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Analysis of the Science Assessment Items Using Scientific Literacy Competencies

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Abstract

This research aimed to analyze the science assessment in Junior High Schools in Tangerang Selatan City using scientific literacy competencies. This study used a descriptive method by collecting questions for the final semester assessment from four schools in Tangerang Selatan City, Indonesia which were determined by random sampling. A total of 180 science item test from four schools in Tangerang Selatan City, Indonesia were analyzed using scientific literacy competency indicators contained in the 2018 PISA framework. The results showed that only a small proportion (7.22%) of the items contained scientific literacy competencies. The items used tend to directly ask students' mastery of concepts and do not present data/information that students need to investigate on the items. Most of the questions presented are in the form of concept/definitions so that it does not require students to think at high levels, especially at the reasoning stage.

Keywords: Assessment, Scientific Literacy, Scientific Competence, PISA Framework

INTRODUCTION

Science and technology are developing rapidly in various countries. Development is determined by the quality of science education applied in learning. Science education is a foundation in forming quality human resources. Science education in the 21st century requires proficiency in scientific literacy. Scientific literacy is defined as the ability to engage in issues related to science and provide scientific ideas in order to solve these problems or issues in life, as a reflective human being (OECD, 2016). Scientific literacy is not merely the ability to understand the science concept, but also the ability to understand the scientific process and apply it to face real conditions that occur in the environment (Rostikawati, 2016; Deryati & Maharta, 2013).

The quality of education in Indonesia, especially science education, is low compared to other developing countries. This is indicated by the low achievement of scientific literacy levels in the Program for International Student Assessment (PISA). PISA is a study of international student assessment organized by the Organization for Economic Cooperation and Development (OECD). PISA aims to measure knowledge and skills that are essential to be able to participate as citizens or members of society in sustainable development.

Indonesia's scientific literacy score is still very concerning. Based on Trends in International Mathematics and Science Study (TIMSS) data, the science literacy scores of Indonesian students from 1999-2015 are only around 397-510. Even in 2015, Indonesia was on

the 44th place out of 47 participants (Martin, 2016). Meanwhile, based on PISA, Indonesia is ranked 62 out of 70 participants with a score of 403 (OECD, 2016). Based on the new PISA report released in December 2019, Indonesia's scientific literacy score is ranked 70 out of 78 participants (OECD, 2018). This data shows that the level of scientific literacy of students in Indonesia is still very low. The low ability of scientific literacy can be caused by (1) teachers' understanding of scientific literacy, (2) the learning model has not trained scientific literacy, (3) teaching materials have not yet contained scientific literacy (4) the assessment instrument has not been based on scientific literacy, (5) instrument technique who do not fully accommodate the criteria for assessing scientific literacy, (6) Students have not been trained in solving scientific literacy-based questions (Permanasari, 2011; Fa'idah & Mahanal, 2019; Odja & Payu, 2014; Thomson, et al., 2013, Udeani , 2013, Astuti & Prasetyo, 2012).

The items used by science teachers in the assessment were mostly in the Lower Order Thinking Skills (LOTS) category. The percentage of the number of items classified as Higher Order Thinking Skills (HOTS) on the Daily Assessment is 6.7%, the Mid-Semester Assessment (PTS) is 1.1%, and the Final Semester Assessment is 1% (Pratiwi, 2019; Tiarrahmadani, 2018; Herlant & Nophitalia, 2005). Even though HOTS is very much needed to achieve the competency demands of the 21st century. Other research shows that teachers in the learning process do not stimulate students to think at higher levels such as providing introductory text in assessment and learning, media images and scenarios of a case for students to solve.

Analysis of the items used by teachers/schools using scientific literacy competences has not been found much. Research is more on analysing content, quality of written test items and students' thinking level abilities (Damayanti, et al., 2016; Amrianto, 2017; Ariyana, 2011; Johari, 2018, Samudar, 2019; Septiana, 2016). Even though the suitability of the items used with scientific literacy competences can help students improve scientific literacy. Research related to item suitability can provide information in order to determine a better strategy for achieving good score in PISA. Therefore, researchers are interested in seeing the suitability of the items used in the science assessment with scientific literacy competencies.

