

CHAPTER I

PRELIMINARY

1.1 Background

The projection of education in the 21st-century is centered on the developments of the industrial revolution 4.0 era (Mardhiyah et al, 2021). The rapid growth of the industrial revolution era demands that the education world constantly transform to produce human resources who are capable of keeping up with the pace of science and technology development (Janah et al, 2019; Mardhiyah et al, 2021). In this case, Indonesian education must be able to prepare students with various 21st-century skills as capital to compete and adapt themselves. Some of these skills are critical thinking skills, communication and collaboration skills, social and cross-cultural skills, and information literacy (Wijaya, 2016).

The urgency of developing 21st-century skills as a fundamental skill that students must have at this time has received attention from various parties. There are several ways to develop 21st-century skills, and one of them is through mathematics. This idea is consistent with the statement proposed by Saputri et al. (2019) that mathematics as scientific thinking means plays an essential role in the evolution of 21st-century knowledge and skills. Mathematics as a discipline also provides unique processes, knowledge, and skills as well as opportunities through an exploration of key math concepts to connect school-based learning into interdisciplinary themes which are important for each student's ability to thrive as a global citizen (P21, 2012).

Through mathematics, students can find ways to solve problems and create ways of thinking about the world around them. Szabo (2020) revealed that 21st-century skills could be acquired and taught through mathematics because teachers can actively involve students in complex mathematical tasks and develop students'

strategic thinking, which impacts personal and professional life circumstances. Mathematics no longer only requires students to have numeracy skills but also the capability to think logically and critically (Setyaningsih and Munawaroh, 2022). Furthermore, students are also required to be able to solve problems through logical and critical reasoning (Masjaya and Wardono, 2018; Fadillah and Munandar, 2021). Thus, studying mathematics will develop students' 21st-century skills through increasing reasoning abilities, critical thinking, and logical thinking in solving problems.

As a preparation for facing the demands of the 21st century, learning mathematics must be able to develop and facilitate students to "identify data sources, access data, evaluate data critically, and use it as material for exploring various questions about the world" (P21, 2012). Those abilities are included as information literacy abilities. Several studies by P21 (2012) also show that information literacy as a result of learning mathematics is in line with the practice of mathematics involving argument development, criticizing other people's reasoning, and seeking and expressing regularities in repetitive reasoning. Characteristics of information literacy skills in solving problems related to information literacy require students to recognize the identity of reference problems and to be competent in finding and distinguishing between relevant and irrelevant information (Wijaya, 2016). Interestingly, these competencies are also known as characteristics of mathematical literacy which shows how information literacy and mathematical literacy have the same features (Wijaya, 2016).

Mathematical literacy is one of the abilities needed to build students' 21st-century skills (Anggoro et al, 2019; Rizki and Priatna, 2019; Nurutami et al, 2018). However, the results of the Program for International Student Assessment (PISA) by the Organization for Economic Cooperation and Development (OECD) which aims to measure world-15 years old-students abilities in mathematical literacy, reading literacy, and scientific literacy for every 3 years implementation period shows that Indonesia continues to be in the top 10 lowest ranking of all PISA participating countries in the category of mathematical literacy. The PISA assessment is used because it can measure students' cognitive skills in the literacy

aspect to map the ability to construct information and integrate knowledge in new contexts (Hewi and Shaleh, 2020). The following are the results of the Indonesian PISA test in 2000 - 2018

Table 1.1 Indonesian PISA Test Result for 2000-2018

Year	Indonesian Mathematical Literacy Score	OECD Average in the Mathematical Literacy Category	Mathematical Literacy Rating	PISA Rating	Total Participating Countries
2000	367	500	39	39	41
2003	360	500	38	38	40
2006	391	498	50	50	57
2009	371	496	61	57	65
2012	375	494	64	64	65
2015	386	490	63	64	72
2018	379	489	73	74	79

Source : Data processed from (OECD, 2019)

Based on table 1.1 of Indonesia's PISA test results for 2000-2018, Indonesia's mathematical literacy score is constantly below the OECD average standard. This condition indicates that Indonesian students' achievement of mathematical literacy is still below the world average. Indonesia's PISA data also suggests that the quality of Indonesian education does not meet global community standards. This presumption arose because the PISA assessment has become a standard of reference and evaluation of the quality of education in PISA-participating countries (Hewi and Shaleh, 2020).

