A STUDY OF STUDENT'S MATHEMATICAL LITERACY BASED ON THEIR SELF-REGULATED LEARNING ABILITY

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ABSTRACT

Mathematical literacy is one of the capacities that students need. Students with good mathematical literacy will be better prepared to mingle with society. Self-regulated learning is one of the elements that contribute to disparities in students' mathematical literacy. This article scrutinizes students' mathematical literacy as observed from their independent learning. This qualitative study involved fourth-grade students of SD Negeri 1 Sokanegara in the 2020/2021 academic year. The data collection technique employed was observation and interviews. To ensure credibility, data triangulation was carried out to get valid data. Data analysis used the Miles and Huberman model. The results of this study indicate that students with a high self-regulated learning ability can fulfill all aspects of the mathematical literacy process, students with a moderate self-regulated learning ability can fulfill the process of communication, representation, and using mathematics tools, and students with a low self-regulated learning ability have not demonstrated mathematical literacy skills that no mathematical literacy process has been completed.
Keywords: mathematical literacy, mathematics, and self-regulated learning

1 INTRODUCTION

Mathematics is a subject that is taught in schools from elementary to high school. Mathematics plays a significant role in schooling. Mathematics is learned and developed to equip students with the ability to think logically, analytically, systematically, critically, and creatively (Wardono et al., 2016). This is in line with the Content Standard of the 2013 Curriculum as stipulated in the Regulation of the Ministry of Education and Culture Number 21 of 2016 concerning Content Standards for Elementary and Secondary Education explains the competencies of mathematics including (1) showing a positive attitude towards mathematics when solving problems, (2) understanding, explaining, and applying mathematics flexibly, accurately, and efficiently, (3) using mathematics in everyday life, and (4) developing attitudes that are consistent with mathematical principles. If these competencies can be achieved, there is hope that students in Indonesia will have no difficulty in solving problems such as PISA.

PISA or Programme for International Student Assessment is under the Organization for Economic Co-operation and Development (OECD). One of the abilities measured in PISA is mathematical literacy to assess learning outcomes in knowledge and skills (Edo, Hartono, & Putri, 2013; Hwang & Ham, 2021; Putra, Zulkardi, & Hartono, 2016; Wilkens, 2011). Mathematical literacy is the application of mathematics in everyday life (Dasaorawira, et al, 2019; Holenstein et al, 2021). Meanwhile, according to Bolstad (2021), mathematical literacy is a skill required to contribute to life. To summarize, mathematical literacy is the ability to apply mathematics in everyday life and to make a positive contribution to society. Based on the grasp of the concept, mathematical literacy is crucial. However, Indonesians still have a poor mathematical literacy that in 2009, Indonesian students were ranked 55 out of 65 countries with an average score of 371, far below the international average score of 496 (OECD, 2009 in Pulungan, 2014). In 2012, Indonesian students dropped in rank to 64 out of 65 countries (Khikmiyah & Midjan, 2016). The latest information was in 2015 that Indonesia is ranked 62 out of 70 countries with an average score of 403 (Afni & Rokhimawan, 2018). According to Wardhani and Rumiati (2011), the poor PISA result is due to pupils' lack of preparation for contextual and non-routine questions.

Poor mathematical literacy is also found in SD Negeri 1 Sokanegara. Based on interviews and observations, students cannot process and use the information to solve problems. Some students correctly answer questions but do not show the information they have obtained or draw conclusions from the answers they have received.

If students have good literacy skills, they can prepare themselves for socializing in society (OECD, 2018). With good literacy, students can apply mathematical concepts in their lives that help them make the right decisions in solving problems (Maulana et al., 2019). Mathematical literacy can help students make the necessary decisions by understanding, building, applying, and self-reflecting (Kuswidyanarko, Wardono, & Isnarto, 2017). One of the factors that cause poor mathematical literacy is the lack of self-regulated learning ability (Egok, 2016).