METHOD

This research aimed to examine the suitability of science assessment items used in junior high school at Tangerang Selatan City, Indonesia with scientific literacy competencies. This research used a descriptive study method by collecting the final semester assessment questions. The data are final semester assessment items in science subjects which are used as a written test assessment in junior high school at Tangerang Selatan City, Indonesia. The research sample used random sampling technique. The items collected from four junior high schools in

Tangerang Selatan City, Indonesia were analysed using the 2018 PISA framework scientific literacy competency indicators as shown in Table 1.

Table 1. Scientific Literacy Competency Indicators

Competency	Indicator
Identifying scientific issues	a. Identify issues that may be investigated scientifically b. Identify key words for scientific information c. Recognize the characteristics of scientific investigation
Describe scientific phenomena	a. Apply scientific knowledge in a given situation b. Describing or interpreting phenomena and predicting change c. Identify appropriate descriptions, explanations and predictions
Using scientific evidence	a. Interpret scientific evidence and draw conclusions b. Provide reasons to support or reject conclusions and identify assumptions made in reaching the conclusion c. Communicating conclusions related to the evidence and reasoning behind the conclusions and making reflections based on the social implications of scientific conclusions

The analysis was carried out by looking at the question indicators on each item. The question indicators are reviewed by the researcher in order to see the competence being measured. If it contains indicators of scientific literacy competence, then the question is declared "suitable" with the competence of scientific literacy. Apart from being categorized as appropriate, the questions will also be categorized into "close to suitable" and "unsuitable". The question is categorized as "close to suitable", if it contains indicators of scientific literacy competence, but the questions do not have a stimulus.

RESULTS AND DISCUSSION

The items test were analyzed using the indicators of scientific literacy competence as described in Table 1. A total of 180 items of final test in science subjects were multiple choice and essays were collected from four junior high schools in Tangerang Selatan City, Indonesia. Based on Figure 1, it can be seen that only a small proportion of the item test according to the scientific literacy competency (7%). Competence in identifying scientific issues (2%) is dominated by indicators of recognizing the characteristics of scientific investigation. This competency was mostly found in grade 7^{th} class questions. Competence in explaining scientific phenomena (3%) contained more indicators describing or interpreting phenomena and predicting change. The competence in using scientific evidence (2%) contains more indicators that provide reasons to support or reject conclusions and identify assumptions made in reaching conclusions.

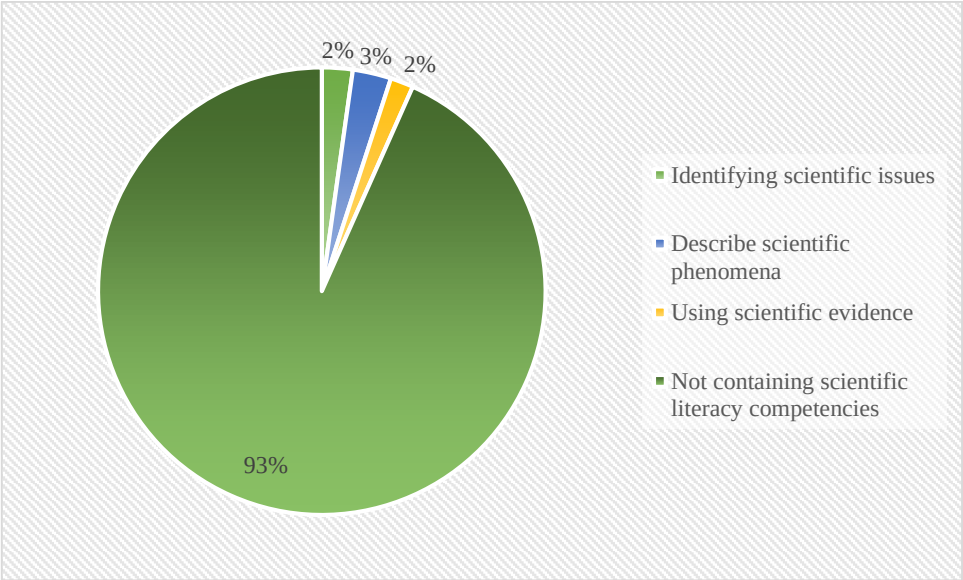


Figure 1. Percentage of question items in accordance with scientific literacy competencies in four junior high schools in Tangerang Selatan City

Based on the explanation above, the following are some items that fall into the criteria of "suitable", "close to suitable", and "unsuitable" in relation to scientific literacy competencies obtained from four junior high schools in Tangerang Selatan City.

