

Analysis of Mathematical Literacy Processes in High School Students

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ABSTRACT

The results of the Programme for International Students Assessment (PISA) survey published by the Organization for Economic Cooperation and Development (OECD) show that Indonesia is still a country with low mathematical literacy skills. The ability of mathematical literacy is closely related to interpreting contextual problems into mathematical language. In modern times like today, what is needed is not only mathematics as arithmetic, but also mathematical literacy is needed related to mathematical reasoning and problem solving. The government has included contextual aspects of the curriculum applied in schools. However, in reality many schools still do not have contextual abilities that are in line with the still low literacy abilities of students in Indonesia. The purpose of this study is to describe the mathematical literacy process in senior high schools which in this study were students with majoring in science and students with majoring in social studies. This type of research is descriptive qualitative research. The research subjects were grade X students majoring in science and majoring in social studies. The instruments used in this study were the authors themselves, math literacy questions sheets, and interview guidelines. The results showed that the mathematics literacy process of high school students obtained was both students with majoring in Natural Sciences and students with majoring in Social Sciences are 1) The social science students have been able to reasoning and planning to solve the problem well, even though there still mistakes. The natural science students well in calculation and use formula. However, the natural science students are unable not to argue mathematically and express opinions. 2) the social science students are not good at reasoning and planning to solve the problem, however well in express what students thought verbally. For diagrams translate and solve to math language, the students from social science still difficult. Use of formula in natural science students still not right.

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1. INTRODUCTION.

The ability to interpret mathematics in various life contexts including mathematical reasoning, using concepts, procedures and facts to describe, explain and estimate phenomena or events is known as mathematical literacy. The ability of mathematical literacy helps humans to understand the role and usefulness of mathematics in life and can be used to make correct decisions as educated humans. With mathematical literacy skills, humans can solve problems related to various contexts in life mathematically according to mathematical principles. In modern times like today, we not only need mathematics as an arithmetic, but also require mathematical literacy related to reasoning and problem solving mathematically.

The importance of mathematical literacy for students in Indonesia is not in harmony with Indonesia's achievements in the International. One survey of capabilities that includes aspects of mathematical literacy in it and carried out at the international level is PISA (Program for International Students Assessment). In the PISA report published by the Organization for Economic Cooperation and Development (OECD), in the field of mathematical literacy, in 2009 Indonesia was ranked 68th out of 74 PISA participants, in 2012 Indonesia was ranked 64th out of 65 PISA participating countries, and the latest in 2015 Indonesia was ranked 65th out of 72 PISA

participating countries (Appendix 2). From the achievements of Indonesia's ranking which is still ranked below, it can be seen that Indonesia is still a country with low mathematical literacy skills. Even though mathematical literacy is one aspect that is considered important and used in problem solving in real life students.

Until now, there has been no specific study that states that mathematical literacy is related to exact or social abilities because basically all majors of both special and social specialization both require literacy skills both in learning efforts and in solving students' daily problems. Through initial research by giving the soat test to two classes at SMAN 1 Muaro Jambi, namely class X IPA 5 and class X IPS 3, researchers found that the lack of mathematical literacy skills in both classes was seen from the way they answered the questions. Students in class X of IPA 5 generally answered more questions than students in class X IPS 3, but in both classes there were still many students who answered incorrectly especially in mathematical modeling.

From the results of the initial research, researchers finally assumed that there were many factors that influence the students' mathematical literacy skills at Muaro Jambi Senior High School 1, and students with different specialization majors also had different

abilities and thinking patterns in working on mathematical literacy questions. Based on the explanation above, the author took the topic of research concerning the analysis of the mathematics literacy process of students viewed from the majors of specialization. In this study, it will explain how the mathematical literacy process of students with majoring in Natural Sciences and how the mathematical literacy process of students with majoring in social studies. The author took the place of research at Muaro Jambi State High School where at the school the majors in the specialization of students were based on a number of tests so that the students who had been grouped were considered as they should be.

