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ANALYSIS OF STUDENT'S PROBLEM-SOLVING ABILITIES AS AN EFFORT TO IMPLEMENT THE STEM-BASED MICROLEARNING APPROACH

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Abstract. Advancements in science and innovation influence the progress of education in Indonesia. The current situation in Indonesia is characterized by a lack of competent human resources (HR). Quality education helps students develop the values they need for life. The purpose of this research is to describe students' problem-solving abilities so that the implementation of the STEM-based Microlearning approach can yield optimal results. The research will be conducted in the eighth-grade class of Ibn Sina Islamic Middle School. A quantitative descriptive approach is used in this research. A set of 10 problem-solving based descriptive questions is the instrument used in this research. The instrument to be used has been validated. The expert validation results for the questions yielded an average score of 95.33. Data analysis results show that students' problem-solving abilities on the "useful description" indicator obtained an average score of 64%, which can be interpreted as falling into the "good" category. On the "physics approach" indicator, an average score of 64% was obtained, also interpreted as "good." On the "specific application of physics" indicator, an average score of 64% was obtained, which falls into the "good" category. Similarly, on the "mathematical procedures" indicator, the average score obtained by students was 60%, categorized as "satisfactory." Additionally, on the "logical progression" indicator, students obtained an average score of 60%, which can be interpreted as "satisfactory." The research results are used as a reference for further research to improve students' problem solving abilities by developing learning media technology or learning models.

Keywords: *Problem Solving Ability, STEM, Microlearning*

INTRODUCTION

Advancements in science and innovation influence the progress of education in Indonesia. The development of education is continuously evolving alongside the advancement of information technology, which encourages various business sectors to adapt further. The educational process has shown rapid progress in terms of teaching strategies, facilities, and curriculum. Overall, it can be said that these changes constitute educational system reforms to keep pace with global advancements in science and technology. Schools can also serve as a force for change towards better conditions (Kartika et al., 2021; Tanjung & Nababan, 2019).

In line with the ongoing era of globalization, significant efforts are being made to enhance the nation's competitiveness. The current situation in Indonesia is characterized by a lack of competent human resources (HR). Technology and knowledge are developing optimally, and HR is required to take the era of globalization seriously, demonstrating quality and competitiveness on a global scale in terms of intellect, talent, and abilities. Education plays a significant role in preparing the nation's future leaders; therefore, it is crucial to produce high-quality human resources (Apriliasari et al., 2019; Ardiyanti et al., 2019; Arum et al., 2019; Ashnam et al., 2022; Sarya et al., 2019; Suastra et al., 2019; Yuliati et al., 2018). Quality education also contributes to the development of individuals who are capable of enabling a nation to compete internationally. Quality education helps students develop the values they need for life (Kartika et al., 2021; Tanjung & Nababan, 2019).

Students' participation in national and international studies is one of the indicators of a nation's educational quality. This is greatly influenced by students' ability to solve the problems presented in these studies. An individual's ability to represent problems and generate solutions is known as their problem-solving ability. According to Hmelo & Silver (2004), someone with good problem-solving skills will be able to identify real problems and solve various issues (Silver-Hmelo, 2004).

Problem-solving skills assist students in understanding science concepts and answering questions. Students with strong problem-solving abilities can

effectively address problems, allowing them to imaginatively assist, reason, revolve, and engage in the realm that is both concrete and unique by independently creating physics materials (Permendikbud, 2013). As a result, students' problem-solving abilities must be enhanced.

Research on students' problem-solving abilities in science subjects is very important (Docktor & Mestre, 2014). Problem-solving skills are crucial for everyday life and students' future careers (Ekasari, Aprilita, Diantoro, Markus, Parno, 2022; Ekasari, 2023; Ekasari et al., 2018; Ekasari, Algiranto, et al., 2023; Ekasari, Diantoro, et al., 2023; Nursiam et al., 2023; Sumiantari et al., 2019). The primary goal of science education is the aspiration for students to be able to solve scientific problems and become competent problem solvers (Taale, 2011; Yeung et al., 2003).

Many studies on problem-solving abilities have been conducted. These outcomes indicate that students' problem-solving abilities are still low in the subject of science (Dwi et al., 2013; Ekasari et al., 2018; Kumar & Refaei, 2013; Lozano et al., 2015; Neo & Neo, 2005; Prihartanti et al., 2017, 2017; Yeung et al., 2003). It is expected that students with strong problem-solving skills will have a greater understanding of the process of seeking solutions to problems.

There is still room for improvement in students' problem-solving abilities, as shown by various results from previous studies. This can be interpreted as a motivation to understand the extent of students' problem-solving abilities in the Papua region, especially at the Ibnu Sina Islamic High School in Merauke Regency. Consequently, efforts to overcome this problem with a STEM-based *Microlearning* approach, which is the first application carried out in the Papua region can be successfully carried out.