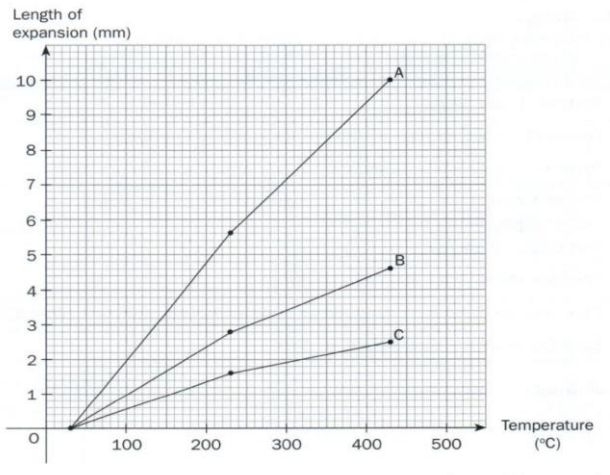
1. (Unsuitable; Multiple Choice) A celestial object that is small in size floating in the air and has no trajectory is ...
   a. Meteoroid
   b. Satellite
   c. Asteroids
   d. Comet
2. (Unsuitable; Multiple Choice) The ability of organisms to produce offspring is called ....
   a. Reproduction
   b. Adaptation
   c. Respiration
   d. Regeneration

Item test number 1 and 2 are categorized as unsuitable with the indicators of scientific literacy competence. Item test number 1 has indicators that students can determine the definition of a celestial body, while number 2 has indicators that students can determine the definition of reproduction. Item test that measure student knowledge related to the definition of a concept are not included in scientific literacy competencies. In addition, questions that ask for an understanding of a concept require low-level abilities (Low Order Thinking Skills) (Hartini, et al. 2020).

3. (Close to suitable; Essay) Why when cold do you feel hungry quickly? Explain!
4. (Close to suitable; Complex Multiple Choice) When a grandfather reads a book, He pulling books away from the normal distance for reading. this is due to lack of good for the eyes in work, the cause of this problem and the solution is ...
   a. Grandfather eye lens is too flat
   b. Requires biconvex lenses to help overcome it.
   c. Grandfather eye lens is too convex
   d. Requires biconcave lens to help overcome

Item test number 3 contains indicators that students can explain body metabolism when it is cold and number 4 contains indicators that students can explain eye defects in humans. In both item test students are asked to explain a scientific phenomenon, so that it can be categorized as measuring scientific literacy competence. The two questions are still categorized as close to suitable because of the absence of a stimulus in the question. Without a stimulus, questions tend to ask or assess the memory (Puspendik, 2019). If the two questions are given an appropriate stimulus, then the two questions can be categorized according to the scientific literacy competence.

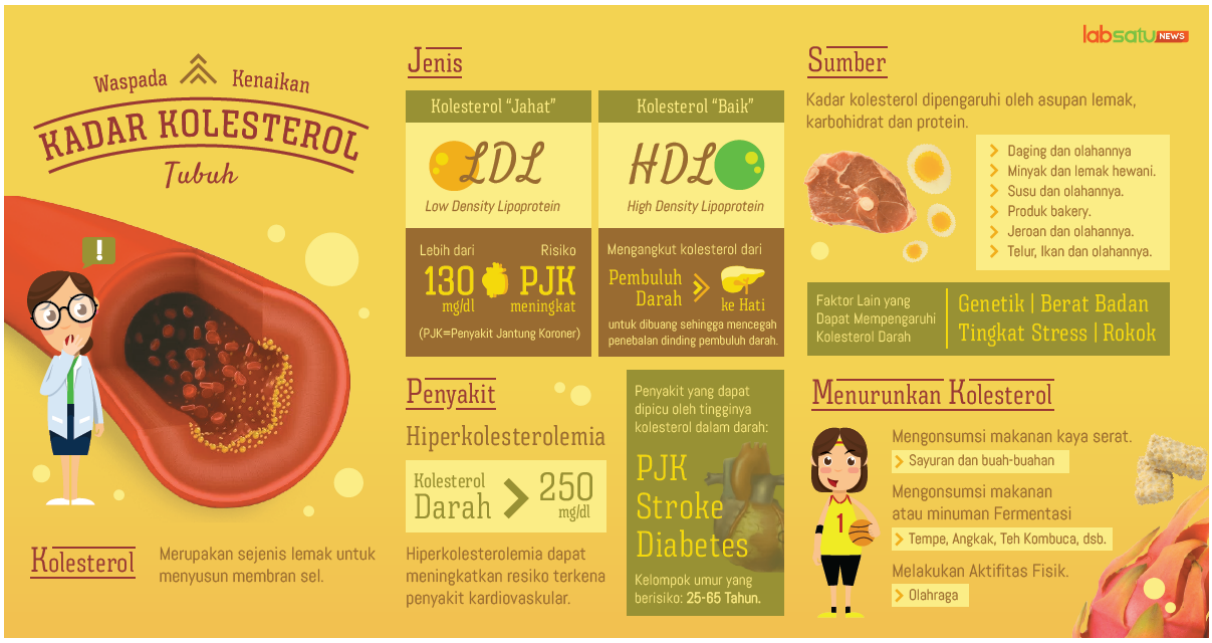
5. (Suitable; Multiple Choice with Reason) Alfarabi conducted an experiment by testing three different types of metal plates A, B and C. All metal plates are the same size. Alfarabi heats all metal plates from 30^0C to 430^0C. Alfarabi noted the increase in the length of the metal at temperatures of 30^0C, 230^0C and 430^0C. Then the results are displayed in the following graph. Metal Plate A is very suitable as a material for making ...



