



LEVEL OF SCIENTIFIC LITERACY ABILITY OF MIDDLE SCHOOL STUDENTS IN MEDAN BASED ON FRAMEWORK PISA 2018

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Accepted: November 24th, 2023. Published: December 31th, 2023

Abstract

Based on the PISA 2022 results, the scientific literacy abilities of Indonesian students are still below the international average. This research aims to see the level of scientific literacy abilities of junior high school students in Medan City in 2023. This research was carried out at several representative schools designated by researchers as schools representing sub-districts in Medan City. Sample selection was carried out using stratified random sampling. From the 21 sub-districts in the city of Medan, one superior junior high school in each sub-district was selected. From the 21 selected schools, 1 superior 8th grader from that school was taken from each school. The instruments used are scientific literacy questions which have previously been developed by researchers following the indicators set out in the PISA 2018 framework which consists of 15 indicators for 3 scientific literacy competencies in the PISA 2018 framework. It can be concluded that the average scientific literacy ability of students in Medan City was still in the sufficient category. Student achievement was still low in several PISA 2018 framework scientific literacy competency indicators.

Keywords: Scientific Literacy, Competence, PISA 2018

Introduction

Literacy and numeracy skills have become well-known terms in the field of education in Indonesia. The government designed the independent curriculum in such a way as to help schools, especially teachers, to improve students' literacy and numeracy skills. The curriculum is a set of plans and arrangements regarding objectives, content and learning materials or everything related to extracurricular and intracurricular activities which are used as guidelines for organizing learning activities for students so that they can live a good life and achieve educational goals (Simatupang, H. et al, 2019). Based on this definition, it provides clarity that all student activities in schools have been regulated by the government in order to direct students to improve their literacy and numeracy skills. Literacy and numeracy are important or the focus of education in Indonesia not without reason. This is due to the low literacy skills of Indonesian students which can be seen from the results obtained by Indonesian students in international literacy studies organized by the Program for International Student Assessment (PISA).

PISA was formed by countries that are members of the Organization for Economic Co-operation and Development (OECD). Indonesia has been following this literacy assessment for twenty years. In the twenty years that Indonesia has participated in this assessment, Indonesia has never obtained satisfactory results, namely above the PISA standard average. Indonesia is always in the last 10 rankings out of dozens of countries participating in this international assessment study (Hardinata, A., 2019). In this international assessment study conducted by PISA, several literacies were measured, namely reading literacy, mathematics literacy and scientific literacy. Apart from that, economic and social factors that are thought to influence the results of students' literacy skills in their daily lives are also discussed in this study (OECD, 2019).

This is of course a logical reason for Indonesia to be able to concentrate on improving literacy and numeracy skills,

especially scientific literacy skills. Scientific literacy capabilities are the focus of countries that are members of the OECD because these countries believe that the quality of individuals in a country must be ensured to have good competence so that the country's progress can be maintained and improve a country's economy.

The results of the literacy assessment test held by PISA in 2022 can now be seen. Based on these results, Indonesia experienced an increase in ranking compared to other countries in reading literacy, mathematics literacy and science literacy, but experienced a decrease in points in these three literacies (OECD, 2023). This also happens to all participating countries that are members of this international assessment. This happened because of the impact of disrupting state stability, especially in the education sector, during the previous Covid-19 pandemic.

PISA has also released a draft framework for 2025 which will be used for subsequent literacy assessments. Based on the draft that has been released, there is a slight difference in scientific literacy competencies compared to the previous 20 years. The first competency, namely "explain phenomena scientifically", remains the same, but for the other two competencies there has been a change to "Construct and evaluate designs for scientific inquiry and interpret scientific data and evidence critically" and "Research, evaluate and use scientific information for decision making and action" (OECD, 2023). This shows that the PISA team continues to improve the basis used to measure the ability or competence of a child in each country to prepare a quality next generation and improve existing human resources. Therefore, it is also necessary to measure the scientific literacy abilities of junior high school students in Medan City as knowledge or consideration for further research.

Research Method

This research was carried out at several representative schools designated by researchers as schools representing sub-districts in Medan City. Sample selection

was carried out using stratified random sampling. From the 21 sub-districts in the city of Medan, one superior junior high school in each sub-district was selected. From the 21 selected schools, 1 superior 8th grader from that school was taken from each school. Because the literacy abilities measured by PISA are students aged 15 years (OECD, 2013).

The research method used in this research is a quantitative descriptive method. This method was applied in order to reveal the level of scientific literacy abilities of grade 8 junior high school students in the city of Medan (Sugiyono, 2016). This descriptive study only tries to describe clearly and sequentially to the research questions that have been determined before the researcher enters the field and there is no special treatment or hypothesis as a guide to the direction of the research. The quantitative approach in this study was to describe in full and in depth about level of scientific literacy ability of grade 8 junior high school students in the city of Medan for each scientific literacy competency indicator in the PISA 2018 framework.

