Mathematical literacy skill of students of Pisa type in the context of coconut

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Abstract. Indonesia has experienced the improvement of the result of PISA despite its lower result besides other countries. Therefore, the result of this study is to find out the mathematical literacy ability of students in using PISA model questions in the context of coconut. This article also describes the ability of students in solving mathematical problems in the context of coconut. This is design research with two development studies types, namely preliminary and formative evaluation, which includes self-evaluation, expert reviews, one to one, small group, and field test. Based on the result of the analysis, the researcher showed that in solving the mathematical problem of PISA model in the context of a coconut tree, students mostly utilized to choose a strategy in solving the problem and communication ability.

1. Introduction

According to OECD, mathematical literacy is the individual capacity to formulate, apply, and define maths in a variety of situations [1]. Meanwhile, the definition of mathematical literacy itself is the visualization of a person's reasoning ability in using mathematical concept, procedure, fact, and tool to describe, explain, and predict phenomenon in daily life [2]. Literacy in maths aims to find out the ability of students to identify, comprehend, and utilize basic mathematical concepts that students need in facing life reality. On the other side, Moll [3] stated that literacy shows the ability of reading, writing, speaking, and using language.

PISA (Programme for Internasional Student Assesment) is an international study held by OECD (Organization for Economic Cooperation and Development) which describe the literacy ability of students [4]. This program implicates 15 years old students or junior high school students. Therefore, PISA questions are mostly based on the real problems which assessed through the mastery of process, concept understanding, and the ability to apply it [5].

Three essential components which can be identified in the PISA study of mathematical literacy, namely process, context, and content [6]. Generally, the process in mathematical literacy could be divided into three categories, which is (1) Formulating situations mathematically, (2) Employing mathematical concepts, facts, procedures and reasoning, and (3) Interpreting, applying, and create evaluating mathematical outcomes [4]. The three processes rely on the seven fundamental mathematical capabilities such as communication, argumentation, representation, reasoning, problem-solving, using symbolic, formal, and technical language, and operations, and using of aids and tool [1, 2, 7].

Indonesia has participated in the PISA program since 2003. According to the result of PISA in two last period, Indonesia has undergone improvement even if it is still insignificant compare to other countries [7]. Indonesia is in the 64 positions of 65 countries. Later, Indonesia is in the 62 position of 72 countries in 2015. Various things cause the low result of PISA; one of them is that students are not adjusted to solve the problem in context. Also, Wijaya [8] stated that students find difficulties in solving
mathematical problems like using context in PISA. Besides, according to [9, 10] which relates to the statement of Wijaya, Heuvel-Panhuizen, Doorman dan Robitzsch [11], students find difficulties in understanding (38%), transformation (42%), mathematical process (17%) and coding mistake (3%) in solving PISA problems. In further, the researcher considers this to assess mathematical literacy level of students in using PISA model in the context of coconut fruit in which coconut is very identical with archipelago country like Indonesia. Students will also be able to understand the context easily because coconut is very easy to find, especially in Palembang. By the use of context, Indonesian experts have developed Pendidikan Matematika Realistic (RME) or PMRI. Putri [12] stated that PMRI is innovative learning which adapted from RME in using Indonesia context.

2. Method
The method in this study was design research which included two stages, namely preliminary and formative evaluation stage. This study involved first-grade students in senior high school. The first stage was initial, where the researcher analyzed the curriculum, student, and PISA. The next was the evaluation stage, where the researcher analyzed the outline, question card, RPP, and teacher instruction in the early prototype. The next stages were expert review and one-to-one. Expert validation was done face to face with three maths teachers at the school. One-to-one involved three students of the first grade of senior high school.

A small group stage was done with six students of the first grade of high school to find out the practicality of the problem. There were two students of low ability, two students of high ability, and two students of average ability. The last stage was the field test. Field test involved 30 students of the first grade of senior high school. Then, the result was analyzed to assess the literacy ability of students in solving the problem which according to [1, 2] students who have literacy ability are students who can formulate, apply, and interpret maths in different situations.