The low ability of Indonesian students' mathematical literacy based on PISA results needs to be one of the concerns in the Indonesian education world. This is because mathematical literacy is an essential ability for students to have in the 21st century. In line with that, according to Masfufah and Afriansyah (2021), students must have high mathematical literacy skills to be able to compete with other countries. This is because high mathematical literacy skills can also improve the quality of human resources (Masjaya and Wardono, 2018). Additionally, increasing literacy skills must be carried out because humans need literacy to find, select, interpret, analyze, and produce relevant information (Genlott and Gronlund, 2016).

Some previous research also tried to figure out why Indonesian mathematical literacy scores always tend to be stagnantly low. Research by Sandrom, et.al (2013) states that students experience difficulties in solving problems that require mathematical literacy skills because students have a low ability to reason mathematically and low self-confidence in solving questions related to word problems. Other research states that students' low mathematical literacy skills in the PISA test are because students are not capable to understand questions in the form of stories similar to PISA and constructing them into mathematical models and are unable to apply the concepts used to solve the questions given (Saputri et al., 2022).

Furthermore, similar research conducted by Masfufah & Afriansyah (2021) showed that based on the results of students' work in solving similar problems to PISA given the space and shape content, students' mathematical literacy skills were still low because students were not familiar with similar questions like PISA questions. The same thing was conveyed by Efriani et al. (2019), Firdaus (2017), and Hadi et al. (2018), who found that students' mathematical literacy was still low even though the questions had been adapted to the Indonesian context. Students answer the questions given without giving calculation steps and providing explanations for their written answers. This shows that students cannot provide arguments against the math questions tested in the math test. In addition, Munawaroh & Lukman (2022) also stated that students with moderate and low mathematical abilities were not capable to demonstrate their mathematical literacy skills because each student was only able to fulfill one or two indicators of mathematical literacy ability.

Besides PISA data, the concerns about Indonesian students' mathematical literacy abilities are also supported by facts on the ground. The results of preliminary observations made in one of the junior high schools, namely SMP Swasta Muhammadiyah 21 Dolok Batu Nanggar grade VIII showed that the conventional learning process carried out by the mathematics teacher did not support the development of students' mathematical literacy abilities. Mathematics

learning in class VIII SMP Swasta Muhammadiyah 21 Dolok Batu Nanggar is still teacher-centered and uses the lecture method. In this case, during the lesson, the teacher explains the learning material to students until it is finished. Then students are allowed to ask questions to the teacher if something is not understood. Furthermore, the teacher will answer student questions and provide examples of questions that will be worked on together. After working on sample questions, the teacher will give practice or routine questions that students must complete.

This teacher-centered learning method causes class VIII students of SMP Swasta Muhammadiyah 21 Dolok Batu Nanggar not actively participate in the learning process. Along with that, research by Bature (2020) states that the conventional learning process makes students only acquire procedural knowledge as a step-by-step solution to solving mathematical problems without improving students' understanding of the conceptual thinking behind the concepts they have learned. As a result, students in class VIII SMP Muhammadiyah 21 Dolok Batu Nanggar have difficulty solving problems that require mathematical literacy like formulating, applying, and interpreting various mathematical contexts. Students' low abilities can be seen when the teacher gives them simple math problems related to everyday issues.

The questions given during the observation were in the 'Let's Practice 5.5' section of the 2017 revised edition of the class VIII mathematics textbook, page 235 :

“Dalam lomba balap kelinci, kelinci milikmu berada 3 meter di depan kelinci milik temanmu. Kelincimu berlari dengan kecepatan rata-rata 2 meter per detik. Kelinci temanmu juga berlari 2 meter per detik. Sistem persamaan linear yang menyatakan situasi tersebut adalah $y = 2x + 3$ dan $y = 2x$. Apakah kelinci temanmu akan menyusul kelinci milikmu ? Jelaskan”

(In a rabbit racing competition, your rabbit is 3 meters ahead of your friend's rabbit. Your rabbit runs at an average speed of 2 meters per second. Your friend bunny also runs 2 meters per second. The system of linear equations that expresses this situation is $y = 2x + 3$ and $y = 2x$. Will your friend's rabbit catch up with your rabbit? Explain)

After the teacher gave the questions above, the teacher asked the students to work on the problem and came forward to explain the answers that had been obtained but none of the students were able to answer the question. In the end, the math teacher explains how to solve the problem to students because no one can solve it. Furthermore, interviews with students were also conducted after class. Students said that they had difficulty answering the questions and they did not understand the meaning of the questions given. This shows that student's ability to reason and use their reasoning in solving mathematical problems is still in the low category. Furthermore, according to the interview results with the math teacher, the math teacher also stated that students have difficulties in solving problems that require mathematical literacy skills such as reasoning and problem-solving. Students are only able to solve questions that already have the same model as the example questions given by the teacher.

