Mathematical Literacy of Junior High School Students in Kecamatan Tampan Kota Pekanbaru in Geometry

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ABSTRACT

This study aimed to determine the mathematical literacy (reasoning and communication of mathematics) of junior high schoolstudents in KecamatanTampan Kota Pekanbaru in geometry. The research instrument used instruments PISA 2012 with space and shape content translated into Indonesian. Overall, the test consists of 14 items with the nine themes. The population in this study are student at class IX of SMPN 20 and SMPN 23 Pekanbaru. Randomly selected one class from each school in order to obtain a sample of 74 people. The results showed that students' mathematical literacy is still low with an average score of 46.90 and a standard deviation of 15.15. For aspects of mathematical reasoning abilities, students tend not able to use patterns and relationships to analyze mathematical situations, provide explanations using models, facts, attributes, and relationships, as well as estimating the answer and the solution process. For aspect of communication, students tend not able to connect real objects, drawings, and diagrams into mathematical ideas.

***Keywords**: Mathematical literacy, mathematical reasoning skill, mathematical communication skill*

Introduction

Literacy has become a hot conversation among the international and a great hope of the world. Various parties, especially educational experts intensively conduct literacy assessments and and find ways to improve literacy in various countries, including Indonesia. One way is be involved in the Program for International Student Assessment (PISA). PISA is a premier international-scale assessment conducted on a regular basis once every three years since 2000 to find out the literacy of 15-years-old students in reading, mathematics, and science. The focus of the PISA is the theliteracy that emphasizes students skills and competencies gained from school and can be used in everyday life and in various situations (Rahmah, 2012). In practice, PISA is sponsored by Organization for Economic Cooperation and Development (OECD).

Indonesia's involvement in this activity is an effort to find out and evaluate educational programs when compared to other participating countries. This can be a reference in improving the quality of education so that its human resources can compete globally and not be left behind with other countries. At the start of following PISA in 2000 for matehmatics, Indonesia was ranked 39th from 41 countries with a score of 367. Three years later, Indonesia's score dropped to 360 and placed Indonesia in 38th out of 40 countries. In 2006, Indonesia ranked

50th out of 57 countries with a score of 391. The PISA results in 2009 ranked Indonesia 61th out of 65 countries with a score of 371 and ranked 64thout of 65 countries with a score of 375 in 2012 (OECD, 2013).

The result of study PISA can be seen that Indonesia has not been able to give birth a literacy generation. Indonesian junior high school studentsare very weak in solving non-routine problems (mathematic problems) that require reasoning to solve them. This is in accordance with the facts revealed by Sri (2011) that learning outcomes assessment instrument designed by mathematics teacher of Junior High School in Indonesia is less facilitate the students in developing the literacy ability so that the impact on the low achievement of student in the event of literacy assessment in the world.

Mathematical literacy within the PISA 2012 framework is defined as an individual's ability to formulate, use, and interpret mathematics in a variety of contexts, including the ability to do mathematical reasoning mathematically and use concepts, procedures, facts, as a tool to describe, explain and predict a phenomenon or event. This means that mathematical literacy can help individuals to recognize the role of mathematics in the real world and as a basis for consideration and decision-making needed by society (OECD, 2013).

Mathematical literacy involves the seven basic skills students must possess (OECD, 2010), namely: (1) Communication, the ability to communicate problems; (2) Mathematising, the ability to convert problems from the real world to mathematical form or otherwise; (3) Representation, the ability to restate a mathematical problem; (4) Reasoning and argument, the ability to give reasons; (5) Devising strategies for solving problems,the ability to use strategy to solve problems; (6) Using symbolic, formal and technical language and operation,the ability to use the symbols language, formal language and technical language; and (7) Using the mathematics tools, the ability to use mathematical tools, for example in measurement.

Literacy issues in the PISA study demand reasoning and problem-solving skills that emphasize the various problems and situations in everyday life. The capability tested in PISA are grouped into component processes (OECD, 2010), namely problem-solving ability, reasoning ability, communication skills.