3. Result and Discussion
The early prototype produced 6 unit of questions. Then, the researcher examined the prototype, which was made to determine the subject, place of research, analyze students, and curriculum. The result of this prototype was called prototype. The following was question 1 in the prototype.

![Figure 1. Question unit 1 prototype 1](image-url)
Then, the result of prototype one was validated by experts who were a maths teacher in senior high school and three students of first grade in senior high school. The following was the result of validation in expert reviews, and one-to-one is table 2.

| No | Comment                                                                 | Revision                                      |
|----|--------------------------------------------------------------------------|-----------------------------------------------|
| 1  | Change the location description in the second question                    | Change the location description in the first question |
| 2  | For the field size, is it possible for someone to go around the field with the amount of time? | The researcher keeps the question             |
| 3  | Give space in the word between “time” and “15 minutes”                   | Add space in the sentence                     |

The result of expert validation and one-to-one expert was named prototype two, which later was followed by small group stage. The result of the small group showed that almost all students were able to solve the problem as well as comprehend the problem well. The result of a small group was named prototype 3, which later followed by a field test. The following was the result of prototype 3.

A field test was the last stage, which involved 30 students of the first grade of high school. The purpose of the field test is to assess the potential effect of the question in mathematical literacy ability. The following was the strategy description of the student's answer.
Figure 3 showed a student's strategy in answering question unit 6. Based on the answer, the question brought out the ability to choose a strategy in solving problems (K.5) in which students used the concept of rectangle area to determine the number of lost calories in exercise. This showed K.5 indicator in which students were able to utilize strategy through various procedures which led to the mathematical solution and conclusion, which was known and complete.

Furthermore, based on the student's answer sheet, the question brought out communication skill (K.1) in which students wrote down the result of the integration of the amount of coconut which was needed to revert the lost calories. It could be seen from the student's answer sheet, which integrated 1,89 into two coconuts. It showed K.1 indicator in which students were able to resolve the mathematical result correctly and completely.

There were seven students out of 30 who were able to apply strategy through the different procedure, which led to the mathematical solution and conclusion which was familiar and complete. This showed that students were able to apply the ability to choose a strategy in solving problems. Other than that, there were 7 out of 26 able students, to sum up, the mathematical result wholly and correctly. This showed that students were able to apply communication skill.

Figure 4. Students' answer sheet unit 1 question 1 strategy 1

Figure 4 was strategy 2 in answering the question. Based on the picture, a student's answer sheet showed the ability to choose approach in solving a problem (K.5) where students calculated the area of the field by using the concept of addition. This showed K.5 indicator, which was the ability to use strategy through the different procedure, which led to incomplete mathematical solution and conclusion.

Later, students showed communication skill (K.1). The student was able to interpret the picture by calculating the area. This showed K.1 indicator in which students were able to interpret the question, problem statement, object, and picture, which was incomplete.

There were 3 out of 30 students who were able to apply strategy through the different procedure which led to incomplete mathematical solution and conclusion. This showed that students were able to apply the ability to choose a plan in solving a problem. Furthermore, there were 3 out of 26 students who were able to interpret the incomplete question, problem statement, object, and pictures.

Figure 5. Unit 1 Answer Sheet Question 2
In the picture, the student answered the question of unit 1. The student's answer sheet showed reasoning and argumentation ability (K.4). The answer showed that student calculated the length of track which had been through by multiplying the amount of running time of the athlete. This showed K.4 indicator in which student was able to gain and connect the information to find a mathematical solution completely. Moreover, the student also showed communication skill (K.1) in which student was able, to sum up, the amount of coconut which was needed to replace the lost calories. This showed K.1 indicator in which student was able, to sum up, mathematical result correctly and completely. 

There were 7 out of 26 students who were able to link the information which has been found to determine the mathematical solutions completely. This showed that students were able to apply reasoning and argumentation skill. On the other hand, there were 7 out of 26 able students, to sum up, the mathematical result completely and correctly. This showed that students were able to apply communication ability.

4. Conclusion

Based on the result and analysis of the study, the researcher shows that students' answer sheet in answering the mathematical question PISA model in the context of coconut mostly utilize the ability to choose a strategy in solving problem and communication skill.

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