Thus, based on preliminary observation and interview, it can be concluded that students still have difficulty formulating problems or questions given in mathematical concepts. The low ability of students in reasoning and interpreting problems causes the majority of students having difficulty solving problems that requiring mathematical literacy ability. In addition, the results of preliminary observation and interview also show that many students still do not know the types of PISA questions and do not understand the importance of mathematical concepts in working on mathematical problems. Hence, they only focus on the final result without showing the process of mathematical literacy.

The fact that conventional learning process is not able to improve students' mathematical literacy abilities. Then, the fact that conventional learning is still used in SMP Swasta Muhammadiyah 21 Dolok Batu Nanggar becomes one of the reasons why concrete analysis regarding the abilities of students' mathematical literacy is needed in SMP Swasta Muhammadiyah 21 Dolok Batu Nanggar. Research needs to be carried out to discover whether these conditions impact students' mathematical literacy abilities with an indication that students' mathematical literacy abilities of SMP Swasta Muhammadiyah 21 Dolok Batu Nanggar are also at a low level, following the PISA scores of Indonesian students.

In addition, the results of interviews and preliminary observations which indicated that students at SMP Swasta Muhammadiyah 21 Dolok Batu Nanggar have low mathematical literacy skills are also an important reason why it is necessary to carry out an in-depth analysis to describe students' mathematical literacy abilities in solving real-world problems using PISA-based questions. So, practical and efficient improvement steps can be conducted to improve students' mathematical literacy abilities. Therefore, the authors are interested in conducting research with the title 'Analyzing Students' Mathematical Literacy of SMP Swasta Muhammadiyah 21 Dolok Batu Nanggar Using PISA-Based Questions'.

1.2 Problems' Identification

Based on the background, problems' identification of this research is as follows :

1. The low ability of Indonesian students' mathematical literacy in terms of PISA result which is below the world's average achievement of mathematical literacy
2. Students' mathematical literacy tend to be stagnant (not increasing) based on the results of the 2000-2018 PISA with scores in the 300s and rankings that are always in the bottom 10 of PISA-participating countries
3. The teaching and learning process at SMP Swasta Muhammadiyah 21 Dolok Batu which is still teacher-centered has not been able to support the improvement of students' mathematical literacy
4. The low ability of SMP Swasta Muhammadiyah 21 Dolok Batu students in gathering information, reasoning, formulating, interpreting and applying their knowledge and experience causes students can't solve simple mathematical problems

1.3 Scope of Problem

For research to be more focused and directed, the limitations of the problem in this study are as follows :

1. This research was conducted on class VIII students at SMP Swasta Muhammadiyah 21 Dolok Batu Nanggar
2. The object of research is students' mathematical literacy skills in solving PISA-based questions

1.4 Formulation of the Problem

Based on the background and identification of the problem, the formulation of the problem in this research is : How is students' mathematical literacy of SMP Swasta Muhammadiyah 21 in Dolok Batu Nanggar using PISA-based questions ?

1.5 Research Objectives

Based on the formulation of the problem, the research objective is to describe students' mathematical literacy of SMP Swasta Muhammadiyah 21 in Dolok Batu Nanggar using PISA-based questions

1.6 Research Benefits

The benefits of this research are as follows

1. Benefits for Researchers
 - a. As a tool to increase the knowledge, insight, and experience of researchers regarding students' mathematical literacy abilities and the factors causing low students' mathematical literacy.
 - b. As a tool to find out the PISA-based questions used by the OECD on an international scale to measure students' mathematical literacy
 - c. As study material for other researchers to examine similar problems with other invention
2. Benefits for Teachers
 - a. As a tool to describe students' mathematical literacy and the causes of low students' mathematical literacy
 - b. As a reference material for the development of learning tools that can improve students' mathematical literacy

3. Benefits for the World of Education

- a. As a reference material to be able to overcome the low scores of students' mathematical literacy on the PISA test so that they can find the most effective solutions to increase Indonesia's PISA scores in the future



THE
Character Building
UNIVERSITY