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Achievement of Students' Mathematical Literacy Skills Based on Stacey's Definition Measured from the Results of the Elementary Linear Function Test

(Capaian Kemampuan Literasi Matematika Siswa Berdasarkan Definisi Stacey Diukur dari Hasil Tes Fungsi Linear Elementer)

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Abstract
This study aims to analyze the achievement of students' mathematical literacy skills based on Stacey's definition. The achievement is measured using the answers to the basic linear function test results. The objectives are achieved using a descriptive qualitative approach. The indicators of achievement of mathematical literacy skills used are that students can: understand mathematical problems (I1); apply mathematical concepts (I2); use facts to formulate mathematical problems (I3), and; present and solve mathematical problems (I4). The subjects involved in the test consisted of 33 students, and then 3 students were selected by stratified random sampling to be interviewed, where each sample represents a group of students with high (S1), medium (S2), and low (S3) mathematical abilities. The instruments used to measure are test instruments and interview guidelines. The collected data were analyzed based on the Milles & Hubberman stages. The results of the data analysis concluded that students (S1) could achieve all indicators; students (S2) could not achieve the indicators of presenting and solving mathematical problems, and students (S3) could not achieve all the indicators set. Another finding is the existence of student self-confidence that affects their mathematical literacy skills
Keywords: *Mathematical literacy skills*, *Stacey's Indicator*, *Elementary linear functions*

Abstrak
Penelitian ini bertujuan untuk menganalisis pencapaian kemampuan literasi matematika siswa yang didasarkan pada definisi dari Stacey. Pencapaian tersebut diukur menggunakan jawaban hasil tes fungsi linier tingkat dasar. Tujuan dicapai menggunakan pendekatan kualitatif deskriptif. Indikator pencapaian kemampuan literasi matematika yang digunakan yaitu siswa dapat: memahami masalah matematika (I1); menerapkan konsep matematika (I2); menggunakan fakta untuk merumuskan masalah matematika (I3), dan; menyajikan dan menyelesaikan masalah matematika (I4). Subjek yang terlibat dalam tes terdiri dari 33 siswa, dan selanjutnya dipilih 3 siswa secara stratified random sampling untuk diwawancara, yang mana setiap sampel mewakili kelompok siswa dengan kemampuan matematika kategori tinggi (S1), sedang (S2), dan rendah (S3). Instrumen yang digunakan untuk mengukur adalah instrumen tes dan pedoman wawancara. Data yang terkumpul dianalisis berdasarkan tahapan Milles & Hubberman. Hasil anaisis data menyimpulkan siswa (S1) dapat mencapai seluruh indikator; siswa (S2) tidak dapat mencapai indikator menyajikan dan

menyelesaikan masalah matematika, dan siswa (S3) tidak dapat mencapai seluruh indikator yang ditetapkan. Temuan lainnya adalah adanya rasa percaya diri siswa yang mempengaruhi kemampuan literasi matematikanya.
Kata Kunci: Kemampuan literasi matematika, Indikator dari Stacey, Fungsi linear elementer

I. Introduction

One of the important competencies that students must have in this digital era is mathematical literacy, this is because mathematics not only functions as a basic science, but also as a tool to understand and solve problems in everyday life [1], [2]. Mathematical literacy includes the ability to formulate, apply, and interpret mathematics in various contexts, both in academic and practical environments [3]. Stacey defines mathematical literacy as the ability to understand problems, use concepts, facts and procedures in formulating, presenting and solving mathematical problems [4]. According to NCTM *(National Council of Teachers of Mathematics)*, good mathematical literacy allows students to think logically, creatively, and critically in solving various mathematical problems, and helps them develop the ability to adapt to changing situations outside the school environment [5].