The results of research showed that the ability of mathematical literacy and high order thinking skills of Junior High School students in Pekanbaru are still low (Syarifah, et al., 2015). This study only provides a general overview of students' mathematical literacy abilities. Therefore it needs to be studied more deeply about the basic capabilities that are part of mathematical literacy ability, in this case is the ability of mathematical reasoning and communication. It is based on the definition of the mathematical literacy which refers to the individual's ability to reason in giving explanations and justification (aspects of reasoning); and able to communicate explanation/argument and problem solving (aspects of communication). Mathematical reasoning and communication ability is one of the eight mathematical skills that junior high school students as a goal of learning mathematics mandated by Curriculum 2013 (PermendikbudNomor 58Tahun 2014).

Mathematical reasoning can be defined as the process of thinking that is done by drawing conclusions. A general conclusion can be drawn from individual cases. But it can be vice versa, from a general case to an individual case (Suherman and Winataputra in Yaya S. Kusumah, 2008).

Turmudi (2008) adds that the mathematical reasoning ability is the ability to express arguments that are essential for understanding mathematics. Mathematical reasoning is a habit of brain work that must be developed consistently by using various contexts.

In this study, the ability of mathematical reasoning to be studied are: (1) the ability to use patterns and relationships to analyze mathematical situations; (2) the ability to estimate the answers and solution processes; (3) the ability to provide explanations by using models, facts, traits, and relationships; and (4) the ability to draw logical conclusions.

The communication of mathematics can be interpreated as an event of dialogue or mutual relationships that occur in the classroom environment, resulting in the transfer of messages. The transferred messages contains about mathematics material learned in the form of concepts, formulas, or problem solving strategies. Theway messages can be transfer either orally or in writing.

According to the NCTM (2000), communication skills help students in the process of organizing ideas, connecting ideas with one other, and pouring ideas or ideas as ideas, verbally or in writing. UtariSumarmo (2003) argue that the students' mathematical communication skills can be seen abilities in: (1) connecting the real objects, images, and diagrams into mathematical ideas; (2) explaining the ideas, situations, and mathematical relations both orally and in writing with real objects, images, graphs and algebra; (3) declare everyday events in language or mathematical symbols; (4) listening, discussing, and writing about mathematics; (5) reading with the understanding of a written presentation; (6) making conjectures, formulating arguments, formulating definitions and generalization; and (7) explain and make mathematics questions learned.

In this study, mathematical communication skills to be studied are: (1) the ability to read with understanding of a written presentation; and (2) the ability of connect real objects, images, and diagrams into mathematical ideas.

This study was conducted to trace how the ability of mathematical literacy of junior high school students, especially in the aspect of reasoning and communication in geometry. Geometry is one part of mathematics that is very close to daily life of the students. Geometry is also one of the content tested on PISA, namely space and shape.

Methodology

This study is descriptive research. The population were all students of class IX of SMPN 20 and SMPN 23 Pekanbaru. Selections of students of class IX because it is assumed that students of class IX majority are 15 years old according to PISA study subject. From each schoola randomly selectedclass was chosen. Students from this selected classwere sample in this study with a total of 74 people.

The object in this study is the students' mathematical literacy in geometry. In the data collection used the test. The test is used to measure the ability of mathematical literacy, especially the ability of reasoning and mathematical communication. The question used instrument of PISA 2012which has been translated into Indonesian. Of the 60 items with 23 themes, the questions werw chosen for space and shape content (geometry), so the tested questions were 14 items with nine themes. The fourteen items have represented four contexts with details of two itemsusing a personal context, five itemsusing the occupation context, two items using the social context, and five items using a scientific context.

The question that have been answered by students was given a score. Scoring is done by using a rubric that is based on indicators of the ability of mathematical reasoning and communication. If the indicator of each the aspect is seen in the student's answer, it is given a score of 1. If the indicator is not visible, then the student is given a score of 0. To provide an overview of mathematical literacy of students in geometry, the answer of the students isanalyzed specifically in terms of mathematical reasoning and communication abilities.