Independent learning is an important component in learning, especially in learning mathematics (Wong et al., 2019). Self-regulated learning ability is an attitude and behavior that does not easily depend on others, allows pupils to explore their interests and develop talents in their own way, and can organize learning materials autonomously (Hasibuan, Saragih, & Amry, 2019; Mulyono, Asmawi, & Nuriah, 2018). Independent learning has a positive influence on learning outcomes as suggested by previous studies (Bungsu et al, 2019; Dewi, Asifa, & Zanthy; Fajriyah et al, 2019; 2020 Suhendri, 2011). According to Wongsi et al. (2002 in Kurniawati, Junaedi, & Mariani, 2015), individuals with a high self-regulated learning ability tend to learn better, can monitor, evaluate, and manage their learning effectively, save time in completing tasks, manage study time efficiently, and obtain high scores. Hence, self-regulated learning is tempting to be investigated since each student has a different independence level with different achievements in the mathematical literacy process (Faridh, Sukestiyarno, & Mariani, 2019).

1.1 Research Problem

Based on the description earlier, several problems can be identified. They are (1) low mathematical literacy, (2) contribution of mathematical to daily life, and (3) self-regulated learning ability as one of the factors determining students' high and low mathematical literacy. From the identification of these problems, there is a need for solutions. Thus, this study seeks to investigate "How is students' mathematical literacy based on their self-regulated learning ability?"

1.2 Research Objectives

This study attempts to analyze students' mathematical literacy based on their self-regulated learning ability.

2 METHOD

Because the subject of this study is a phenomenon involving mathematical literacy skills in terms of student self-regulated learning ability, qualitative research methodology was used. The qualitative research method is used to investigate a natural state (Sugiyono, 2015). The subjects of this study were fourth-grade students of SD Negeri 1 Sokanegara in the academic year 2020/2021. The research informants were selected based on the results of the group work on mathematical literacy and self-regulated learning ability. The research instruments were performed as measuring tools to determine students' self-regulated learning ability and to describe their mathematical literacy as observed from their self-regulated learning ability. The instruments used in this study are the self-regulated learning instrument and mathematical literacy instrument. After selecting the research subject, the instrument employs a human instrument since the researcher is the research instrument in qualitative research. Sugiyono (2015) explains that because the problem is not clear and definite from the beginning, the researcher is the main instrument in qualitative research; nevertheless, once the research focus is established, basic research instruments can be constructed using the data collected. After developing the research instrument, data collection was carried out using observation and interviews related to student work of mathematical literacy. For credibility, the triangulation technique was employed to obtain valid data. The triangulation technique refers to the use of observation, interviews, and documentation. Data analysis used the Miles and Huberman model comprising data collection, data reduction, data display, and conclusion drawing (Miles & Huberman, 2014). The research procedure in this study include (1) developing research instruments, (2) testing the research instruments of self-regulated learning and mathematical literacy, (3) analyzing the feasibility of the research instrument, (4) data collection using mathematical literacy tests and self-regulated learning questionnaires, (5) selecting the informants in the research, (6) data collection with triangulation technique, and (7) data analysis.

3 RESULTS AND DISCUSSION

3.1 Self-regulated learning

Students' self-regulated learning ability is measured through a questionnaire. The results of the Self-regulated learning Questionnaire are grouped based on three levels of high, moderate, and low self-regulated learning ability. The categories of self-regulated learning are presented in Table 1.

Table 1. Students' Self-regulated learning Ability

Level	Number of Student	Percentage
High	8	23.53%
Moderate	18	52.94%
Low	8	23.53%
Total	34	100%

Table 1 presents that there are 8 (23.53%) of students with high self-regulated learning ability, 18 (52.94%) of students with moderate self-regulated learning ability, and 8 (23.53%) of students with low self-regulated learning ability. An informant from each category was selected for further investigation.

3.2 Mathematical Literacy

Mathematical literacy tests was administered online. The results are categorized into 3 groups of upper, middle, lower liners. The grouping of mathematical literacy is depicted in Table 2.

Table 2. The Grouping of Mathematical Literacy

Group	Number of Student	Percentage
Upper	6	17.65%
Middle	21	61.76%
Lower	7	20.59%
Total	34	100%

Referring to Table 2, mathematical literacy in this study is divided into three of upper, middle, and lower liners. There are 6 (17.65%) students in the upper group, 21 (61.76%) students in the middle group, and 7 (20.59%) students in the lower group.

3.3 Mathematical Literacy as Observed from Self-regulated learning

There are 9 informants in the analysis of mathematical literacy in terms of self-regulated learning ability. The informants are A1, A2, A3, B1, B2, B3, C1, C2, and C3. They were selected from the classification of self-regulated learning ability with mathematical literacy group.