The development of mathematical literacy competency can be achieved through mathematics learning in schools including at the junior high school level. At this level, students will be introduced to basic mathematical concepts that will be the foundation and provision for them in studying mathematics at a more advanced level [6]. One of the materials that can play an important role in improving mathematical literacy skills for junior high school students is material with the main topic of linear functions [7]. A linear function is a function that can be presented in the form of $f(x) = ax + b$, $a \neq 0$ where x is the independent variable and y is the dependent variable with a being the rate of change or slope and b being a constant [8]. In everyday life, linear functions are widely implemented in the fields of economics and business, such as to describe supply and demand functions [9], [10].

Until now, the level of mathematical literacy skills of students in Indonesia still requires serious attention from mathematics teachers who teach in schools. The mathematical literacy skills of students in Indonesia in general can be seen from the results of measurements carried out by the OECD, the assessment of which was carried out through PISA *(Program for International Student Assessment) in* 2022, the results of which placed Indonesia in 69th place out of 80 participating countries [11]. The details of the scores for the literacy skills measured are mathematics: 366; reading: 359, and; science: 383 [12]. This condition is a description of the literacy skills of students in Indonesia aged 15-16 years. Therefore, based on the PISA results, it can be said that serious improvement efforts are still needed so that the literacy skills of students at the junior high school level can increase.

The researcher believes that what needs to be done first to fix the above problems is to analyze students' mathematical literacy skills. The analysis will be carried out on students who have studied linear function material, this is based on the results of the literature review as explained above, namely the learning process with linear function material can be used as a means of practicing improving students' mathematical literacy skills. The results of this analysis can later be used as a basis for consideration for teachers in determining the right learning plan aimed at improving mathematical literacy skills. Through the identification of students' levels of understanding and difficulties, it will also be possible to find out the factors that influence students' mathematical literacy skills.

II. Research Methods

Through this study, an analysis of the mathematical literacy skills of grade VIII students was conducted based on their ability to solve basic linear function problems. The objectives of the study were achieved using a qualitative descriptive method, namely a research method that is focused on gaining an in-depth understanding of students' experiences and thoughts related to the subject matter that is the object of the study [13]. The subject matter referred to in this study is basic linear function material. Therefore, the test instrument used to collect data was in the form of 5 descriptive questions containing basic linear function problems, as presented in Figure 1.

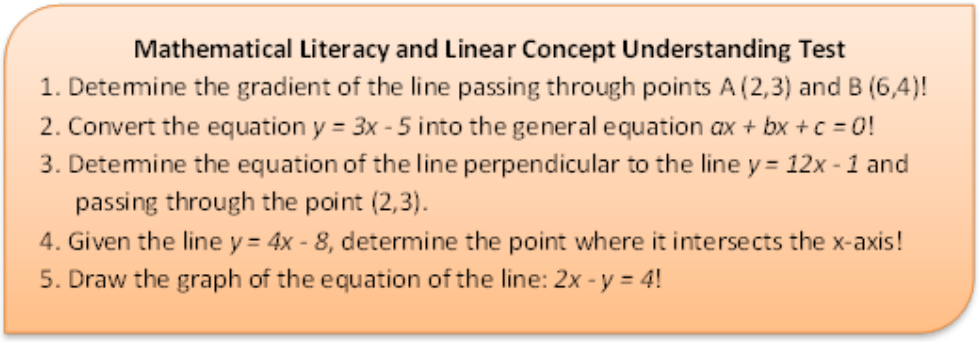

Figure 1. Basic Level Linear Function Test Instrument

A total of 33 students of grade VIII were involved in working on the test questions above. Students' answers were corrected and analyzed to determine their achievement of mathematical literacy skills. The indicators to measure the achievement of students' mathematical literacy skills were developed by researchers by referring to the definition of mathematical literacy skills given by Stacey [14]. Stacey defines mathematical literacy skills as the ability to understand problems, use concepts, facts and procedures in formulating, presenting and solving mathematical problems. This definition is used as a basis by researchers to develop indicators of mathematical literacy skills of grade VIII students which in this study will be measured based on students' achievements in completing basic linear function tests. Indicators of mathematical literacy skills and student abilities that are measured or observed are presented in Table 1.

