science subjects in elementary schools are adapted to student growth so that through science subject's students can create their own knowledge and concepts from everything they learn in nature through science subject's students are required to be able to think critically well. According to [8] Science is a compulsory subject at all levels of education in Indonesia, this subject is related to the process or way of gaining knowledge about science in a structured way. [13] stated that science is a subject that teaches interaction between learning components between educators, students, learning tools or media where all of this functions to achieve the goals and competencies of science that have been set.

The problem-based learning model is the right choice for teachers to be able to create a more enjoyable learning atmosphere for their students. Problem Based Learning is a student-oriented learning model by placing students in learning to solve real world problems in the environment of everyday life [15].

According to [11] the problem based learning model is a teaching technique that encourages and trains students to solve problems independently, this learning model trains students to improve their logical, critical, analytical, technical and creative thinking skills. [10] stated that problem-based learning is a learning model that provides a process of grouping students to learn to solve unstructured real-world problems, usually these problems are packaged in the form of content to achieve learning goals.

According to [6] the characteristics of the problem based learning model are: 1) There are problems that can be in the form of content or questions; 2) There is an attachment between various sciences; 3) There is a process of exploring authentic problems; 4) There is a collaborative process through student collaboration in groups; 5) Students show the results of problem solving in the form of works.

Science learning taught through a problem-based learning model can foster students' critical thinking skills. According to [4] critical thinking is thinking that aims to prove something, interpret what something means and solve problems. [1] stated that critical thinking is a skill in connecting new insights with old insights that have been obtained or reflective thinking to formulate reasons for something he believes in. According to [9] critical thinking is a skill to analyze, evaluate and justify wrong information.

The facts show that most students think that science subjects are boring learning with loads of memorization, learning only focuses on giving material and practicing questions from LKS books. Implementation of such learning does not foster students' critical thinking skills, for example when learning takes place the teacher only provides questions related to ordinary problems that are not controversial, other facts show that students are less interested because the learning model implemented seems less challenging so that students who answer questions and ask only the same people each time given the opportunity to answer questions and ask. Circumstances like this will greatly affect student

learning outcomes. This is the problem that occurs at Prembun 2 Public Elementary School for fifth grade students in science subjects who still use the 2013 curriculum.

Based on observations on the UTS score results document which was held on Monday, December 26, 2022, data on UTS scores for grade 5 students, especially in science subjects, showed that the highest score was (76) while the lowest score was (62). Many of the learning outcomes of students in science subjects do not enter the Minimum Completeness Criteria (KKM) set by the school, namely (70). A total of 15 students in grade 5 SD N 2 Prembun, students who have fulfilled the KKM are 8 people or 53% while students who have not reached the KKM are 7 people or 46%. This shows that the learning outcomes achieved in science subjects are still low.

Based on the results of interviews with the fifth grade teacher at SD Negeri 2 Prembun which was held on Monday, December 26, 2022, it can be seen that the teacher has several problems in implementing science learning, namely: 1) Science material is complex but the time to teach it is very short so this makes the implementation process learning seems rushed and pays little attention to students' ability to understand the material; 2) Learning is still centered on the teacher; 3) Educators are limited to inviting students to carry out learning with questions and answers and group discussions; 4) In the learning process have not used adequate learning media and teaching aids; 5) The teacher only carries out the conventional learning process by relying on LKS books, teacher books and student books from the Ministry of Education and Culture supported by makeshift learning media, namely blackboards

Through the observations, it can be seen that the learning process for science class V at SDN 2 Prembun has not encouraged students to be able to think critically, students have not been able to analyze information in problems, categorize information, state conclusions, formulate ideas and check the suitability of ideas with problems to be solved.

If this situation continues, it is suspected that the objectives of learning science in elementary school will not be achieved optimally. So we need a learning model that can be student-oriented, fun, active, creative, promotes critical thinking and problem solving, the

choice of model that contains these aspects is the Problem Based Learning model.

The Problem Based Learning model is oriented towards Socio Scientific Issues or scientific problems that are related to social life which are full of debate, controversial and long-term in nature will be able to improve students' critical thinking skills. According to [5] socio scientific issues are scientific problems that have a large impact on society, causing controversy and ethical dilemmas by offering two confusing choices. Meanwhile [16] stated that socio scientific issues are community issues related to natural ideas and principles that are complex and controversial in nature.

