

Analysis of Scientific Literacy Abilities of Junior High School Students in Palembang

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ABSTRACT

This study aimed to find out the scientific literacy abilities of Palembang Public Junior High School students in explaining phenomena scientifically, interpreting scientific data and evidence, evaluating and designing scientific questioning in solving base PISA questions. This study used descriptive quantitative methods to obtain data on the ability of students in Indonesia, especially in Palembang in solving PISA questions. The subjects of this study were students from several junior high schools in Palembang. The results showed that the students' scientific literacy skills in solving the question based PISA were 1.04% very good category, 2.08% good, 18.04% fair, 39.06 % less and 39.32 % poor. Based on the grade level, the results show that it has no significant effect on the ability of scientific literacy in solving the question based PISA, except for the indicators of interpreting scientific data and evidence.

Keywords: *Scientific Literacy, Junior High School, PISA, Quantitative Method.*

1. INTRODUCTION

Mathematics and Science are a universal family of Exact Science that underlies the development of modern technology and have an important role in various disciplines and advancing human mind. The rapid development in the field of information and communication technology today is not independent of the current development of mathematics and natural sciences. Therefore, to be able to compete in mastering and creating technology in the future someone is necessary to have mastered mathematics and strong natural sciences earlier.

One of the programs that consistently measures the ability of mathematics and science even a language is the PISA program. The Program for International Student Assessment (PISA) is a world-level assessment program held every three years in order to test the academic performance of the 15-year-old students whose implementation conducted by an organization for Economic Cooperation and Development (OECD). The implementation of PISA aims to test and compare the

achievements of school children around the world, with the intent to improve the methods of education and its results. In each round of PISA, one subject is tested in detail, taking almost half of the total test time. The main subject in 2018 was reading, as in the years 2000 and 2009. Mathematics is the main subject in the years 2003 and 2012, while the science was the main subject in Indonesia in 2006 and 2015. With this alternating schedule, the overall achievement analysis in each of the three core subjects is presented every nine years; trend analysis is offered every three years [1],[2],[3],[4].

The Framework for Assessment and Analysis (OECD 2019, PISA 2018) is as follows: (1) Reading literacy is defined as the ability for students to understand, use, evaluate, ponder, and engage with a text to achieve goals, develop a person's knowledge and potential, and participate in the community; (2) Mathematical literacy is defined as the ability for students to formulate, use, and interpret mathematics in a variety of contexts. It includes mathematical reasoning and the use of concepts, procedures, facts and mathematical tools to illustrate, explain and predict a phenomenon; (3) Science literacy is

defined as the ability to engage with science-related issues, and with science ideas, as reflective citizenship [1]. A literate person is scientifically willing to engage in a reasoned discourse about science and technology, which requires competence to explain the phenomenon scientifically, evaluate and design scientific investigations, and interpret the data and scientific evidence. The framework that forms the basis of PISA is scientific literacy.

Thus, scientific literacy in PISA 2018 is defined by three competencies: 1). Explain the phenomenon scientifically; 2). Evaluating and designing scientific questions; and 3). Interpreting data and evidence scientifically [1].

PISA is used as a valuation tool in many regions of the world, based on the data of the OECD (2019) we can see some of the countries becoming the participants in the PISA program. The first assessment was applied in 43 countries, (32 in 2000 and 11 in 2002), in the second assessment (2003), there were 41 participating countries, in the third assessment (2006) there were 57 participating countries, in the fourth assessment there were 75 participating countries (65 in 2009 and 10 in 2010), in the fifth assessment (2012) there were 65 participating countries, in the sixth assessment (2015) there were 72 participating countries. In 2018, there were 79 participating countries in PISA [1],[2],[3],[4]. Two of them were Indonesia and Thailand.