Mathematical literacy in PISA (Program for International Students Assessment) is defined as the ability of individuals to formulate, use, and interpret mathematics in various contexts (OECD 2016). This includes mathematical reasoning and the use of concepts, procedures, facts and mathematical tools to describe, explain, and predict phenomena. This leads individuals to recognize the role of mathematics in life and make good judgments and decision making needed by constructive, reflective residents.

From this understanding it can be interpreted that mathematical literacy is not only needed in mastering the material but also needed in reasoning, concepts, facts and mathematical tools to solve everyday problems. Mathematical literacy also familiarizes students in communicating mathematics in problems in their lives and everyday phenomena and trains students to be able to explain the phenomena they face in mathematical language that are short and clear.

Mathematical literacy consists of 6 levels, each level measuring different mathematical knowledge. The higher the level, the more complex the knowledge needed to answer the problems given. The levels of the students' mathematical abilities are:

Table 2.1 Student's mathematical ability level

Level	Description
1	Students can use their knowledge to solve routine problems, and can solve problems that are in a general context
2	Students can interpret problems and solve them using formulas
3	Students can carry out procedures well in solving problems and can choose problem solving strategies
4	Students can work effectively with models and can choose and integrate different representations, then connect them to the real world
5	Students can work with models for complex situations and can solve complex problems
6	Students can use their reasoning in solving mathematical problems, can generalize, formulate and communicate their findings

2. RESEARCH METHOD

The approach in this study uses a descriptive approach. Descriptive research is a type of research that is widely used in the world of education, especially in the field of research in educational psychiatrists. The thing described in this study is how the mathematical literacy process of students who are majoring in specialization either in the Department of Natural Sciences or who are often called the majors of science and majoring in Social Sciences or who are often called social majors. In addition to describing the students' literacy process in each of the specialization majors, this study also describes the results of research on the presence or absence of a relationship between majors of specialization with the students' mathematical literacy process where it is known that the material taught in these two

departments is different.

The data sources in this study were 2 students, each one student in class X MIPA 5 and 1 student in class X IPS 3 in SMA Muaro Jambi 1 semester of the academic year 2017/2018. Class selection is based on the consideration of the mathematics teacher who argues that class X MIPA 5 and X IPS 3 is a class in which there are students who are consistently enthusiastic in learning especially mathematics.

3. RESULT AND DISCUSSION

3.1 Results of Determination of Research Subjects and Data Collection Methods

Determination of research subjects originated from the results of observations and interviews with mathematics teachers at the school which was the location of the study, namely, SMA 1 Muaro Jambi. The researcher got two classes that were suitable for the purpose of the study. The two classes chosen are classes with high interest in learning mathematics and are active in mathematics learning, this is important considering that in this study a good response from students is needed during the research process in order to be able to gather complete information in terms of students' mathematical literacy processes. The two classes consist of one class with science majors and one class with IPS majors.

The two classes that were chosen were then given initial tests using math literacy test questions. It aims to select students who will be the subject of research. The criteria for research subjects that have been determined by researchers are 1) students with high mathematical literacy skills and mathematical literacy skills who are currently in each class, 2) students with a good interest in learning and have a response and good communication skills, 3) students who willing and willing to volunteer to be the subject of research.

The first class given the math literacy test question is class X IPA 5. The test is conducted on Monday May 5 2018. The duration of the test is 65 minutes with 24 items. Based on the workmanship of the question 15 students were selected with the results of the answers to the questions correctly above the class average which is above 4.97. Then from 15 students, one student was chosen with the most number of correct answers. After being discussed with the mathematics teacher who taught was a student with a good interest in learning mathematics and actively communicating his opinion well in class so that it met the research needs. Then the students with the most correct answers are given the code S.A.

The second class that was given the math literacy test question was class X IPS 1. The initial test was conducted on May 7, 2018. Based on the test results obtained the average number of correct answers 3.37 and 14 students who answered correctly above average were taken that is. Then one student with the most correct number was then selected, then given the code S.S.

3.2 Student's Mathematical Literacy Process Selected as Subject

The most important part of mathematical literacy is the mathematical process. The process in question is the process of formulating, using, and interpreting, and evaluating mathematics from various contexts (Sari, 2015). In reality there are still many students who have difficulty doing it. Likewise with the results obtained by researchers.