According to [14] the Socio Scientific Issues-oriented Problem Based Learning model can improve students' critical thinking and communication skills. Adding to this opinion [7] states that Socio Scientific Issues oriented learning is able to increase students' critical thinking skills.

Based on this explanation, the researcher wants to make improvements to the quality of learning in the hope that the critical thinking skills of 5th grade elementary school students in science subjects can increase. The researcher intends to conduct Classroom Action Research (PTK) entitled "Application of Socio Scientific Issues Oriented Problem Based Learning Models in Increasing Critical Thinking."

The formulation of the problem from this research is 1) What are the steps for applying the problem based learning model oriented to socio scientific issues in increasing critical thinking in the material effect of heat on temperature and the shape of objects for class V students at SDN 2 Prembun? 2) How can the problem-based learning model oriented towards socio-scientific issues improve critical thinking on the material effect of heat on temperature and the shape of objects for class V students at SDN 2 Prembun? 3) What is the student's response when participating in problem-based learning oriented towards socio-scientific issues on the material effect of heat on temperature and the shape of objects of class V SDN 2 Prembun?

II. METHODOLOGY

Research Design

The design of this research is classroom action research According to [2] classroom action research is research that describes the causal process of the treatment, and describes things that happen when the action is

practiced, and describes all the steps from the beginning of the action to the effects of the action. In this research, the researcher acts as the action manager and the educator becomes the executor of the action made by the researcher.

In this research, it is used to first analyze and describe the extent to which the application of the problem based learning model oriented to socio scientific issues is carried out with appropriate steps.

The second is to analyze the improvement of students' critical thinking skills which include aspects of analysis, interpretation, inference, explanation, creation and evaluation in science subjects during the application of the problem based learning model oriented to socio scientific issues.

The third analyzes the increase in student responses which include responses in learning activities, learning conditions and students' interest in learning during the application of the problem based learning model oriented to socio scientific issues in science subjects.

The subjects in this study were all 15 students in class V at SDN 2 Prembun, consisting of 8 female students and 7 male students. In addition, the research subject was a class V teacher at SDN 2 Prembun for the 2022/2023 school year.

The source of the data in this study were fifth grade students at SDN 2 Prembun who acted as executors of the action in applying the problem based learning model orientated to socio scientific issues. The teacher who was used as a source of data in this study was a class V teacher at SDN 2 Prembun.

The teacher acts as an executor of action in applying the problem based learning model oriented to socio scientific issues. The observers in this study were researchers and colleagues who observed the learning process that had been carried out through direct observation.

The document used in this study is a list of grades (Mid Semester Assessment) 1 science subject for fifth grade students at SDN 2 Prembun for the 2022/2023 academic year. In addition, there are pretest and posttest results as a comparison of the results of critical thinking tests before and after the application of the Socio Scientific Issues-oriented Problem Based Learning model in science subjects.

Data collection technique

Data collection techniques in the form of tests and non-tests. The test is used to measure the improvement of critical thinking skills in the cognitive domain from cycle one to cycle three based on predetermined material indicators.

Nontest consists of observation, interview and document study. In observation or observation using the rating scale observation tool (rating scale) to obtain data by observing the process of applying the socio scientific issues oriented problem based learning model carried out by the teacher and fifth grade students of SD N 2 Prembun, observing student responses and observing students' attitudes in thinking critical.

Interviews in this study were carried out directly with students and teachers of class V at SDN 2 Prembun regarding the application of the problem-based learning model oriented to socio-scientific issues that had been implemented.

The document study used in this research is the first midterm assessment scores for science subjects for fifth grade students at SDN 2 Prembun in the 2022/2023 academic year. The learning outcomes document is used to compare the results obtained before and after the implementation of the problem-based learning model oriented towards socio-scientific issues in science subjects.

Data Collection Procedures

The researcher requested an observation permit from the campus to carry out observations at the school that would be used as a research location, namely Prembun 2 Public Elementary School. After obtaining the observation permit, the researchers carried out initial observations in February 2023 at Prembun 2 Public Elementary School to obtain pre-action data in the form of observations and interviews with teachers and students as well as the results of critical thinking tests on students.