The results of PISA assessment 's ability indicate that Indonesian students experienced an increase in both science, mathematics and language skills. As contained in the According to Compass (2019), in 2006, the achievement of science capability was at the number 393, then went down at the number 383 in 2009 and 382 in the year 2012, in the year 2015 it got up with a score of 403. Unfortunately, on the last report of PISA 2018, the scientific ability score decreased again in the year 2018 with the score of 396. It is almost the same as those on reading and mathematical skills. It makes The rank of Indonesia is always in the bottom order. According the findings Anwar et al, that one of the reasons is because of the fact that students are not accustomed to working on the contextual problems that requires students to analysis thinking [6].

There are some neighboring countries having a lower level of standard when compared to fellow southeast Asian countries; Indonesia is below Thailand and Singapore. Looking at these poor results, it is advisable for Indonesia to be able to reflect and learn from other countries. Demographically, Indonesia can observe how the education system having been run in neighboring countries such as Thailand, Malaysia, and Singapore. Therefore, it is necessary to be careful on how the ability of the Indonesian and Thai students to are able to solve the problems of PISA. This study looked at how the

junior high school students in Palembang (Indonesia) competently explained the phenomena scientifically, evaluated and designed scientific inquiry, and interpreted data and evidence scientifically. The body text starts with a standard first-level heading like INTRODUCTION or any other heading suitable to the content and context. First level headings are in all caps. Copy the content and replace it for other first-level headings in remaining text. Reference citations should be within square bracket [1]. Headings should always be followed by text.

2. METHOD

2.1. Research Sites and Subjects

This research was carried out in several Junior high School in Palembang, namely 1, 7, 12, 14, 17 and 28 Palembang.

2.2. Research Types and Procedures

This research used quantitative methods as the preliminary study to obtain data on the ability of students in Indonesia, especially in Palembang in solving PISA questions. This research was carried out in several stages: first, conducting a preliminary study, then determining the objectives of the exam, studying literature, determining the research methods, samples, conducting exams, analyzing data, and making conclusions. The instrument used in this study was a test of the PISA model.

2.3. Technique of Data Analysis

All data collected were analyzed quantitatively. The data were analyzed descriptively using test results with the following steps:

- Provide the total score for each subject by:

$$\text{Achievement of learning result} = \frac{\text{The total score obtained by the subject}}{\text{maximum total score}} \times 100$$

From the data analysis, the results were converted to the assessment of learning outcomes towards the subjects which were grouped in the following categories in Table 1.

Table 1. Validation result from validator

Validator	Score	Percentage
Learning steps	4,78	92%
Skills improvement	4,15	87,19%

(Modified from [7])

To measure indicators explaining phenomena scientifically, interpreting scientific data and evidence, evaluating and designing scientific questions in solving PISA model questions were analyzed descriptively and inference using the MANOVA test.

3. RESULT AND DISCUSSION

The results showed that the students' scientific literacy skills in solving the PISA model questions in the Public Junior High School Numbers 1, 7, 12, 14, 17 and 28 Palembang were 1.04 percent in the very good category, 2.08 percent good, 18.04 percent fair, 39.06 percent is less and 39.32 percent is in the poor category. This is in accordance with the PISA study report where there is an up and down trend in the achievement of student science literacy scores in Indonesia. From the results of the report, it was found that the scientific literacy skills of Indonesian students were still low.

The normal distribution of data was determined by using skewness and kurtosis values with the applied

range of -2 to +2, such as the limits [8]. The results of the normal distribution analysis of the three observed indicators were: explaining phenomena scientifically, interpreting scientific data and evidence, evaluating and designing scientific questions within the normal distribution range with skewness and kurtosis values within the allowable range (-0.542 to 1.746). Therefore, the data for the three indicators of PISA mastery in six schools were in normal distribution.

