The Students' Weaknesses in Solving the Problems Related to Mathematics Literacy

Dani Kusuma[1*], Y.L Sukestiyarno[2], Wardono Wardono[2], Adi Nur Cahyono[2]

[1]Universitas Negeri Semarang, Doctoral Student of Graduate School, Indonesia,

[2]Universitas Negeri Semarang, Department of Mathematics, Faculty of Mathematics and Natural Science, Indonesia

* Corresponding Author: kusumadani021@students.unnes.ac.id

Abstract. Literacy ability is the ability to formulate, apply, and interpret daily life problems into mathematical form. In this case, mathematical literacy is an ability that needs be mastered by the students. The purpose of this study is to investigate the weaknesses of the students in solving problems related to mathematical literacy. This research is a descriptive qualitative research by using triangulation in conducting data analysis. The triangulation refers to the triangulation between the results of student work, interviews, and observations. The subjects in this study are 15-years old students. Then, the instruments used in the study are mathematical literacy tests, interview guidelines and observation guidelines. The results show that in the process of solving the mathematical literacy problems, students experience difficulties in the process of understanding the problem in mathematical form, known as mathematising. Therefore, the obstacles in the mathematising process result in students' ability to complete the next stage. The problems found from the research show that students are less familiar with literacy-based questions so that they have difficulty in the process of understanding

Key words: Mathematics Literacy; PISA; academic outcomes; academic achievements.

How to Cite: Kusuma, D., Sukestiyarno, Y. L., Wardono, W., Cahyono, A. N. (2021). The Students' Weaknesses in Solving the Problems Related to Mathematics Literacy. *ISET: International Conference on Science, Education and Technology*, *7*(1), 731-735.

INTRODUCTION

Literacy ability is one of the mathematical abilities that a person needs in the process of achieving good and fluent mathematical abilities. Literacy ability is an ability that is the focus and priority to be mastered by students in Indonesia from primary to secondary education levels. Literacy skills are one of the main topics in the PISA test organized by the OECD, which include reading literacy skills, mathematical literacy skills and scientific literacy. The importance of achievement in literacy skills is a benchmark for students in several countries. Literacy is a person's main ability to be able to absorb information correctly. Literacy is a person's ability to process and understand information while doing the reading and writing process. Literacy is the ability to read and write fluently (Cambridge Assessment 2013). There are five main points of literacy, namely knowing the information needed; find and evaluate the quality of information; store and retrieve information; use information effectively and ethically; apply information to create and communicate knowledge (Catts and Lau 2008).

In learning mathematics literacy, understanding of mathematical topics is very important because students' understanding depends on reading comprehension. According to OECD/PISA mathematical literacy is the ability of students to analyze, reason, and communicate ideas/thoughts effectively, formulate, solve and interpret mathematical problems in various situations (OECD 2017). Mathematical literacy is an individual's awareness and understanding of the application of mathematics in real life, and has an assessment based on standard meanings and uses mathematics for their needs as humans (Ilhan, Tutak, and Celik 2019; Umbara and Suryadi 2019). Indirectly, mathematical literacy is not only understanding mathematical concepts but also being able to solve problems in life using mathematics (NCTM 2000). The results of the last PISA test show that in general the mathematical literacy skills of students in Indonesia who are in the low category with new literacy levels enter level 2 of 6 levels of mathematical literacy abilities. So it is necessary to increase students' mathematical literacy skills. In more depth, the low ability of mathematical literacy results in educational schemes that are changed and encouraged in improving mathematical literacy skills (Anggraeni 2019). Efforts to improve mathematical literacy skills are needed a habituation of students in working on and solving problems related to mathematical literacy. Based on the description that has been described shows that, literacy skills are very important and pursued systematically in the education system so that literacy skills become better. The aspect of concern in this study is the

weakness of students in students' weaknesses in solving problems related to literacy. This study aims to determine the difficulties of students in the process of solving problems related to mathematical literacy.

METHOD

Research Goal (Sub-titles should be italic and not bold)

This research is a descriptive qualitative research, relating to students' weaknesses in mathematical literacy skills. The purpose of this study was to determine the students' weaknesses in the process of solving problems related to literacy skills related to everyday

Sample and Data Collection

subjects in this study were 30 grade 7 junior high school students in Salatiga City. Then 3 subjects were selected with low mathematical literacy test results. Collecting data using tests related to mathematical literacy and then conducting in-depth interviews with research subjects in order to obtain the results of the study.

Analyzing of Data

Analysis was carried out by triangulating data which included test results, observations and interviews with research subjects.