Table 3. Classification of Self-regulated learning with Mathematical Literacy

Self-regulated learning Ability	Mathematical Literacy Group					
	Upper		Middle		Lower	
	N	%	N	%	N	%
High	5	83.33	3	14.29		
Moderate	1	16.67	17	80.95		
Low			1	4.76	7	100
Total	6	100	21	100	7	100

Table 3 describes the details of the informants interviewed and observed. First, three students with a high self-regulated learning ability were selected, two (A1 and A2) informants are in the upper group of mathematical literacy and one (A3) informant is in the middle group of mathematical literacy. Second, three students with a moderate self-regulated learning ability comprise of one (B1) informant in the upper group of mathematical literacy and two (B2 and B3) informants in the middle group of mathematical literacy. Third, informants with a low self-regulated learning ability include one (C2) informant in the middle group of mathematical literacy and 2 informants (C1 and C3) in the lower group of mathematical literacy.

3.3.1 Mathematical Literacy of Students with High Self-regulated learning Ability

The findings of this study were analyzed based on student answers and interviews. The aspects of the mathematical literacy process in this study include (1) communication, (2) mathematizing, (3) representation, (4) reasoning and argument, (5) devising strategies for solving problems, (6) using symbolic, formal and technical language and operation, and (7) using mathematics tools (OECD, 2018).

In terms of communication, based on interviews and the observations of students' work, Informant A1 could tell the problem in the questions. Informant A1 recognized, understood, and planned problem-solving well. While Informant A2 could communicate verbally despite being lack of detail in his writing. Informant A3 could recognize, understand, and plan problem solving quite well even though he wrote down the problem without changing it into a mathematical model. It indicates that students with a high self-regulated learning ability can recognize, understand, and plan problem solving both orally and in writing. It can be concluded that students with a high self-regulated learning ability can communicate problems on questions by recognizing, understanding, and planning problem-solving.

The next process is mathematizing. The results of interviews and observations with Informant A1 show that they can calculate in order. Informant A1 can explain the problem-solving plan in order and change questions into a mathematical form. Informant A2 can also do the calculation in written and oral form. Informant A2 changed the math problems in mathematical form by using pictures that represent problem-solving and an easier way to solve problems. Informant A3 involves the ability to convert problems into mathematical forms. Hence, it can be seen that students with a high self-regulated learning ability can do Mathematizing as reflected by problem-solving planning. Students with a high self-regulated learning ability wrote and explained problem-solving plans and changed math problems into mathematical forms. It can be concluded in mathematizing, students with a high self-regulated learning ability can write and explain problem-solving plans and convert math problems into mathematical forms.

The next process of mathematical literacy is Representation. The results revealed that Informants A1, A2, and A3 represented information well. Informants A1 and A3 only interpreted the contents of the diagram, while Informant A2 did better by representing the information in the form of drawings to plan and solve problems. It can be concluded that students with a high self-regulated learning ability can represent the information on the questions, that is, they can interpret the contents of the diagram and can solve the math problems.

In Reasoning and Argument, Informants A1, A2, and A3 provided reasonable arguments in solving math problems. It reflects their reasoning abilities. Meanwhile, during the interview, Informants A1, A2, and A3 presented detailed explanations and rationales. It can be concluded that students with a high self-regulated learning ability can provide written and oral arguments in solving problems and show reasoning abilities.

Devising Strategies for Solving Problems is the next process of mathematical literacy. Informants A1, A2, and A3 can apply the problem-solving plans to obtain the correct answers. They have shown their ability in the process of Using Symbolic, Formal and Technical Language and Operation. Informants can solve problems correctly and accurately, with appropriate mathematical symbols. Although some students are less thorough when writing, when interviewed, they can give

the proper response right away. While in Using Mathematics Tools, Informants A1, A2, and A3 can use factor trees and pictures in finding the perimeter of a square.