Table 1. Stacey's Mathematical Literacy Indicators (I) and Measured Student Abilities

Stacey's Mathematical Literacy Indicators (I)	Measured Student Abilities	Question Number
Understanding mathematical problems (I1)	Can determine basic algebraic operation procedures to calculate gradients and/or convert linear equations to different formats.	1,2
Applying mathematical concepts (I2)	Can use the concept of gradient and points on a line to determine the equation of a line.	3
Using facts to formulate mathematical problems (I3)	Can determine the point of intersection by substituting the known *x*-point or *y*-point into the line equation.	4
Presenting and solving mathematical problems (I4)	Able to use key points to draw graphs accurately on the Cartesian plane.	5

The students' answer sheets will be analyzed based on the indicators and abilities that must be achieved in Table 1 above, after which interviews will be conducted with 3 students selected using stratified random sampling. Each student represents a group of students with high (S1), medium (S2), and low (S3) mathematics ability categories. The purpose of the interview is to strengthen the results of the analysis of the answers written by students. The data collected were analyzed using the procedure from Miles & Huberman [15]. The stages of the research that were passed are as presented in Figure 2. Through the stages in Figure 2, conclusions can be drawn regarding the indicators of mathematical literacy abilities that students can achieve.

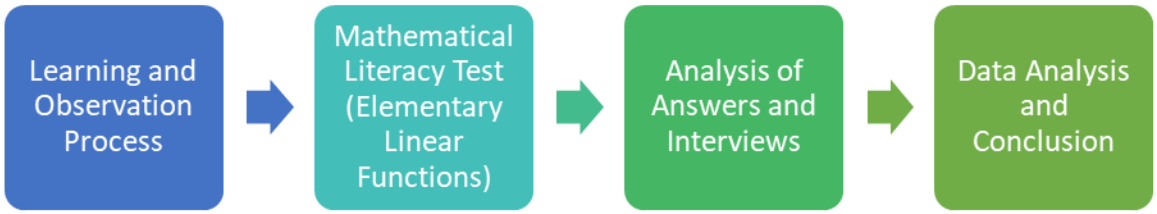

Figure 2. Research Stages adapted from Triyono, et al. [16]

III. Results and Discussion

3.1. Result

According to the established research procedure, the research stages begin with the learning process on the basic linear function material which takes place in 2 meetings. The first meeting discusses the topic of linear functions as linear equations, and the second meeting discusses the topic of how to interpret linear equations with graphs. The next stage is the implementation of the test. The test answers are then collected to be corrected and analyzed in depth. The results of the analysis of test answers and interviews with students (S1), (S2), and (S3) are explained as follows.

Based on the answers written by students, it can be analyzed regarding the basic linear function problems that can be solved correctly. The steps taken by the researcher are to group students' answers based on the indicators of mathematical literacy skills that have been successfully met. Furthermore, the percentage achieved in each indicator can be calculated, as presented in Table 2.

Table 2. Percentage of Elementary Linear Function Problems that Students Can Solve

Observed Abilities and Mathematical Literacy Indicators (I) Achieved by Students	Achievement	
	Total Students	(%)
Can determine basic algebraic operating procedures to calculate gradients and/or convert linear equations to different formats (I1)	11	64,71%
Can use the concept of gradient and points on a line to determine the equation of a line (I2)	9	52,94%
Can determine the point of intersection by substituting the known *x*-point or *y*-point into the line equation (I3)	9	52,94%
Able to use key points to draw graphs accurately on the Cartesian plane (I4)	4	23,53%

Table 2 shows that: students who achieved the indicator of being able to understand problems (I1) were 11 or 64.71%; students who achieved the indicator of being able to apply mathematical concepts (I2) were 9 or 52.94%; students who achieved the indicator of being able to use facts to formulate mathematical problems (I3) were 9 or 52.94%, and; students who achieved the indicator of being able to present and solve mathematical problems (I4) were only 4 or 23.534%.