RESULTS AND DISCUSSION

The results show that the mathematical literacy process consists of 3 main components, namely formulate, employ, and interpret. The process is analysed and described as follows.

Formulate

The formulate process is a process to formulate a problem related to everyday problems into mathematical form. Based on the results of student work, it shows that in the process of formulating students do not experience many difficulties for questions with easy levels, namely levels 1 and 2. However, for higher levels, namely levels 4, 5, and 6 students have difficulty in formulating in mathematical form. Here is one view of the process of working on the subject.

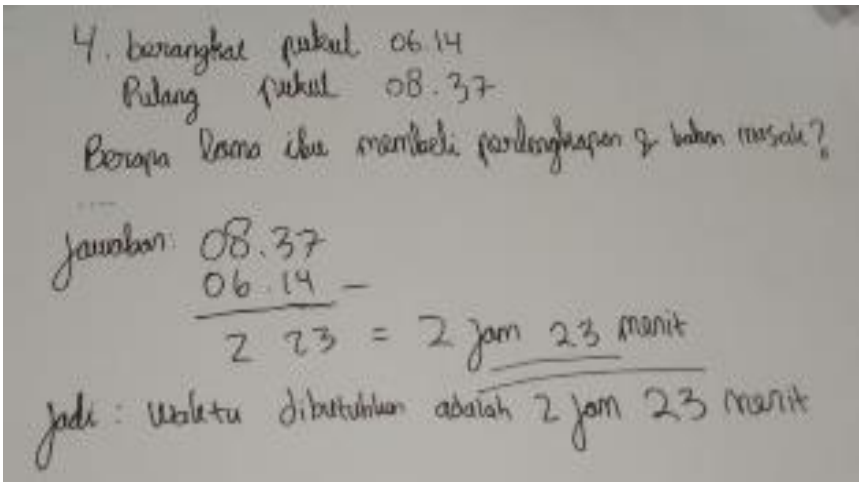


Figure 1. Formulate Process

Based on the results of the subject's work, it shows that in the process of working the subject is able to translate questions in mathematical form. Based on the indicator of mathematical literacy, it is included in the mathematising indicator. Mathematising is an indicator in changing the form of problems in solving mathematics. The weakness of students in this process is the low ability of students to solve more complex problems and have more than 1 completion stages. Based on Figure 1 shows that questions with simple levels and not too complicated, can be easily understood and solved by students. The results of the interviews showed that the difficulties experienced by students were caused because students were not used to solving problems with similar models and levels of difficulty.

Employ

The employ process is a process in applying mathematical principles in solving problems related to mathematical literacy. Students' difficulties in the employ process are shown in questions with difficulty levels at levels 4,5, and 6. The following is an example of a question related to the employ process

7. Ayah Ruben berencana untuk membeli sebuah mobil keluarga. Terdapat 4 pilihan mobih yang mungkin dapat dibeli oleh Ayah Ruben. Berikut model dan spesifikasi dari keempat mobil tersebut.

Model	Avansa	Xenia	Xpander	Mobilio
Tahun	2019	2018	2020	2020
Harga	Rp. 131.000.000,-	Rp. 120.000.000,-	Rp. 145.000.000,-	Rp. 137.000.000,-
Jarak Tempuh (km)	105.000	115.000	128.000	109.000
Kapasitas mesin (liter)	1,49	1,496	1,52	1,481

Berdasarkan tabel diatas, manakah mobil yang memiliki kapasitas mesin paling kecil?

Figure 2. Problems in the Employ process

Figure 2 is an example of the application of the employ process in the ability test mathematical literacy. These questions condition the subject to be able to apply his abilities related to understanding related to the concept of fractions. Subjects who have a good understanding of the concept of fractions do not experience much difficulty in solving the problem. The following is one of the subject's work processes in solving problems.

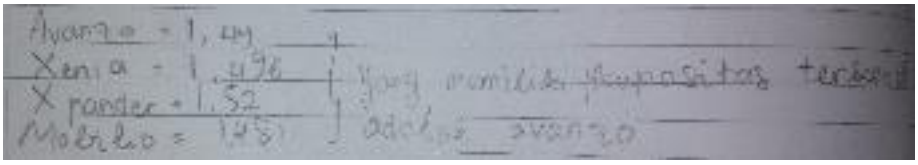


Figure 3. Subject work in the Employ process

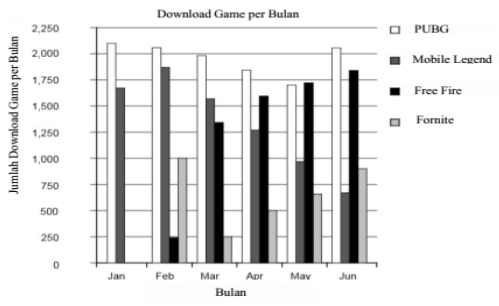
The results of the subject's work show that the subject is able to understand the problem but has not been able to complete and make conclusions from the information that has been obtained. This shows that the subject has not understood the concept of fractional numbers well, as a result, is unable to make the right final conclusion.