All in all, it can be concluded that students with a high self-regulated learning ability meet the entire process of mathematical literacy assessment comprising (1) communication, (2) mathematizing, (3) representation, (4) reasoning and argument, (5) devising strategies for solving problems, (6) using symbolic, formal and technical language and operation, and (7) using mathematics tools. The results of this study are in line with the research conducted by Aliyyah, Puteri, and Kurniawati (2017) and Wijayanti and Wardono (2020) that self-regulated learning ability affects learning outcomes. Students with a high self-regulated learning ability can acquire good mathematical literacy. In addition, according to Faridh, Sukestiyarno, and Mariani (2019), students with a high self-regulated learning ability can master the entire process of mathematical literacy assessment well. Students with a high self-regulated learning ability have good mathematical literacy since they did not rely on the help of others. They learn due to their awareness to apply their knowledge in solving problems in daily life (Suhendri, 2011).

3.3.2 Mathematical Literacy of Students with Moderate Self-regulated learning Ability

The findings of the study were examined based on observations and interviews. The results refer to the aspects of mathematical literacy that include (1) communication, (2) mathematizing, (3) representation, (4) reasoning and argument, (5) devising strategies for solving problems, (6) using symbolic, formal and technical language and operation, and (7) using mathematics tools (OECD, 2018).

The results of interviews and observations on students' work revealed that Informant B1 could meet the process of Communication from recognizing, understanding, and making mathematical models. Different results are shown by Informants B2 and B3. Informants B2 and B3 recognized and understood math problems, yet they could not form mathematical models. Thus, students with a moderate learning dependency can recognize and understand math problems even though they are not the best when it comes to forming mathematical models.

In terms of mathematizing, Informant B1 changed the problem in mathematical form. However, Informant B1 was unable to provide a detailed explanation verbally. Meanwhile, informants B2 and B3 have not been able to convert the problem into mathematical form correctly. It can be concluded that Mathematizing has not been seen in students with a moderate self-regulated learning ability.

In the Representation, all Informants B1, B2, and B3 interpreted the contents of the diagram well. However, the interpretation did not help them in solving problems. In providing arguments, Informant B1 showed reasonable arguments, while B2 and B3 had not been able to use their reasoning abilities so they cannot explain the reasons for solving the problem. However, B1 has not been able to make an oral argument based on the responses provided. Hence, the reasoning and argument for students with a moderate self-regulated learning ability were not identified. They have not been able to use their reasoning abilities to give reasons for their work.

Devising Strategies for Solving Problems were not shown by Informants B1, B2, and B3. Because the plan is inadequate, the problem-solving is also incorrect. Furthermore, because they have not been able to organize problem-solving, the employment of symbols in problem-solving is also undetectable. Students with a moderate self-regulated learning ability were not been thorough in problem-solving. In giving reasons, they have not been able to give reasoning. In Using Mathematics Tools, Informants B1, B2, and B3 can use mathematical tools, for example, the

multiplication board in solving the greatest common factor (GCF) and using multiples of numbers to solve problems related to the least common multiple (LCM).

From the discussion, the mathematical literacy of students with a moderate self-regulated learning ability can meet the aspects of (1) communication, (2) representation, and (3) using mathematics tools. Students with a moderate self-regulated learning ability need a stimulus from teachers and parents. Self-regulated learning ability has an impact on the outcomes of less-than-ideal mathematical literacy. This confirms the research of Wijayanti and Wardono (2020) stating that self-regulated learning ability affects learning outcomes. So, students with a moderate self-regulated learning ability will have a different effect. In addition, based on the research of Faridh, Sukestiyarno, and Mariani (2019), students with a moderate self-regulated learning ability cannot meet all aspects of mathematical literacy. In this study, students with a moderate self-regulated learning ability can only meet the aspects of (1) communication, (2) representation, and (3) using mathematics tools. This corroborates Wardono et al. (2016) that students still have difficulty in solving mathematical problems, especially in terms of presenting arguments that are well-founded in light of the issues at hand.

3.3.3 Mathematical Literacy of Students with Low Self-regulated Learning Ability

The results of this study were analyzed based on observation and interview results. The results use aspects of mathematical literacy of (1) communication, (2) mathematizing, (3) representation, (4) reasoning and argument, (5) devising strategies for solving problems, (6) using symbolic, formal and technical language and operation, and (7) using mathematics tools (OECD, 2018).

The first aspect is Communication. The results of interviews and observations with Informant C1 show that he has not been able to communicate the question well. Informant C1 only recognized the problem. Yet, the recognition of the problem did not help Informant C1 in making a problem-solving plan. While Informant C2 communicated well in understanding and recognizing problems, he cannot fully use the mathematical models in solving problems. On the other hand, Informant C3 has not demonstrated effective communication in understanding and recognizing problems as well as forming mathematical models in solving problems. Therefore, in the process of Communication, students with low independence have not been able to recognize, understand, and make mathematical models in solving problems properly.

