

Analysis of Students' Critical Thinking Skills as an Effort to Implement STEM-based PBL

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ABSTRACT

Advances in science and innovation affect the progress of education in Indonesia. The current situation in Indonesia is characterized by a lack of competent human resources (HR). A quality education helps students develop the values they need to live. The purpose of this study is to describe students' critical thinking skills so that efforts to apply the STEM-based PBL approach can provide maximum results of research that will be carried out in grade VII of SMP IT Ibnu Sina. A quantitative descriptive approach is used in this study. Description of 10 questions based on critical thinking is the instrument used in this study. The instrument to be used has been validated. The results of expert validation of the questions received an average score of 91.55%. The results of the data analysis showed that the students' critical thinking skills in the interpretation indicator obtained an average score of 64% so that it could be interpreted in the good category. In the analysis indicator, an average score of 64% was obtained, which can be interpreted in the good category. In the conclusion indicator, an average score of 64% was obtained, which was included in the good category. Similarly, in the evaluation indicator, the average score obtained by students is 60% which is included in the sufficient category. As well as in the elaboration indicator, the average score obtained by students is 60%, which can be interpreted in the sufficient category

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INTRODUCTION

The development of the 21st century is an advancement in the field of technology, where information is abundant and human resources are replaced by technology [1], [2]. This development is adapted to the demands of 21st century education [1]. The skills prioritized in 21st century learning are known as the 4Cs, namely problem-solving and critical thinking, collaboration and communication, and creativity [3]. Keterampilan abad ke-21 yang menjadi lima domain utama merupakan literasi digital, produktivitas tinggi, komunikasi yang efektif, pemikiran intensif, dan nilai-nilai spiritual dan moral [4], [5]. The 21st century skills that make up the five main domains are digital literacy, high productivity, effective communication, intensive thinking, and

spiritual and moral values (critical thinking, knowledge and creativity), learning (reading and writing skills), and learning with others (personal, social, and civic responsibilities [6]–[9])

Critical Thinking is an effective, organized, and operative cognitive period that allows us to develop an understanding of our own thoughts and the ideas of others as well as our ability to explain opinions [10]. Critical thinking is a positive analysis that allows us to understand the events that are happening around us [11]. This analysis system is a system that can be used to define problems, start studies on any subject that is being targeted, decide and make retrospective evaluations [12].

Critical thinking is a sensible and reflective thinking that focuses on making decisions about what to believe or do, its description in detail

of several characteristics including the process of interpretation, analysis, evaluation, inference, explanation, and self-regulation [13]. Critical thinking is one of the elements of higher-order thinking skills that can be taught [14]–[22]. Educators believe that improving students' critical thinking is very important [23], [24]. But few of them have any idea how to teach it. In fact, one of the goals of university education is to increase students' critical power. Thinking about it, courses are generally taught by the lecture method and the content has little opportunity for students to discuss topics so that they can improve their critical thinking [3], [25]–[28]. Teaching critical thinking requires a holistic approach and must involve a set of appropriate, goal-oriented learning models that can lead to learners being manipulated with their cognitive skills [25], [26], [29], [30]. Many studies on critical thinking skills have been conducted. The findings show that students' critical thinking skills are still low in science material [25], [26], [29]–[31]. Many studies on critical thinking skills have been conducted. The findings show that students' critical thinking skills are still low in science material.

Developing critical thinking skills can be learned with many activities, observation programs, and problem-solving [32] especially on temperature and heat materials. Temperature and heat matter are closely related to human life and require observation to solve problems in them. Therefore, to support the development of critical thinking skills, students need to apply the right learning model [33]–[35]. The application of the learning model in the teaching and learning process can affect learning and can determine the final outcome of students' critical thinking skills [33], [36]–[39]. A learning model that can improve critical thinking skills and improve students' independent learning skills, especially for science lessons, is a problem-based learning model [14]–[22] where the implementation uses complex problems in the real world [40], [41] to motivate students in identifying and analyzing the principles and

concepts needed to devise solutions to solve problems in science lessons [42]–[44]. There are three important points in the problem-based learning model, namely problems, tutors and students [45], [46]. There are three important points in the problem-based learning model, namely problems, tutors and students [14], [18], [20]. The problems given are unstructured, so they require various solutions to solve them. In addition, it can indirectly develop students' cognitive abilities [15]–[17], [19], [21], [22] while teachers have a role as mentors or facilitators in the teaching and learning process to provide metacognitive problems, to prepare a student-focused learning environment and to provide instruction without directly providing solutions to students from the given problems [14]–[22].