Based on the results of the research on the math literacy test sheet and interview results, the overall subjects of S.A and S.S have not fulfilled all mathematical literacy competencies in the questions given both in stage I and stage II. Students' mathematical literacy skills can be seen from how students use mathematical abilities and skills to solve problems that might occur in various situations or contexts that relate to each individual.

According to Sumarmo and Permana (2007: 117) reasoning is a thought process in the process of drawing conclusions. With mathematical reasoning, students can submit suspicions then submit evidence and manipulate mathematical problems and draw conclusions correctly and precisely. The achievement indicators for mathematical thinking and reasoning in this study are to draw logical conclusions, provide explanations using models, facts, traits, and relationships, and use patterns and relationships to analyze mathematical situations, draw analogies and generalizations.

From the results of the research, in solving this part of the problem, when S.A reads the question, he understands the questions given. However, it is quite difficult to express what he thinks and the difficulty in drawing conclusions from the results he has obtained. While S.S tries to connect between available paint cans and available funds. However, S.S has not been able to provide a reason for the patterns and relationships that he made. When interviewed, S.A and S.S2 often looked confused and mumbled more.

In fact, reasoning ability is one of the goals in mathematics learning, namely to train ways of thinking and reasoning in drawing conclusions, developing problem-solving skills, and developing the ability to convey information or communicate ideas through oral, written, drawing, graphics, maps and diagrams (Sumartini, 2015).

NCTM (2000) stated (Umar, 2012) conceptual mathematical understanding can be built through problem solving, reasoning, and argumentation. The meaning of argumentation in this case certainly involves the ability to communicate both verbally and in writing. From the results of the study, S.A was able to argue well. S.A knows what is mathematically proven and how that proof is from the other mathematical evidences. First, he calculated the area, then the wall area was reduced by the door area with the window area. However, S.S claimed that he was also confused by the solution. S.S is also not sure about the answers he wrote.

To be able to argue, students must be able to know what is mathematically proven and how the proof is from the other mathematical evidences. In addition, students must be able to make logical mathematical arguments and justify the reasons.

Communication skills are important in all disciplines. In mathematics education, communication skills are one of the high-level abilities students must possess. Mathematical communication is the ability to communicate which includes the use of writing skills, listening, studying, interpreting, and evaluating ideas, symbols, terms, and mathematical information observed through the process of listening, presentation, and discussion (Ramdani, 2012)

One of the indicators is that students must be able to explain ideas, situations, and mathematical relations, verbally or in writing, with real objects, images, graphics and algebra, expressing daily events in a language or mathematical symbol S.A has been able to connect real objects, drawings, and diagrams into mathematical ideas, and get results obtained. S.A claimed to have seen the same problem before and understood what was described by the diagram. However, S.S has not been able to communicate it in the answer sheet. S.S said that what was reduced was the result of selling fruit.

This means that S.S knows the purpose of the problem, only it can communicate mathematical ideas verbally.

The modeling process begins by conceptualizing several problem situations. Followed by simplification, structuring, and making the situation more appropriate in accordance with the knowledge, goals, and interests of the problem solver which then leads to the specification of the problem. The first step in the modeling process is to understand the situation of the problem that is given for later construction (Sari, 2015). This is done by S.A. First, he looks at the shop diagram, then selects the store that produces the most sales. Whereas S.S said he did not understand the purpose of the matter.

According to Edo (Edo, 2013) students experience difficulties in the process of formulating problems in everyday life into mathematical models. This was found in S.S which did not write down what was known on the question and what was asked. As a result, S.S cannot identify problems and make settlement plans.

In addition, student difficulties also lie in evaluating the reasonableness of mathematical solutions in real-world contexts. But according to him, students do not have problems in completing the mathematical models they have built. This was found in S.A who completed the mathematical model that he had made and carried out the calculation (carrying out the plan) carried out the plan. However, there are those who are wrong in their steps to get the wrong results.