   a. Heavy vehicle tires.
   b. Thermostat.
   c. Coin coating.
   d. Car body.

Reason: .....

6. (Suitable; Essay) Take a look at the following info graphic!



Question: Make a lunch menu so that body cholesterol can be maintained with the reason!

Item test number 5 and 6 are categorized suitable to scientific literacy competencies. Both questions have been equipped with a stimulus. The stimulus order students to high thinking skills. Item test number 5 and 6 contain the competence to explain scientific phenomena with indicators of applying scientific knowledge in a given situation. In question number 5, students were given a stimulus in the form of a graphic. Based on this stimulus, students are asked to determine suitable materials in accordance with the given situation. In question number 6, a stimulus is given so that students can arrange a meal menu according to the given situation. In addition to determining the menu, students are also asked to argue about the preparation of the menu.

The low content of scientific literacy on written test item items used by teachers / schools could be due to differences in targets for scientific literacy skills in learning applied in schools (even though they have used the 2013 Curriculum) with the goal of scientific literacy in PISA (Diana, 2016). In addition, science learning in schools includes assessments that are used more limited to the development of science content, while the target in PISA scientific literacy questions is more on the application of scientific thinking (reasoning) in everyday life (Fives, et al. 2014; Pranoto, 2013) and focuses on practical knowledge action and measures the ability to use scientific principles in non-academic contexts (Schwartz, et al., 2006).

Textbooks used by teachers and students also affect science literacy learning in the classroom. Textbooks can influence learning patterns, thereby affecting the assessment process developed by teachers. Penney, et al. (2003) stated that textbooks are an important factor in the development of scientific literacy. The textbooks used by teachers mostly contain scientific

knowledge which presents facts, concepts, principles, laws, theories and a number of questions that demand answers related to considering concepts, knowledge and information (Wahyu, et al., 2016).

Another cause of low scientific literacy in learning is the learning process in schools (including in universities) which emphasizes mastery of content, not scientific processes (Surples, et al., 2014). The low ability of science literacy for junior high school teachers can affect the ability of teachers to develop scientific literacy question items. There is a gap between science learning in schools and the demands of scientific literacy (Ardianto & Rubini, 2016), so it requires improvements in science learning. Some improvement steps can be started from the application of science literacy-based teaching and the development of learning assessments that address aspects of scientific literacy (Widiyanti, et al., 2015, Sariwulan, et al., 2015).

CONCLUSION

Based on the research, there are a small part written test items containing scientific literacy competence in science subjects in junior high school who used teacher / school in the Mid-Test and Final Test. This research reinforces previous studies that showed that the items used in science teaching is still little scientific literacy which includes competency. The small number of items makes students unaccustomed to working on questions that test scientific literacy competencies. This is in line with PISA results in recent years. This research can be continued by developing a science assessment that includes scientific literacy competencies. Science assessments that are in accordance with scientific literacy competencies can improve the quality of science education in Indonesia.

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