In the effort to implement the STEM-based *Microlearning* approach, research will be conducted regarding the analysis of students' problem-solving abilities in line with the outcomes of previous studies. Ideally, this exploration will serve as a basis for the methodology in Physics Education, in planning for future physics educators. Additionally, this is done to support the research roadmap for policy development established by Musamus University.

RESEARCH METHODS

The type of research used in this study is quantitative descriptive research. Descriptive research is done to simply describe a situation or event. It does not test hypotheses or attempt to explain relationships. The purpose of this study is to collect comprehensive actual data describing phenomena in the field. The research will be conducted at SMP Ibnu Sina, South Papua, Merauke Regency. The conduct of the study is planned from September to November. The sample size in this review consisted of eighth graders at Ibn Sina Middle School. The study sample is part of the entire population. In this study, total sampling is used, which refers to sampling where the sample size is equal to the population size. According to Sugiyono, the entire population is used as a research sample when the population size is less than 100 (Nugroho, 2018). This study uses 10 problem solving ability (PSA) descriptions that use valid, reliable, and appropriate problem-solving ability indicators as research instruments for data collection (Docktor & Mestre, 2014). The collected quantitative data will undergo direct statistical analysis. In addition, it is also carried out on average per indicator of problem-solving ability. Descriptive data will be used to process the results of the analysis qualitatively. The results of the data analysis will then be used at the final stage to draw conclusions.

RESULTS AND DISCUSSION

The research related to the analysis of students' problem-solving abilities in the subject of temperature and heat, as an effort to implement a STEM-based microlearning approach at Ibnu Sina Islamic Middle School, is elaborated as follows. The instruments used in this research have undergone expert validation, and the results are outlined as follows.

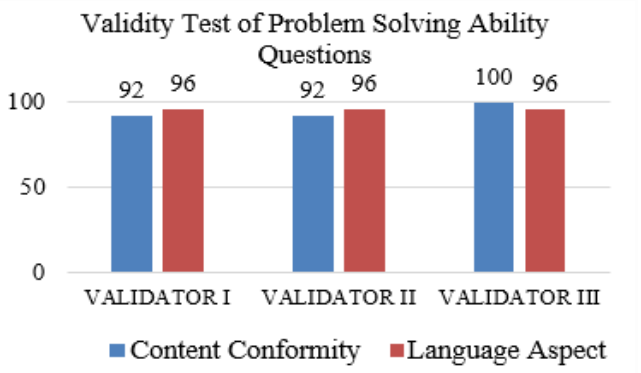

Figure 1. Expert Validation Results

Based on figure 1, the results of expert validation are obtained as follows, the scores obtained from the validation of content conformity are obtained respectively 92, 92 and 100 so that if given an average of 95. With these results, it can be said that the suitability aspect of the content is said to be very feasible for sampling. While in the language aspect, the validation score obtained from each validatot is 96,96,96 so that the average validation of the question is 96 and is said to be very feasible. There are several things that must be corrected in some punctuation marks and some typographical errors on the instruments used. Based on the results of validation, the problem-solving ability instrument is declared feasible to retrieve data.

Students' problem-solving ability is measured using five indicators proposed by doctor consisting of usefull desciption, Physics approach, Specific application of pyisich, Mathematical procedure and Logical progression which are described in the following figure.

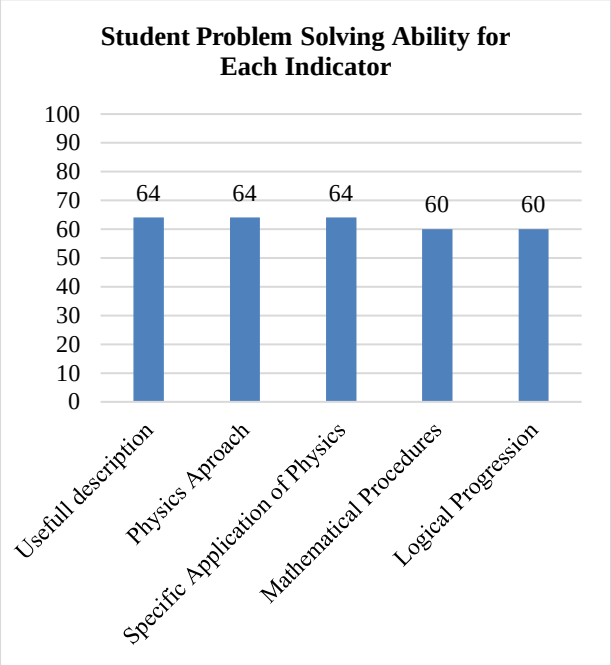

Figure 2. Results of Problem Solving Ability Analysis

The research related to the analysis of students' problem-solving abilities in the subject of temperature and heat, as an effort to implement a STEM-based microlearning approach at Ibnu Sina Islamic Middle School, is summarized as follows. The instruments used in this research have been validated by experts, and the results are outlined as follows. Based on the data presented in Figure 5.2, an average score of 64% was obtained by students on the problem-solving ability indicator "*Useful description*." This score is interpreted as a good category. For the *physics approach* indicator, students obtained a score of 64%, which falls into the category of "satisfactory." Meanwhile, for the third problem-solving ability indicator, which is a specific application of physics, the average score obtained by students is 64%, also classified as "satisfactory." The fourth problem-solving ability indicator is the mathematical procedure, with an average score obtained by students of 60%, which is considered "satisfactory." Lastly, the fifth problem-solving ability indicator is logical progression, and the result obtained by students is 60%, which also falls into the "satisfactory" category.