In presenting the problem situation, students need to construct a model of the main components of the problem. To present the problem accurately, students must understand the situation and the main key issues to determine the elements of mathematics and ignore elements that are not relevant. This step can be facilitated by making drawings / diagrams, writing equations, or creating more appropriate forms of representation (Herman, 2007).

This is done by S.A. S.A describes the sizes of ceramics that exist and looks for the size of ceramics that do not have much residue. Students who have good strategic competence, are not only able to solve non-routine problems in various ways, but must have the ability to be flexible in choosing strategies, such as trial and error, algebraic methods, or other means, which are right to answer problems according to demand and situation (Herman, 2007) However, S.S answered that he still did not understand because he did not think of getting there, S.S said he did not understand.

4. CONCLUSION AND SUGGESTIONS

Based on the results of the study it can be concluded that the mathematics literacy process of high school students obtained is both students with majoring in science (S.A) and students with majoring in Social Sciences (S.S) as a whole have not had good literacy skills because both have not fulfilled literacy competencies mathematics. However, S.A has almost approached literacy competencies which are expected even though there are still many mistakes in the mathematical literacy process such as errors in mathematical reasoning, S.A's uncertainty in arguing and communicating the answers, errors in drawing conclusions, and modeling and formulation of problems that are still inaccurate both its use and explanation of the formula itself. Whereas S.S has not fulfilled all mathematical literacy competencies including S.S not correct in reasoning where S.S only estimates the answer without any thought process in its solution. In arguing and communicating the answers S.S is still unsure and doubtful and in some answers S.S is not even able to provide an explanation. Solving the S.S

problem is still low in terms of solving problems that only estimate answers without a thought process. In addition, the use of S.S formulas and mathematical modeling is still not appropriate.

The suggestion from the writer is that it is expected that the mathematics learning process is carried out based on real problems faced by students so that mathematics can be the solution to students' daily problems and mathematics can be more real for students. Through this research, it is expected that all parties can pay more attention to the importance of the ability of mathematical literacy and can seek to increase mathematical literacy skills in Indonesia where Indonesia's overall mathematical literacy abilities are still low.

REFERENCES

- Edo, S. I. (2013). Investigating Secondary School Students Difficulties in Modeling Problems PISA-Model Level 5 And 6. *Indo MS. J,M,E*, 41-58.
- Herman, T. (2007). Pembelajaran Berbasis Masalah untuk Meningkatkan Kemampuan Penalaran Matematis Siswa SMP. Bandung: Cakrawaa Pendidikan UPI.
- Johar, R. (2012). Domain Soal PISA untuk Literasi Matematika. *Jurnal Peluang*, 1-14.
- Lange, J. D. (2006). Mathematical Literacy For Living From OECD-PISA Perspective. *Tsukuba Journal of Educational Study in Mathematics*, 25-39
- OECD. (2016). *Mathematics Framework*. Paris: OECD Publishing.
- Permana, U. S. (2007). Mengembangkan Kemampuan Penalaran Koneksi Matematik Siswa SMA Melalui Pembelajaran Berbasis Masalah. *Educationist*, 116-123.
- Ramadani, Y. (2012). Pengembangan Instrumen dan Bahan Ajar untuk Meningkatkan Kemampuan Komunikasi Penalaran dan Koneksi Matematis dalam Konsep Integral. *Jurnal Penelitian Pendidikan FMIPA UNISBA*, 44-52.
- Sari, R. H. (2015). Literasi Matematika: Apa, Mengapa, dan Bagaimana. Seminar Nasional Matematika dan Pendidikan Matematika UNY (p. 715). Yogyakarta: UNY.
- Sumartini, T. (2015). Peningkatan Kemampuan Penalaran Matematis Siswa melalui Pembelajaran Berbasis Masalah. *Jurnal Pendidikan Matematika*, 1-10.
- Umar, W. (2012). Membangun Kemampuan Komunikasi Matematis dalam Pembelajaran Matematika. *Jurnal Ilmiah Program Studi Matematika STKIP Siliwangi Bandung*, 1-1