Result and Discussion

In this research, the mathematical literacy ability isshown by the student's answer. Difficulty level or proportion of correct answer on each item indicates the level of student achievement on each item. From the results of the data processing, it is known that the average student score is 46.90 with standard deviation of 15.15. From the answer sheetit appears that quite many students are giving answers without explanation. This shows that students are less able to provide explanations/description/argument to the mathematics problems tested. The following presented the achievements of students' mathematical literacy in geometry studied based on reasoning ability and mathematical communication.

a. Literacy Achievement Based on Mathematical Reasoning Ability

The PISA questions of 2012 with geometric content are reviewed based on indicators of mathematical reasoning ability. Each item can be used to measure the ability of mathematical reasoning, with indicators that can be different for each item.There are even two items that contain two indicators of mathematical reasoning ability. The distribution of mathematical reasoning indicators for each item is presented in Table 1.

Table 1. Distribution of Indicators of Mathematical Reasoning by Problem Item

No.	Indicators of Mathematical Reasoning Ability	Number of Questions
1	Use patterns and relationships to analyze mathematical situations	2, 6, 8, 9, 10, 11, 13, 14
2	Estimate answers and solution processes	1, 3, 6, 8, 9, 10, 11, 12
3	Provide an explanation by using models, facts, properties, and relationships	1, 12, 13
4	Make logical conclusions	4, 5, 7, 14

The average number of students for each achievement of the mathematical reasoning indicator is presented in Figure 1.

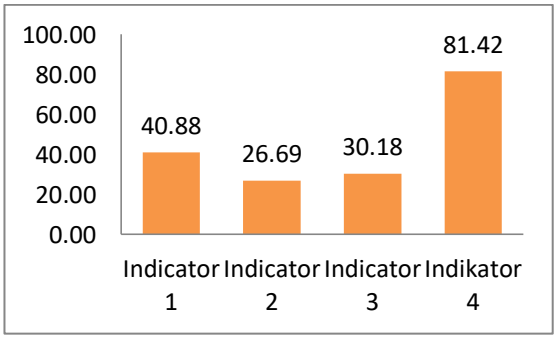

Figure 1Percentage of the number of students who achieved the mathematical reasoning ability indicator

From Figure 1, it can be seen that 81.42% of students achieving the fourth indicator, i.e. the ability draw logical conclusions. Students can estimate the position of an object on the basis

of rotation and time required in the game a ferriswheel. With the use of space capabilities, students can conclude another display of a three dimensional (seen from the front, back, or top). Students may also conclude that the central angle of a circle is the angle that is formed from two sectors of circles.

In this study, less than half the number of students (40.88%) whose have the ability to use patterns and relationships to analyze mathematical situations. Students have not been able to use Pythagoras's theorem in the real context that exists in everyday life. Students are only fixated that the Pythagorean theorems is used only to calculate the length of the oblique side of a right triangle. Some students have been able to analyze the mathematical situation in everyday life related to polygons and circles (arc length). Students also have the ability to use the pattern of wake (cube) which is constructed into an irregular wake up space.

For the third indicator, only 30.18% of students have the ability to provide explanations using models, facts, traits, and relationships. A third part of the number of students may indicate another way to determine the floor area of the house based on the four outermost sides of the floor. Some students can estimate the area irregularly using the facts contained in the picture.

The percentage of the lowest number of students in the aspect of mathematical reasoning is the ability to estimate the answers and the solution process. Students are able to analyze situations related to polygons and circles, but have not been able to perform mathematical operations to solve problems. Students are able to perform mathematical operations (measurements) if the size is clearly shown in the picture or discourse.

Of the four indicators of mathematical reasoning ability can be said that students' mathematical reasoning ability is still low. By using the PISA problem, found many students who have not solved these problems. The results of this study indicate that there are problems that cause low ability of students' mathematical literacy. One of them, as Sri (2011) has revealed about the lack of availability of learning tools that can support the development of mathematical literacy skills. The learning result assessment instrument designed by Junior High School mathematics teachers in Indonesia generally presents an instrument of learning outcomes that substance less facilitate students in developing literacy skills.