To test for the similarity of variance, the Levene's test was used to find out the similarity test of the variance matrix between schools. The test results showed that the overall data variants at Junior High School (SMPN) 1, 7, 12, 14, 17 and 28 Palembang were not homogeneous ($p < 0.05$). Furthermore, from the aspect of indicators, the indicators of Interpret data and evidence scientifically and evaluate and design scientific questions were homogeneous variants respectively ($p = 0.147$ and 0.192), but the indicator of explaining phenomena scientifically was non-homogeneous variants ($p = 0.02$).

3.1. PISA Mastery by School

Based on the data analysis of each indicator for six Public Junior High Schools in Palembang City using

Multivariate Variance Analysis (MANOVA), it showed that there was a significant difference for the three independent variables simultaneously presented in Table 2.

Table 2. MANOVA results to differentiate the indicators in the six schools in PISA Mastery

Influence	Value Pillai's Trace	F	Hypotesis Df	Error df	Sig
	0.113	2.937	15.00	1128.000	0.000*

* The mean difference is significant at the .05 level

Looking at the existence of significance in Pillai's Trace, then Univariate ANOVA was implemented for

each PISA Mastery indicator shown in the following Table 3.

Table 3. Results of the MANOVA Analysis of PISA Mastery in Six Public Junior High Schools in Palembang City

Source	Dependent Variable	df	Mean Square	MANOVA	
				F	Sig.
Schools	Explaining phenomena scientifically	5	1.579.631	4.432	.001*
	Interpreting data and evidence scientifically	5	1.337.655	4.062	.001*
	Evaluating and designing scientific questions	5	1.259.071	2.706	.020*
	Total Value	5	1.106.844	5.398	.000*

* = significant at $p < 0.05$

The results of the analysis in Table 3 conclude that basically PISA mastery has a very significant difference in the six public junior high schools in Palembang City ($p = 0.000$). This fact also applies to the three indicators measured, namely explaining phenomena scientifically having a significant difference ($p = 0.001$), interpreting scientific data and evidence ($p = 0.001$), and evaluating and designing scientific questions ($p = 0.02$).

Considering the results of this analysis, it can be assumed that the six Public Junior High Schools in Palembang City have different methods of teaching scientific literacy skills in solving the PISA model questions.

Most of the questions in PISA involve the context of real- life situations, so it is very important to give them to students so that students get used to solving problems that

exist in everyday life. The low results of scientific literacy skills in solving the PISA model questions seem that the students have difficulty in understanding the science material being taught. The teaching method applied is not optimal, only accepting the material described by the teacher and not finding out the material being taught on their own so that the students are not trained in their thinking skills and do not understand the concept of the material being taught. Teachers can provide learning experiences to students by creating a culture of thinking through giving problems related to everyday life so that the students play an active role in learning. There are several factors that influence students' low scientific literacy, namely the tendency that the learning process does not support students in developing scientific literacy skills [8]. In addition, the assessment process that is usually carried out in schools is also the cause of Indonesia's low position in the PISA study. The profile of the quality of science literacy among junior high school students in Pati District was in the low category with a percentage of 55%. In the medium category, the percentage was 45% and there were no students belonging to the high category [9]. In addition, a study by Anwar et al (2015) Scientific literacy skills of junior high school students in Palembang are still low [6].

3.2. Mastery of PISA based on Grade Level

Analysis of Normality based on the grades for six Public Junior High Schools in Palembang City was

carried out based on the scores of Skewness and Kurtosis. Based on the criteria set [8] the distribution of the total value of PISA mastery of the three indicators was in the normal distribution range. Likewise, the distribution at the three grade levels is also in the normal distribution (between - 0.0643 to 1.343). Therefore, based on this skewness and kurtosis range, the data for the three indicators of PISA mastery in the three grades of Public Junior High Schools in Palembang City were in the normal distribution.

To test the variance similarity, the variance matrix similarity test was used between the different grades of Levene's test. The test results showed that the overall data variants in the three grades, namely Grades VII, VIII and IX had homogeneous variants. Furthermore, this condition also applied to the three indicators measured, namely interpreting scientific data and evidence (p = 0.050), evaluating and designing scientific questions that have homogeneous variants (p = 0.217), and explaining scientific phenomena having non-homogeneous variants (p = 0.508). Therefore, the equality of variance applied to the entire grade span of the three indicators being measured.