From March to early April 2023 the researchers carried out actions by implementing actions, namely the application of a problem-based learning model oriented towards socio-scientific issues in increasing students' critical thinking in science subjects.

Researchers make learning implementation plans, learning media, student worksheets, student critical thinking evaluation sheets and teaching materials.

Each cycle consists of two meetings where researchers carry out classroom action research for three cycles, which means there are six meetings. At each meeting the researcher was assisted by two colleagues carrying out observations on learning activities and observations on students' critical thinking attitudes. Researchers conducted interviews with teachers and students in turn after carrying out learning.

Finally, the researcher carried out a critical thinking test on students where this test was carried out twice in each meeting then the results of this test were used to compare students' critical thinking skills before and after being given action.

Data Analysis Procedures

Activities in data analysis include data reduction, data presentation, and drawing conclusions or data verification. Data reduction means summarizing by splitting the core data by focusing on important information and then examining its headings and plots.

Data presentation is the stage that is carried out after data reduction, at the stage of presenting research data where the reduced data is presented in tabular form.

Verification is the final step in data analysis. At this stage, researchers can conclude the final results of their research, which contain the main points of the information that has been obtained and presented in a structured and organized manner.

III. RESULT AND DISCUSSION

1. Steps to Apply the Socio Scientific Issues Oriented Problem Based Learning Model

The application of the problem based learning model oriented to socio scientific issues is carried out by the teacher with the steps that have been made by the researcher. The following is a table comparison between actions from cycle one to cycle three which have been analyzed and presented by the researcher.

Table 1: Comparison between Actions Steps to Implement Problem Based Learning Model Oriented Socio Scientific issues

No	Steps to apply the Socio Scientific Issues Oriented Problem Based Learning Model	Pra	S1	S2	S3
1.	Student orientation	55%	80%	92,5%	96%
2.	Form study groups	60%	83%	95,8%	100%
3.	Information and data exploration	60%	83%	100%	93%
4.	Analysis of information and data	65%	83%	95,8%	92%
5.	Presentation of ideas	65%	82%	90%	90%
6.	Evaluation of ideas	50%	82%	93%	93%

Table 2 informs the teacher's performance in applying the problem based learning model orientated to socio scientific issues. After conducting research for 3 cycles the researcher concluded that the steps for implementing the problem-based learning model oriented to socio scientific issues were the first step of orientation carried out using media in the form of videos on socio scientific issues, then the teacher conveyed the learning objectives by linking them to the videos that had been broadcast, then the teacher gave motivation to learn based on the socio scientific issues presented.

Followed by providing apperception in the form of questions regarding the subject matter but having something to do with the socio scientific issues that have been submitted.

The second step is to form study groups by dividing students into study groups consisting of 3 to 5 people,

each group is given a number name to make it easier to pronounce, after that the teacher distributes student worksheets containing practices that students must do. In the third step of exploration, students are asked to explore and collect as much information as possible through practice with concrete media based on the worksheet instructions that have been distributed, the practice carried out must be based on guidance from the teacher and any results of practice that have been carried out are written on the worksheet.

Step four of information analysis, students are asked to think critically by analyzing information, categorizing and formulating the right ideas to solve the last socio-scientific issues to formulate conclusions from the results of practices that have been carried out. Step five presents ideas, students are asked to present ideas, students are asked to present ideas in oral form through

presentations and in writing through worksheets that have been distributed.

Step six evaluates ideas, the teacher provides input regarding the suitability of the results of the practices that have been carried out with the socio-scientific issues that have been explained, then the teacher corrects the advantages and disadvantages of each group's ideas.

The results of these findings indicate that the application of the problem based learning model oriented to socio scientific issues that has been implemented has one difference from the findings [12], the difference is only in the first step of problem orientation, in the results of research [12] the first step is carried out by directing students to find sources or the literature itself regarding the socio scientific issues raised, then students are asked to analyze the facts found. While in the orientation step carried out by the researcher, the teacher presents learning media with videos on socio scientific issues, conveys learning objectives then conducts apperception and questions and answers with students regarding the subject matter that has been presented in the video on socio scientific issues that has been presented.