This finding shows that the mathematical literacy abilities of students who are the subjects of the study are still diverse. There are 4 students who have been able to demonstrate achievement in all indicators used in this study, but other students still experience difficulties as indicated by their inability to draw graphs on the Cartesian plane. To analyze more deeply the answers written by students, interviews were conducted with samples of students with high ability categories (S1), medium (S2), and low (S3).

3.1.1. Analysis of Test Answers and Interview Results with Students (S1)

Researchers have corrected the mathematical literacy test results for students in the high category (S1). Furthermore, an in-depth analysis of the students' answers and interviews were conducted. The in-depth analysis of the students' answer sheets (S1) is presented in Figure 3.

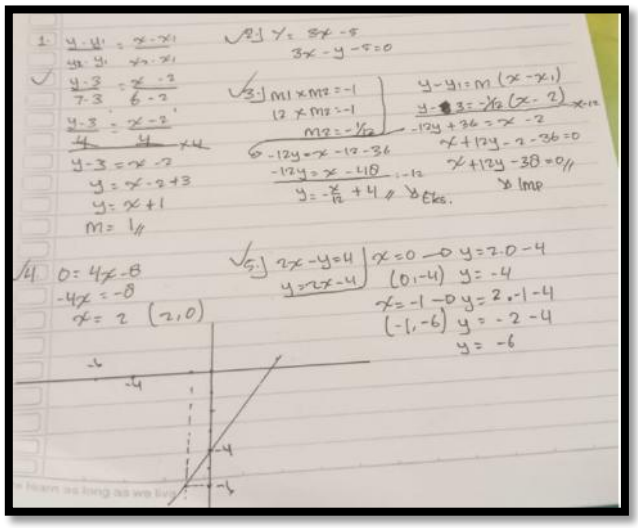

Figure 3. Sample Answers of Students with High Category of Mathematics Ability (S1)

It can be seen in Figure 3 that student (S1) can complete all the test questions that are tested. The answers written for questions 1 and 2 show that student (S1) is able to determine algebraic operations to determine the equation of the line and after the equation of the line is formed, student (S1) successfully determines the gradient of the line. Likewise, when student (S1) solves problem number 2, it seems that he has no difficulty in changing the known linear equation into the form $ax + by + c = 0$. Up to this stage it can be said that student (S1) has fulfilled the indicator of understanding the problem or (I1). Furthermore, from the answer written for question number 3 it can be seen that student (S1) is able to use the concept of gradient and known points to determine the equation of another line that is perpendicular to the equation of the known line. Up to this stage it can be said that student (S1) fulfills the indicator of being able to apply mathematical concepts or (I2). Based on the answer to test number 4, it can be seen that student (S1) is able to determine the point of intersection on the x-axis using the known equation of the line, and from the answer to test number 5 it can be seen that student (S1) can draw a graph correctly by referring to the known information. Up to this stage, students (S1) have fulfilled the indicator of being able

to use facts to formulate mathematical problems and present problems and solve them, or in other words, S1 students have succeeded in achieving the mathematical literacy ability indicators (I3) and (I4).

The achievement of these indicators shows that the mathematical literacy ability of students (S1) on the topic of basic linear functions is classified as very good. Students (S1) can identify problems, apply concepts, present and solve linear function problems based on known facts. Based on the results of observations of the students' answers, it can be said that students (S1) who represent a group of students with a high mathematical ability category have succeeded in achieving all 4 indicators from Stacey. This finding is also reinforced by the results of the interview as in the following transcript.