The data analysis indicates that in the "*Useful description*" indicator, students have obtained an average score of 64%, which means that 36% of this indicator has yet to be achieved by students. This suggests that students have a good problem-solving ability. These results align with previous research on the analysis of physics problem-solving abilities in high schools in Malang City, which explained that students have a higher percentage of correctness in the "*Useful description*" indicator. (Ernila Siringoringo et al., 2018).

In the "*Physics approach*" indicator, students have obtained an average score of 64%, which means that 36% of this indicator has yet to be achieved by students. This indicates that students have a good problem-solving ability in the "*Physics approach*" component. This is consistent with earlier research conducted by Sartika et al., which found that students face more difficulties in planning and describing when seeking solutions to problems in the "*Physics approach*" indicator (Sartika & Humairah, 2018). This can be observed based on the analysis per indicator, which indicates that in the "*Physics approach*" indicator, students have achieved results in the "good" category.

In the "*Specific application of physics*" indicator, students have obtained an average score of 64%, which means that 36% of this indicator has yet to be achieved by students. This result indicates that students have a good problem-solving ability in this indicator. This aligns with the research conducted by Sartika et al., which found that students face more difficulties in planning and describing when seeking solutions to problems in the "*Specific application of physics*" indicator (Sartika & Humairah, 2018). In line with the percentage scores analysis per indicator, it is evident that in the indicator "*Specific application of physics*," students have achieved lower results compared to other indicators.

In the mathematical procedures indicator, students have an average score of 60%, indicating that 40% have not yet reached this level. This indicates that students have a fairly good problem-solving ability in the *mathematical procedures* indicator. These results are consistent with previous research conducted on the analysis of solving science problems at SMPN 2 Banyubiru, which stated that students have a lower percentage of correctness when it comes to problem-solving in the *mathematical procedures* indicator (Astuti et al., 2020). This occurs because students tend to make errors in their mathematical calculations.

In the indicator of *logical progression*, the average score obtained by students is 60%, which falls into the "satisfactory" category, while those who have not met this criterion make up 40%. These results align with previous research outcomes that indicate students achieve the lowest scores when solving problems in the logical progression indicator (Ernila Siringoringo et al., 2018). This is because students tend to encounter difficulties when required to establish connections between the results presented and the chosen concepts in the *Physics approach stage.* By considering the average problem-solving scores of students across the problem-solving stages, the problem-solving abilities of students fall into the "good" category. The achievement of these results is attributed to students encountering difficulties when solving problems using the correct procedures. Students are limited to solving problems from the textbook (module). Consequently, when faced with problems outside of this context or problems related to real-life situations in their daily lives, students encounter difficulties in solving them. This is in accordance with what Lukintawati has researched (Lukitawanti et al., 2020)(Alfika et al., 2019; Faoziyah, 2021; Putra & Utami, 2022; Putri & Juandi, 2023; Rahman et al., 2023).

The constraints experienced by students when solving problems are not solely due to a lack of understanding of the material provided by the teacher but also involve their long-term knowledge (*long-term memory*) (Ernila Siringoringo et al., 2018). Furthermore, to assist students in becoming successful in solving the problems they encounter (*expert problem solvers*), it is essential to provide appropriate learning activities and help students access stored knowledge in *long-term memory* quickly.

The results of this research may not comprehensively depict the problem-solving abilities of students in Merauke as a whole; however, this research can be used as a preliminary research to obtain an initial overview in designing learning and instructional materials that support the implementation of a STEM-based *Microlearning* approach. This research aligns with previous studies that indicate STEM-based approaches are used to enhance learning in problem-solving skills among secondary school students. Students can understand the environment and challenges faced by modern society, relying on the advancement of science and technology, including social and community issues. Therefore, using a STEM approach in learning can be more diverse and innovative, enabling the exploration of various academic concepts alongside real-world applications. Students are aided in acquiring comprehensive knowledge, developing problem-solving skills, and enhancing their critical thinking abilities.

CONCLUSION

According to the data analysis and discussion presented above, it can be observed that the problem-solving abilities of eighth-grade students in the topic of temperature and heat, overall, fall into the "good" category. The obtained data can be used as a reference for designing STEM-based learning and other instructional materials that can support the improvement of students' problem-solving skills, especially in Papua. A suggestion that can be considered for further research, based on the research outcomes, is the need for further investigation into instructional models that support the enhancement of students' problem-solving abilities.

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