Based on the results of the interview, it was found that the subject had understood the problem and the solution that had to be done. However, after being asked a question regarding the conclusion, the subject showed a wrong understanding in the process of concluding. In addition, the subject has not been able to distinguish the magnitude of the number after the comma. This understanding resulted in the subject's error working. Based on the PISA indicators, the subject is not yet capable of Using symbolic, formal, and technical language and operations.

Interpret

Interpret is a process of interpreting everyday problems in mathematical form, it can be in the form of graphs. The following is one of the questions related to the interpreting process.

Daftar jumlah download game online perbulan di tahun 2020



Berdasarkan gambar diatas, game Free Fire pertama kali lebih banyak di download dibandingan game Mobile Legend terjadi pada bulan ….

Figure 4. Literacy problems in the interpreting process

Interpretation questions are examples of questions in interpreting graphs so that students' abilities in the process of interpreting graphs can be measured. Based on the PISA indicator, this is in accordance with the representation indicator, namely interpreting information related to everyday life into mathematical form. Based on the results of the students' work, the majority were able to work on these questions. The results of the interviews showed that in the process of working the students did not experience many problems in understanding the context of the reading and were able to interpret it in the form of an appropriate solution. The difficulties experienced by students are in the process of accuracy and focus on the work process. Errors that arise due to inaccuracy by the subject.

Based on the results of the subject's work from the formulate, employ, and interpret processes, it shows that students' difficulties are caused by students' ability to understand the topic of problems in mathematical literacy problems. Research Wardono et al. (2018) the achievement of mathematical literacy skills based on students' understanding of the context of the problems at hand. So that students' initial understanding at the stage of mathematising, communicating, representation, reasoning and argument is very important in the process of solving problems in mathematical literacy (Bilican Demir 2018; Fadholi, Waluya, and Artikel 2015; Purwanti et al. 2019). Another aspect that affects the achievement of students' mathematical literacy skills is caused by the lack of students usually in dealing with literacy-based problem-solving problems related to everyday life. Habituation in the learning process affects the way students solve and find solutions to problems (Botha and van Putten 2018; Ding and Homer 2020; Sugandi 2013).

The findings in this study are that in the process of working on the problem, it shows that mathematical literacy questions that have a high level of complexity make it difficult for the subject to understand the problem. Subjects tend to understand problems that have one to 2 steps of completion. The more complicated the problem in the problem makes it difficult for the subject to make a solution completion step (Sanjaya et al. 2019; Ünlü and Ertekin 2013).

CONCLUSION

Based on the description that students' mathematical literacy abilities, shows that the difficulties experienced by students in the mathematical literacy process are caused by understanding and habits in the process of solving problems related to mathematical literacy. Students' ability to understand problems at an early stage in both the process of formulating, employing, and interpreting has an impact in the smoothness of students solving problems. The difficulties that students experience are based on the lack of facing similar problems, in addition, the more gradual the completion rate the more difficult students can solve.

REFERENCES

Anggraeni, Prastika Ririt. 2019. "Implementasi Kebijakan Literasi Sekolah Guna Peningkatan Karakter Gemar Membaca." *Indonesian Journal of Sociology, Education, and Development* 1(2):132–42. doi: 10.52483/ijsed.v1i2.12.

Anon. 2021. "Pisa 2021 Mathematics Framework (Draft)." (November 2018).

Bilican Demir, Safiye. 2018. "The Effect of Teaching Quality and Teaching Practices on PISA 2012 Mathematics Achievement of Turkish Students." *International Journal of Assessment Tools in Education* 5(4):645–58. doi: 10.21449/ijate.463409.

Botha, Hanlie, and Sonja van Putten. 2018. "How Mathematical Literacy Teachers Facilitate Mathematisation in Modelling Situations." *African Journal of Research in Mathematics, Science and Technology Education* 22(1):93–102. doi: 10.1080/18117295.2018.1437337.

Cambridge Assessment. 2013. "What Is Literacy? An Investigation into Definitions of English as a Subject and the Relationship between English, Literacy and 'Being Literate' A Research Report Commissioned by Cambridge Assessment." *Cambridge Assessment* (January):24.

Catts, Ralph, and Jesus Lau. 2008. "Towards Information Literacy Indicators." *Statistics* 7:2008.