Meanwhile the steps for implementing the problem based learning model oriented to socio scientific issues that have been carried out by researchers tend to have similarities with research belonging to [12] as in the implementation of the steps for presenting works in research carried out by researchers presenting works by students carried out orally and in writing the results of investigations what they have done and the problem-

solving plans they have made while research belongs to [12] in the presentation step of students' work presenting the results of the investigations they have carried out verbally and in writing.

Based on the results of the research in table 2 which had been carried out by the researchers, the results of the most drastic increase in teacher performance in the section on forming study groups were due to the researcher changing the name of the study group which had previously used the vocabulary of socio scientific issues with the names of numbers.

The decline occurred in the teacher's performance part of which initially the teacher guided students to explore by guiding students to use structured concrete media through worksheets that had been prepared without being asked to relate their findings to the socio-scientific issues that had previously been presented. In cycle three students were not only asked to simply practice using the concrete media that had been provided but students were asked to be able to relate the results of the practice they had done with the socio-scientific issues that had been described earlier.

2. Improving Students' Critical Thinking Using Problem Based Learning Models with Socio Scientific Issues Orientation

After carrying out learning for three cycles using a problem-based learning model oriented to socio scientific issues to measure students' critical thinking skills improvement, the following results were obtained.

Table 2: Comparison between Actions to Improve Critical Thinking

No	Aspects of Critical Thinking	Pra	S1	S2	S3
1.	Analysis	60%	56,5%	66,5%	93%
2.	Interpretation	73%	86,5%	76.5%	90%
3.	Inference	93%	96,6%	93%	86%
4.	Explanation	73%	86,5%	73%	87%
5.	Creation	80%	90%	96,5%	86%
6.	Evaluation	40%	36,5%	90%	83%

Table 3 is a comparison of improving critical thinking skills which includes an aspect of analysis consisting of five indicators that must be implemented by students, namely analyzing misinformation in problems, testing reasons with existing knowledge, solving problems, determining truth in information and explaining differences in information. The aspect of interpretation contains two indicators, namely categorizing information and describing information. The inference aspect contains two indicators, namely stating the truth of facts and stating conclusions. The explanation aspect

consists of two indicators, namely stating results and explaining procedures. The creative aspect consists of two indicators, namely formulating ideas and planning the design of ideas. The evaluation aspect consists of two indicators, namely checking the suitability of ideas with problem solving and comparing the effectiveness of ideas used in problem solving.

In research that has been carried out by researchers, it is found that the most consistently increased critical thinking skills are aspects of interpretation which consist

of categorizing and describing information. Compared to research belonging to [3], the aspect that increases is advanced clarification or providing further explanation.

The two aspects that have consistently increased from these two different studies have similarities in indicators, in the research carried out [3] advanced clarification or providing further explanation consists of defining terms and considering definitions using appropriate criteria, categorizing and describing information, things This is in line with the results obtained by researchers on the interpretation aspect so that it can be concluded that the application of the problem-based learning model oriented to socio scientific issues can significantly improve students' critical thinking skills in the interpretation aspect. In addition, the aspect of critical thinking that is categorized as high in the results of this study is inference which shows a steady increase, the aspect of analysis which increases significantly in cycle three. The explanation aspect shows a fairly consistent value, the creation aspect shows a consistent value and the evaluation aspect shows an increasing value from cycles two and three.

While the aspect of critical thinking that has the lowest increase in the application of the problem based learning model oriented to socio scientific issues in research [3]

is the aspect of elementary clarification or providing a simple explanation consisting of indicators formulating questions and explaining the results with appropriate steps, these results are inconsistent with what the researchers obtained because the indicators from the elementary clarification aspect or providing simple explanations have similarities with the creation aspect with the indicators of formulating ideas and planning the design of ideas. This difference is because the results obtained show that the creative aspect of critical thinking skills gets a high categorized score.

Based on the results of the research in table 3 which has been carried out by the researcher it can be seen that the analysis aspect experienced a significant increase from cycle two to cycle three. and student worksheets are better able to work on aspects of analysis better. The decrease occurred in the evaluation aspect, this occurred because students felt they did not understand the compatibility of ideas with problem solving needed in socio scientific issues as evidenced by the results of practice and test results which tended to be low.