The next process is Mathematizing. Based on interviews and observations on the work of Informants C1, C2, and C3, it was revealed that They have not been able to employ mathematizing effectively, or they have not been able to construct problem-solving plans and are still unsure how to do so. Analyzing the work of Informant C3, it was found that he could not change the problem in mathematical form. In terms of mathematizing, it can be concluded that students with a low self-regulated learning ability still being confused in making plans for problem-solving.

In the process of representation, Informants C1 and C2 only interpreted the contents of the diagram. However, the representation made could not help them in planning and solving the math problems. Meanwhile, Informant C3 did not make any representation of the question. It can be concluded that students with a low self-regulated learning ability cannot fulfill the process of Representation.

In terms of Reasoning and Argument, students with a low self-regulated learning ability also have not attained the process. Informant C1 has not been able to provide a good explanation and has not solved problems using reasoning and arguments. Informant C2 has not been able to use reasoning

and arguments in solving problems. Informant C2 could write the math form, but when asked to explain, he was unable to respond or provide reasonable justifications. Informant C3 could not explain math problems and could not use reasoning and arguments in problem-solving.

Informants C1, C2, and C3 have not yet implemented the process of Devising Strategies for Solving Problems. They did not plan and solve the problem properly. In addition, the use of symbols was not found in the answers of students Informants C1, C2, and C3, which results in careless problem-solving. Students with a low self-regulated learning ability were unable to present valid arguments because they were unable to plan problem-solving from the start. The use of mathematical tools was not found in the work of Informants C1, C2, and C3.

Students with a low self-regulated learning ability were unable to express arithmetic problems effectively in terms of understanding and recognizing problems. Because they cannot understand and recognize the problems, they cannot use mathematical models properly. In the mathematizing process, students with a low self-regulated learning ability could not make plans for solving problems. This also has an impact on Devising Strategies for Solving Problems, in which students with a low self-regulated learning ability could not show it. In addition, the use of symbols was not found in the students' answers. The problem solving was not completed thoroughly. Because from the beginning they were not able to plan problem-solving, students with a low self-regulated learning ability were unable to give justifiable reasons.

Students with a low self-regulated learning ability can only read the contents of the diagram, and even then, it is useless for planning and problem-solving. Students with a low self-regulated learning ability need a stimulus in learning. Teachers need to guide students of low self-regulated learning ability.

From the discussion, it can be concluded that students with a low self-regulated learning ability need stimulus and guidance from teachers and parents. The low self-regulated learning ability affects their mathematical literacy to be less optimal. It corroborates the research of Wijayanti and Wardono (2020) stating that self-regulated learning affects learning outcomes. Students with a low self-regulated learning ability will have less mathematical literacy. In addition, based on the research conducted by Faridh, Sukestiyarno, and Mariani (2019), students with a low self-regulated learning ability have not met all processes of mathematical literacy.

4. Conclusion

Students with a high self-regulated learning can meet all seven processes of mathematical literacy that include (1) communication, (2) mathematizing, (3) representation, (4) reasoning and argument, (5) devising strategies for solving problems, (6) using symbolic, formal and technical language and operation, and (7) using mathematics tools. Students with a high self-regulated learning ability can communicate in recognizing, understanding, and planning problem solving properly and thoroughly. Students with a high self-regulated learning ability can also represent problems both in the contents of the diagram as well as in the form of pictures. Because all processes are met, students with a high self-regulated learning ability can also use symbols, mathematical tools, and provide arguments in solving problems.

Meanwhile, students with a moderate self-regulated learning ability can meet the processes of (1) communication, (2) representation, and (3) using mathematics tools. They recognize and understand problems even though cannot mathematical models. Students with moderate independence can

represent the information even though it is only the contents of the diagram. Students with moderate independence can use mathematical tools even though the solution they give is not thorough.

Students with a low self-regulated learning ability do not indicate good mathematical literacy. They could not understand and recognize the problem. As a result, students with a low self-regulated learning ability become more unable to organize problem-solving, perform calculations correctly and methodically, and explain reasoning in solving math problems.

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