In order to solve a problem, students should use their reasoning to analyze any information useful in solving the problem. However, in this study only a few students were able to do so. Some of the things that can cause this are among other things related to the lack of the instrument of assessment of learning outcomes. Students have not been trained and are not accustomed to solving PISA-type problems that require a lot of reasoning ability. Students are fixated on routine issues that require simple completion in textbooks and memorized by the pattern of completion. Consequently, when given the same problem, but presented in different form, for example converted into contextual story, the student is unable to solve the problem.

b. Literacy Achievements Based on Mathematical Comunication Skills

Scoring of student answers to the questions given adapted to indicators of mathematical communication skills. Of the 14 geometry problems, there are two indicators of mathematical communication skills that must be owned by students to be able to solve them. Both indicators and their distribution on each item are presented in Table 2.

Table2. Distributionof Indicators of Mathematical Communication Capability by Problem Item

No.	Indicators of Mathematical Communication Skills	Number of Questions
1	Read with understanding a written presentation	3, 4, 7, 14
2	Connecting real objects, images, and diagrams into mathematical ideas	1, 2, 5, 6, 8, 9, 10, 11, 12, 13

The percentage of the average number of students for each achievement indicator of mathematical communication ability is presented in Figure 2.

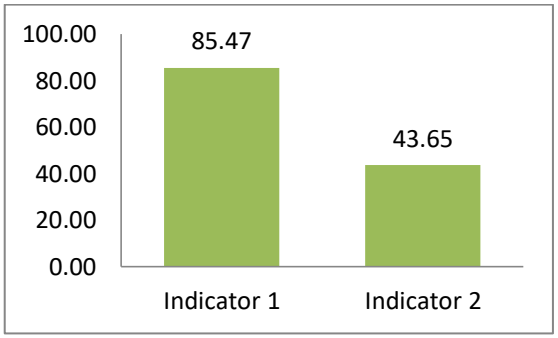

Figure 2Percentage of the number of students who achieved the indicator of mathematical communication ability

From Figure 2 it can be seen that the 85.47% of students achieving the first indicator, namely the ability to read with comprehension of a written presentation. This very clearly, because arguably no more students who could not read and write. Students are no longer read aloud like in elementary school, but students can already read the writing at once understanding the meaning/intent of the writing. Students' ability to understand the readings problems into initial capital to solve the problems. If students can able to understand the issue so students can plan and perform mathematical operations to solve the problem.

The ability of mathematical communication that still needs to trainedfor students is the ability to connect the real objects, images, and diagrams into mathematical ideas. The tested questions are complemented by image and discourse that help students to relate their mathematical situation. However, the images and real objects that are implied in the discourse has not been able to connect students into a mathematical idea.

Students are also have not been too fluent in using language and mathematics rules to express mathematical ideas appropriately. This is shown from the analysis of students answers. Some students complete the answer with incomplete sentences and present the steps of workmanship that is less precise because it is not in accordance with the rules. Students do not provide a sequence of process in working on the problem, such as not to like variables to be sought. Students also rarely give explanations on the steps of workmanship. This is caused by not trained students in working on the problem with the order the proper and systematic work.

When examining the communication aspects in this research, found the students who are less trained in communicating an idea or notion. Students are too fixated on short-term examples without understanding the concept.

Further guidance and instruction from teachers is urgently needed by students.Students misconduct should be immediately followed up so as not to get carried away causing a fatal mistake in its application. According to the National Council of Teacher of Mathematics (2000), assessment should support learning and provide useful information for teachers and students. By knowing what is mastered and

not mastered, students can find out the parts that must be improved and improved again.

Conclusion

Based on the results of research and discussion, it can be concluded that the ability of studentsmathematical literacy in SMP NegeriTampan Kota Pekanbaruin geometry is still low. This is seen from the student's average score of 46.90 and standard deviation of 15.15. Review of the aspects of mathematical reasoning abilities, students tend to be not able to use patterns and relationships to analyze mathematical situations, provide explanations using models, facts, traits, and relationships, and estimate answers and process solutions. Review of the aspects of communication, students tend to be not able to connect the real objects, images, and diagrams into mathematical ideas.

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