The instruments used are scientific literacy questions which have previously been developed by researchers following the indicators set out in the PISA 2018 framework. Based on the PISA 2018 framework, a child is said to have scientific literacy skills if they have mastered 3 competencies, namely Explaining Phenomena Scientifically, evaluating and scientific designing inquiry, and interpreting data and evidence scientifically. Each of these competencies is then broken down into 15 indicators in the PISA 2018 framework.

Result and Discussion

In this results and discussion section, students' achievements in the scientific literacy assessment for each scientific literacy competency in the PISA 2018 framework will be explained. To make it easier for researchers, each indicator of scientific literacy competency in the PISA 2018 framework will be described using certain codes to differentiate each indicator for each competency.

Scientific literacy competency consists of 3 competencies, the first competency is Explaining Phenomena Scientifically. This competency consists of 5 indicators, namely: 1) Recalling and applying appropriate scientific knowledge (P1); 2) Identifying, using and generating explanatory models and representations (P2); 3) Making and justifying appropriate predictions (P3); 4) Offering explanatory hypotheses (P4); and, 5) Explaining the potential implications of scientific knowledge for society (P5). The second competency is Evaluating and designing scientific inquiry. This competency consists of 5 indicators, namely: 1) Identifying the question explored in a given scientific study (E1); 2) Distinguishing questions that are possible to investigate scientifically (E2); 3) Proposing a way of exploring a given question scientifically (E3); 4) Evaluating ways of exploring a given question scientifically (E4); and 5) Describing and evaluating a range of ways that scientists use to ensure the reliability of data and the objectivity and generalizability of explanations. The third scientific literacy competency based on the PISA 2018 framework is Interpreting data and evidence scientifically which also consists of 5 indicators, including: 1) Transforming data from one representation to another (D1); 2) Analyzing and interpreting data and drawing appropriate conclusions (D2); 3) Identifying the assumptions, evidence and reasoning in science-related texts (D3); 4) Distinguishing between arguments that are based on scientific evidence and theory and those based on other considerations (D4); and 5) Evaluating scientific arguments and evidence from different sources (D5).

The description in the results and discussion section will then be explained using the codes specified above.

Students' literacy skills in the "Explaining Phenomena Scientifically" Indicator

Data collection has been carried out in the first student scientific literacy competency, namely Explaining Phenomena Scientifically at Medan City Middle School.

Based on the data in Figure 1, It can be seen that students get good grades with a score of 86 on indicator P1. Based on this score, it appears that there is no great difficulty in explaining a phenomenon that occurs or that they encounter in everyday life. When compared with the cognitive level by Anderson (2001), in this competency students are only required to remember and explain phenomena that occur based on the scientific knowledge they have studied previously. Of course, there are not too many phenomena related to science content in the school curriculum, therefore it is certain that students already understand this and receive explanations from teachers in class.

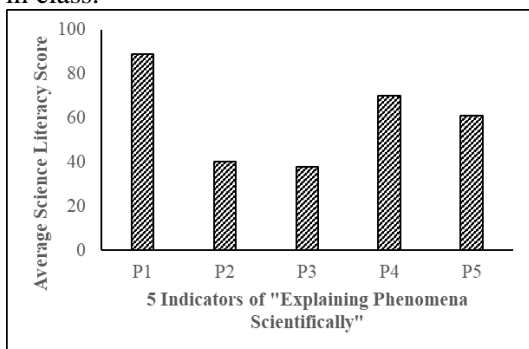


Figure 1. Students' literacy skills in the "Explaining Phenomena Scientifically" Indicators

However, the fact that can be seen from the data obtained is that students' scores are very low on indicators P2 and P3. Based on this data, students have difficulty identifying, using, and forming appropriate explanations to represent an existing phenomenon or event. Students also have difficulty making and determining correct predictions about a phenomenon that occurs if the causal variable is changed. Therefore, it can be concluded that students are less able to study scientific phenomena meaningfully. Students are only able to memorize, and if the variables are changed in an event, students will have difficulty solving it.

From the data in Figure 1, it can also be seen that the scientific literacy competency scores on indicators P4 and P5 were obtained in the medium category with an average score of 71 and 69. This shows that

students are quite skilled in providing appropriate hypotheses regarding scientific phenomena that occur and the benefits or implications. of the possible benefits of scientific knowledge on society.

Students' literacy skills in the "Evaluating and designing scientific enquiry"

Indicators

The competency of Evaluating and designing scientific inquiry is a competency that requires students to be able to think critically or think at a high level so that they are able to provide an assessment and offer a solution to the scientific research or scientific approach being carried out. This is needed by today's students so that they can be creative and critical in solving problems they encounter in everyday life by providing critical thinking and offering solutions to these problems.