The data analysis for each indicator for the three grade levels at six Public Junior High Schools in Palembang City using Multivariate Analysis of Variance (MANOVA) showed that there was a significance in the difference in multivariate analysis for the three grade levels simultaneously.

Table 4. PISA MANOVA results at three grade levels in PISA Mastery

Influence	Value of Pillai's Trace	F	Hypotesis Df	Error df	Sig
	.893	1046.499b	3.000	377.000	.000*

* The mean difference is significant at the .05 level

Given the existence of significance in the Pillai Trace in Table 5, the difference in grade levels has a significant

difference value. Univariate ANOVA was implemented for each indicator of PISA Mastery as shown in Table 5.

Table 5. PISA MANOVA results at three grade levels in PISA Mastery

Source	Dependent Variable	df	Mean Square	MANOVA	
				F	Sig.
Indicators	Explaining phenomena scientifically	2	189.915	.509	.602 tn
	Interpreting data and evidence scientifically	2	1.682.256	5.015	.007*
	Evaluating and designing scientific questions	2	1.074.157	2.273	.104 tn
	Total Values	2	821.980	3.847	.022*

* = significant at p < 0.05; tn = tidak nyata (not real)

The results of the analysis in Table 5 concludes that basically the PISA mastery has a very significant difference in the six public junior high schools in Palembang City (p total value = 0.022). However, the reality is different for the three indicators, namely explaining the phenomenon scientifically has insignificant differences ($p = 0.602$), the indicators evaluating and designing scientific questions have insignificant differences ($p = 0.104$). Meanwhile, the indicators of interpreting data and scientific evidence had a significant difference ($p = 0.007$). Considering the results of this analysis, it can be argued that there is a tendency for the grade level to have no significant effect on PISA mastery except for indicators of interpreting scientific data and evidence.

Scientific literacy is one of the important objects that must be improved in scientific studies [11]. Scientific literacy is used to make personal decisions, contribute to cultural and community activities, and economic productivity [12]. Another reason as given in the curriculum is the student must be involved to understand and apply the knowledge, so that they can solve their own problems and look up to create original ideas [13]. In the curriculum, It should be the students engage in learning, because everyone need to engage their abilities in public discourses and scientific thinking for making a decision in their daily life.

Science learning in the 2013 curriculum has provided a reference in selecting a learning model that is in accordance with the scientific approach [14]. However, there are teacher that using teacher –centered approach so their student are not engage to their science learning process, so that the learning becomes meaningless. If the curriculum directs teachers to do science-based learning, the teacher will develop PISA-based learning that will involve students, that will be able to improve students' literacy skills. PISA frame work based teaching material gives students the chance to practice, enrich their empirical experience, and train their thinking skill [6]. The current education curriculum of 2013 prioritizes cognitive, affectiv and psychomotoric skill. Students are required to understand the content, be active in discussions and presentations, have high courtesy and discipline, and a student learning process that develops their skills, activities and creativity through various interactions and learning experiences.

4. CONCLUSION

The ability of scientific literacy in solving problems in the PISA model of Public Junior High Schools Numbers 1, 7, 12, 14, 17 and 28 in Palembang City shows that 1.04 percent belongs to the very good category, 2.08 percent good, 18.04 percent fair, 39.06 percent less and 39.32 percent poor. The three measured indicators, namely explaining phenomena scientifically, interpreting scientific data and evidence, evaluating and designing

scientific questions in solving the questions based PISA had very significant differences in the six public junior high schools in Palembang City. Furthermore, the results showed that the ability of scientific literacy in solving the PISA model problems based on grade level had no real effect, except for the indicators of interpreting scientific data and evidence.

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