Problem-based learning integrated with the science technology engineering mathematic (STEM) and STEM approaches is an effective approach to facilitate and maintain the integration of science, technology, mathematics, and engineering [47]. EM is described as follows: (1) science is related to concepts and laws related to nature; (2) technology is a skill used in knowledge by using an artificial tool that can facilitate work; (3) engineering/engineering/engineering is the knowledge to design a stage/procedure that can solve problems; and (4) mathematics is a science that relates quantities, numbers, and space based on logic without empirical evidence [48]. The integration of Problem Based Learning with STEM is able to actualize environmental literacy and student [49]. The application of Problem-Based Learning integrated with STEM is able to increase students' science literacy based on [50], improve students' cognitive, psychomotor, and character abilities [51]. Integration of PBL and STEM requires students' motivation and confidence in improving their careers [52]. Based on the importance of students' critical thinking skills and the need for students to relate science, technology, mathematics, and

engineering in learning, the application of learning with PBL-STEM in science learning is carried out. Therefore, the purpose of this research is to analyze students' critical thinking skills through the application of learning with STEM-integrated Problem Based Learning on temperature and heat materials.

RESEARCH METHODS

The type of research used in this study is quantitative descriptive research. Research that only describes a situation or event is called descriptive research. The research will be carried out at Ibnu Sina Junior High School, Merauke Regency, South Papua. The implementation of this research is from September to November 2023. The number of samples in this review is grade VIII students of Ibnu Sina Junior High School. The research sample of this study is a subset of the entire population. In this study, total sampling was used. The sampling method in which the number of samples is equal to the number of population is called total sampling. According to Sugiyono, the entire population was used as a research sample because the population was less than 100 [14]–[22]. This study uses 10 questions describing temperature and heat material by using valid, reliable, and feasible critical thinking skills for data collection as a research instrument. The quantitative data collected will be subjected to direct statistical analysis. Descriptive data will be used to process the findings of the analysis qualitatively. The results of the data analysis are then used in the final stage to draw conclusions.

RESULTS AND DISCUSSION

Research related to the analysis of students' problem-solving skills in temperature and heat materials as an effort to implement the

STEM-based PBL approach at Ibnu Sina IT Junior High School, the results are described as follows. Students' critical thinking skills are measured using five indicators presented by the Doctor consisting of Interpretation, Analysis, Conclusion, Evaluation and Elaboration which are described in the following figure,

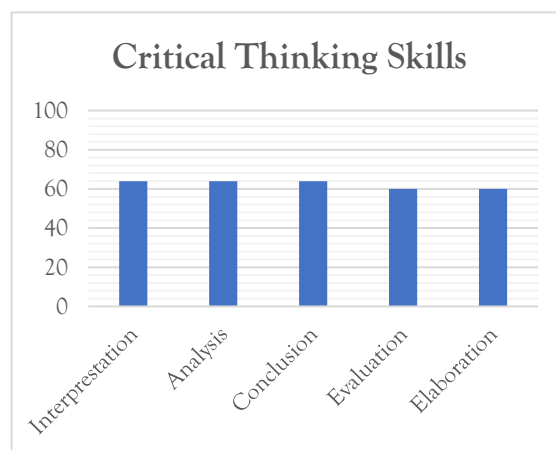


Figure 1. Critical Thinking Skills

Based on the data described in figure 1, the average score obtained by students was 64% on the Interpretation critical thinking ability indicator. This score is interpreted as a sufficient category. For the score analysis indicator, the score obtained by students is 64% which is stated in the sufficient category. Meanwhile, the third indicator of critical thinking ability is a conclusion obtained by the average score of students of 64% which is included in the sufficient category. The fourth indicator of critical thinking ability is Evaluation, with an average score obtained by students of 60%, which is included in the sufficient category. And the fifth indicator of critical thinking ability is Elaboration whose results are obtained by students of 60% which are included in the category of sufficient.