3. Student Responses When Participating in Problem Based Learning Oriented Socio Scientific Issues

Student responses were measured while carrying out the problem based learning model oriented to socio scientific issues as described in the table below.

Table 3: Comparison between Student Response Actions

No	Student Responses Following the Socio Scientific Issues Oriented Problem Based Learning Model	Pra	S1	S2	S3
1.	Students are able to take part in learning orientation activities	60%	70%	97,5%	95%
2.	Students are able to form study groups	56%	79%	95,8%	100%
3.	Students are able to explore information and data through practice using concrete media	70%	83%	91,6%	94%
4.	Students are able to analyze data from practice and look form supporting theories related to their findings	60%	79%	91,6%	92%
5.	Students are able to presents ideas in oral and written forms	70%	82%	90%	90%
6.	Students are able to correct the strengths and weaknesses of the ideas they convey	70%	82%	93%	93%

Table 3 provides a comparison between actions in student responses. Aspects of student responses that have been achieved in this study are first students being able to take part in learning orientation activities, second students being able to form study groups, third students being able to explore information and data, fourth students being able to analyze information and data from practical results and look for supporting theories related to their findings, the five students were able to present ideas in oral and written form and the six students were

able to correct the strengths and weaknesses of the ideas they conveyed.

The results of this study are in line with the opinion of [3] which states that the problem based learning model is oriented towards socio scientific issues which can increase students' responses and interest in learning. Aspects of student responses found in previous studies included categorized student responses related to learning activities, learning interests and learning conditions. While the responses of students who were

observed by researchers also focused on learning activities, learning interests and learning conditions.

Based on the results obtained by researchers, student responses increased messages by applying the problem based learning model oriented to socio scientific issues, namely responses in student interest as indicated by high scores on aspects of students' ability to participate in learning orientation activities, forming study groups, exploring information, analyzing information, present ideas in oral and written form and evaluate ideas. While in [3] the same thing was also shown by the high student response to the aspect of interest in learning with indicators of problem solving skills and critical thinking in the material being taught.

While the results of student responses in learning activities and learning conditions showed a high score with aspects of the accuracy of the application of learning models and the attractiveness of the learning media used. But in the research results of [3] student responses in participating in learning activities and conditions tend to show low scores with aspects of learning novelty using learning models and interesting learning models.

Based on table 3, student responses increased rapidly in the formation of study groups, this was indicated by students showing a high interest in learning by naming groups that were easier to call by using numerical names, then learning conditions and activities also became more conducive because the teacher easily mentioned names. each group of students. Consistent results are shown by students' ability to present ideas in oral and written form. This occurs because students tend to be able to present their ideas in worksheets well and make good presentations.

The research that has been carried out by researchers has obtained positive results from the data that has been collected through test and non-test techniques and after conducting data analysis to measure teacher performance in applying the problem based learning model orientated to socio scientific issues, measuring critical thinking skills and measuring student responses in following learning. So it can be concluded.

Based on the results of observations of teacher performance from cycle 1 to cycle 3 in implementing the steps of the problem-based learning model oriented to socio scientific issues, it has been implemented correctly which reaches an average of 91% exceeding the research performance indicator of 80%. The steps for

implementing the socio scientific issues oriented problem based learning model are the first step to orient students, the second step to form study groups consisting of 3 to 5 people, the third step to explore information and data, the fourth step to analyze information and data, the fifth step to present ideas in oral and written form and the sixth step is evaluating ideas.

In the critical thinking test results obtained from cycle 1 to cycle 3 through the application of a problem based learning model oriented to socio scientific issues which is implemented correctly can improve students' critical thinking skills with an average percentage reaching 84% exceeding the research performance indicator of 80%. Aspects of critical thinking that are measured are aspects of analysis, interpretation, inference, explanation, creation and evaluation.

In terms of student responses, it was shown that through the application of a problem based learning model oriented towards socio scientific issues, it could increase student responses from cycle 1 to cycle 3 with an average percentage of 89% which exceeded the achievement of the research performance indicator of 80%. Student responses measured in this study included student responses when participating in learning activities, learning conditions and learning interests.

Basically the application of the problem based learning model oriented to socio scientific issues depends on the creativity of the teacher in conveying socio scientific issues to students so that students can understand socio scientific issues more easily so that the learning process will take place properly and appropriately.

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