Ding, Huiming, and Matt Homer. 2020. "Interpreting Mathematics Performance in PISA: Taking Account of Reading Performance." *International Journal of Educational Research* 102(December 2019):101566. doi: 10.1016/j.ijer.2020.101566.

Fadholi, Taufik, Budi Waluya, and Info Artikel. 2015. "Analisis Pembelajaran Matematika Dan Kemampuan Literasi Serta Karakter Siswa Smk." *Unnes Journal of Research*

Mathematics Education 4(1):42–48.

Faridh F, Ahmad R., Scolastika Mariani, MTs NU Al Hikmah Semarang, Jl Kyai Aji, Kota Semarang, and Jawa Tengah. 2019. "Mathematical Literacy Based On Student's Self-Regulated Learning by Flipped Classroom with Whatsapp Module." *Unnes Journal of Mathematics Education Research* 8(2):125–32.

Fery, Muhamad Firdaus, Wahyudin, and Herman Tatang. 2017. "Improving Primary Students Mathematical Literacy through Problem Based Learning and Direct Instruction." *Educational Research and Reviews* 12(4):212–19. doi: 10.5897/err2016.3072.

Ilhan, Aziz, Tayfun Tutak, and Halil Coskun Celik. 2019. "What Is the Predictive Power of Visual Mathematics Literacy Perception and Its Sub-Dimensions for Geometry Success?" *Eurasian Journal of Educational Research* 2019(80):1–24. doi: 10.14689/ejer.2019.80.1.

Lestariningsih, L., S. M. Amin, A. Lukito, and M. Lutfianto. 2018. "Students' Mathematisation in Solving Mathematical Literacy Problems with Space and Shape Contents." *Journal of Physics: Conference Series* 1108(1). doi: 10.1088/1742-6596/1108/1/012083.

NCTM. 2000. *Principal and Standards for School Mathematics*. NCTM Publications.

OECD. 2017. "PISA for Development Assessment and Analytical Framework." *OECD Publishing*.

Purwanti, K. L., Sukestiyarno, B. Waluya, and Rochmat. 2019. "Mathematical Literacy Ability with RME (Realistic Mathematics Education) Approach in Fifth Grade Students." *Journal of Physics: Conference Series* 1321(2). doi: 10.1088/1742-6596/1321/2/022118.

Rahmawati, and Mahdiansyah. 2014. "Literasi Matematika Siswa Pendidikan Menengah : Analisis Menggunakan Desain Tes Internasional Dengan Konteks IndonesiaRahmawati, and Mahdiansyah. "Literasi Matematika Siswa Pendidikan Menengah : Analisis Menggunakan Desain Tes Internasional Dengan Konteks." *Jurnal Pendidikan Dan Kebudayaan* 20:452–69.

Sanjaya, Febi, W. P. Dewa Putu, Hongki Julie, Ant Yudhi Anggoro, and M. Andy Rudhito. 2019. "The Mathematics Education Department Students' Ability in Mathematical Literacy for Uncertainty Problems on PISA Adaptation Test." *Journal of Physics: Conference Series* 1366(1). doi: 10.1088/1742-6596/1366/1/012082.

Sugandi, Asep Ikin. 2013. "Pengaruh Pembelajaran Berbasis Masalah Dengan Setting Kooperatif Jigsaw Terhadap Kemandirian Belajar Siswa Sma." *Infinity Journal* 2(2):144. doi: 10.22460/infinity.v2i2.31.

Suryadi, Didi. 2019. "Re-Interpretation of Mathematical Literacy Based on the Teacher ' s Perspective." 12(4):789–806.

Thomson, Sue, Kylie Hillman, and Lisa De Bortoli. 2013. *A Teacher 's Guide to PISA Mathematical Literacy*.

Umbara, Uba, and Didi Suryadi. 2019. "Re-Interpretation of Mathematical Literacy Based on the Teacher's Perspective." *International Journal of Instruction* 12(4):789–806. doi:10.29333/iji.2019.12450a.

Ünlü, Melihan, and Erhan Ertekin. 2013. "The Relationship between Mathematics Teaching Self-Efficacy and Mathematics Self-Efficacy." *Procedia - Social and Behavioral Sciences* 106:3041–45. doi: 10.1016/j.sbspro.2013.12.350.

Wardono, B. Waluya, Kartono, Mulyono, and S. Mariani. 2018. "Development of Innovative Problem Based Learning Model with PMRI-Scientific Approach Using ICT to Increase Mathematics Literacy and Independence-Character of Junior High School Students." *Journal of Physics: Conference Series* 983(1). doi: 10.1088/1742-6596/983/1/012099.