This data analysis shows that the critical thinking ability in the Interpretation indicator, the average score obtained by students is 64%, which can be interpreted as still 36% that has not been achieved. This shows that students have sufficient critical thinking skills. This

result is in accordance with the research that has been carried out related to the analysis of the ability to solve physics problems in the study explaining that students have a greater percentage of truth in the Interpretation indicator [33]–[35], [53], [54].

In the analysis indicator, the average score obtained by students is 64%, which can be interpreted as still 36% that has not been achieved. This shows that students have good problem-solving skills in the analysis section. In accordance with previous research that in the analysis indicator, students have more difficulty planning and describing in finding a solution to a problem [31], [55]–[57]. This can be seen based on the analysis of each indicator which shows that the analysis indicator has a presentation of the results achieved by students in the good category.

In the conclusion indicator, the average score obtained by students is 64%, which can be interpreted as still 36% of the indicators that have not been achieved by students. This result shows that students have good problem-solving skills in this indicator. This is in accordance with the research conducted that in the conclusion indicator, students have more difficulty planning and describing in finding a solution to the problem [29]–[31], [57]. In accordance with the percentage of analysis scores per indicator which shows that the conclusion indicator has a presentation of results achieved by students lower than other indicators.

In the Evaluation indicator, the average score of students is 60%, which means that 40% has not been achieved. This shows that students have sufficient problem-solving skills in the Evaluation indicator. This result is in accordance with research that has been conducted related to the analysis of problem solving ability which states that students have a smaller percentage of truth at the problem-solving stage in the Evaluation indicator [31], [55]–[57]. This happens because students tend

to make mistakes in their mathematical calculations.

In the Elaboration indicator, the average score obtained by students is 60% which is included in the sufficient category, and those who have not met it are 40%. This result is in accordance with research that has been conducted that students get the lowest score in solving problems [3], [23], [58], [59]. Hal ini dikarenakan peserta didik cenderung mengalami kesulitan pada saat dituntut untuk memberikan keterkaitan dengan hasil yang telah dijabarkan dengan konsep yang telah dipilih pada tahap Elaboration.

By looking at the average score of students' overall problem-solving through the stages of problem-solving, students' problem-solving skills are in the good category. The achievement of the results obtained by students is because students experience obstacles when solving problems using the right procedures, students are limited to solving problems in textbooks (modules), so that when dealing with problems outside the context or problems that are related to real problems related to their daily lives, students experience obstacles when completing.

The obstacles experienced by students when solving problems are not only due to a lack of understanding of the material that has been given by the teacher, but also the knowledge they have had in the long term (long term memory) [60]. In addition, to help students succeed in solving problems (expert problem solvers) faced by providing appropriate learning activities and helping students quickly access knowledge that has been stored in long term memory.

The results of this study have not been able to describe the overall critical thinking ability of students in Merauke as a whole, but this study can be used as a preliminary research to obtain a preliminary picture in designing learning and learning materials that support the application

of the PBL-STEM approach. This research is in accordance with previous research which states that learning using the PBL approach is used to improve learning on students' critical thinking skills in high school, students can understand the environment and problems faced by modern society depending on the development of science and technology, especially social problems, so that using the BPL-STEM approach learning will be more varied and innovative students who can learn various academic concepts juxtaposed with the real world. Students are assisted to acquire complete knowledge, develop problem-solving skills, and be able to improve their critical thinking skills.

CONCLUSION

In accordance with the results of data analysis and discussion that have been described above, it can be seen that the critical thinking skills of grade VIII students on temperature and heat material as a whole are in the good category. The data acquisition can be used as a reference in designing PBL-STEM-based learning and other learning materials that can support to improve students' critical thinking skills, especially in Papua. Suggestions that can be considered for further research based on the results of the research, further research is needed on learning models that support the improvement of students' critical thinking skills.

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