Based on data from students' average scores for this competency in Figure 2, we can see that students are quite good at indicators E1, E2 and E3. Based on the numbers shown, it can be concluded that students are quite good at identifying questions that arise from a problem related to science, students are quite good at sorting out questions that can be found for solutions in scientific research or in solving scientific problems in life. everyday, and students are quite good at offering ways or solutions in solving science problems or science phenomena in the form of science questions.

However, in contrast to the previous indicators, we can see that in indicators E4 and E5, students get quite low scores. Based on these data, it can be concluded that junior high school students in Medan City still have difficulty evaluating or thinking critically about determining problems from the phenomena that occur. If students are given different cases with different variables but still involve the same science content or science concepts, students cannot provide solutions or offer questions to the problem. Likewise for indicator E5, students still have difficulty describing and evaluating the variations that can be provided in solving a problem. Students must be able to master material in depth so that they can provide a variety of solutions and broad knowledge

related to the concepts involved in the phenomena that occur.

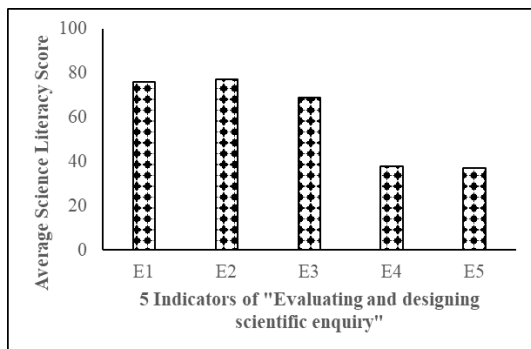


Figure 2. Students' literacy skills in the "Evaluating and designing scientific enquiry" Indicators

Students' literacy skills in the "Interpreting data and evidence scientifically" Indicators

Furthermore, the final competency of scientific literacy according to the PISA 2018 framework is that students are required to be able to draw conclusions from the data obtained. Students are required to be able to think critically in drawing the answers they seek from descriptions of data obtained from research or studies in the field of science. Apart from that, students are also required to be able to change one form of data into another form of data. If the appearance of data is changed, students are still able to give the same answer in drawing conclusions from the data obtained by students.

Based on the data obtained on student competency in this competency in Figure 3, it can be seen that 8th grade of junior high school students in the city of Medan still have difficulties in indicators D1, D2 and D3. Students get low scores on these indicators. Based on this fact, it can be concluded temporarily that students still have difficulty changing data from one form of data to another. Researchers have also found this in previous research on junior high school students in Bandung City, West Java, Indonesia, where students had difficulty determining appropriate graphs from the tables provided regarding the composition of CO² in the air and its effect on temperature in several cities (Hardinata,

A. and Permanasari A., 2017). Apart from that, students are also difficult to determine conclusions from the data provided. Students may not receive complete knowledge so that students still have difficulty in developing their thinking about what is given. Likewise, indicators determine assumptions, evidence and giving reasons related to science.

Then the fact that can be drawn from the data obtained is that students obtained quite good scores on the D4 and D5 indicators. Therefore, it can be temporarily concluded that students have quite good abilities in distinguishing arguments obtained from scientific evidence or in solving scientific problems they face or based on theories they already know. Students are also able to critically differentiate arguments and scientific evidence from various sources that they obtain in solving scientific problems that have been carried out previously.

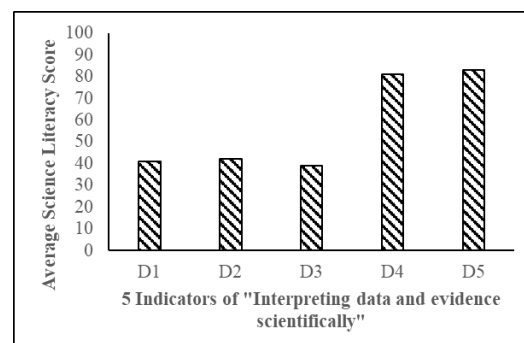


Figure 3. Students' literacy skills in the "Interpreting data and evidence scientifically" Indicators

Conclusion

Based on the results of the research above, it can be concluded that the average scientific literacy ability of students in Medan City was still in the sufficient category. Student achievement was still low in several PISA 2018 framework scientific literacy competency indicators such as Identifying, using and generating explanatory models and representations, making and justifying appropriate predictions, evaluating ways of exploring a given question scientifically, describing and evaluating a range of ways that scientists use to ensure the reliability of

data and the objectivity and generalisability of explanations, transforming data from one representation to another, analyzing and interpreting data and drawing appropriate conclusions, and identifying the assumptions, evidence and reasoning in science-related texts. Hopefully these results can be a consideration for future researchers.

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