Researcher : *Did you have any difficulties while working on the linear function test?*
Student (S1) : *At the beginning I found it difficult, but after trying to understand what was known in the question, it became easier for me to determine how to solve what was asked*
Researcher : *When you faced difficulties, what did you do to understand the linear function problem?*
Student (S1) : *I read the question carefully and wrote down what was known from the question.*
Researcher : *Do you feel confident and feel that you will be able to complete all the tests correctly?*
Student (S1) : *Yes, because I already understand the formulas used and the steps to calculate them.*

Based on the oral statements given, it appears that students (S1) can complete all tests because they have understood the concept of linear functions and have mastered how to perform mathematical operations correctly. Thus, it can be said that students (S1) can achieve indicators of mathematical literacy abilities starting from their ability to understand the concept of linear functions and have mastered mathematical operations.

3.1.2. Analysis of Test Answers and Interview Results with Students (S2)

At this stage, researchers conducted an in-depth analysis of the answers written on the answer sheets by students with moderate ability (S2). To strengthen the analysis, interviews with students (S2) were conducted. The in-depth analysis of the students' answer sheets (S2) is presented in Figure 4.

As seen from Figure 4, students (S2) can solve questions 1-4 well. This shows that students (S2) have achieved the indicators: can understand problems (I1), apply mathematical concepts (I2), and can use facts to formulate mathematical problems (I3). As for question number 5, students (S2) are unable to draw graphs, or in other words, students (S2) have not been able to achieve the indicator of being able to present and solve mathematical problems (I4).

To strengthen the results of the analysis above, it is necessary to conduct interviews with students (S2). The transcript of the interview results is as follows.

Researcher : *Do you feel that you can understand the linear function material well?* Student (S2) : *Yes, because the material is not too complicated.*
Researcher : *Then what caused you to be unable to draw the graph in question number 5?*
Student (S2) : *I am still unsure about how to assign the newly obtained point (x,y) to the coordinate line.*

Based on the oral statement above, it can be said that students (S2) have understood the concept of basic linear functions well. It's just that in question number 5, students (S2) still have limitations in presenting the newly obtained information, namely points (0,-4) and

(2,0) into the coordinate diagram. So that up to this stage it can be said that students (S2) have not met the indicator of being able to present and solve mathematical problems or indicator (I4).

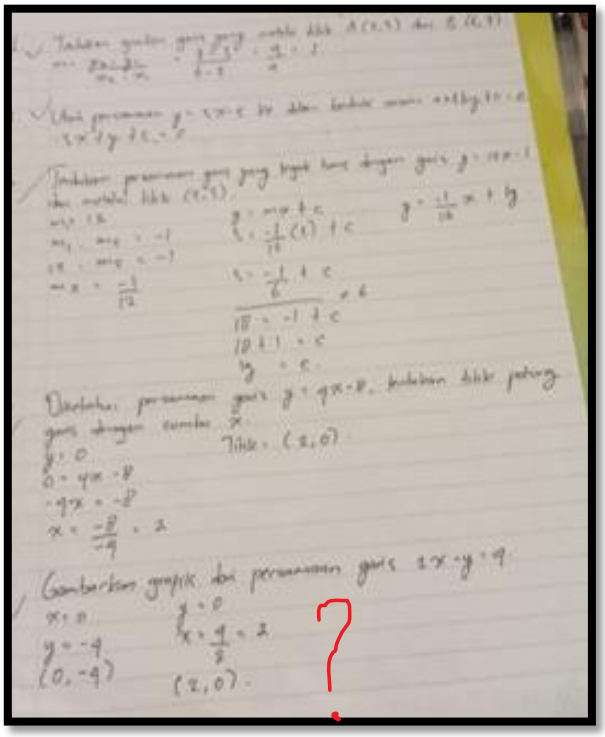

Figure 4. Sample Answers of Students with Medium Mathematics Ability (S2)

3.1.3. Analysis of Test Answers and Interview Results with Students (S3)

In the next stage, the researchers conducted an in-depth analysis of the answers written by students in the low-mathematical ability group (S3). This group of students requires more serious attention from teachers, therefore, the researchers also attempted to be more careful in this analysis process. To examine the answers from the low-mathematical ability group (S3), see Figure 5.

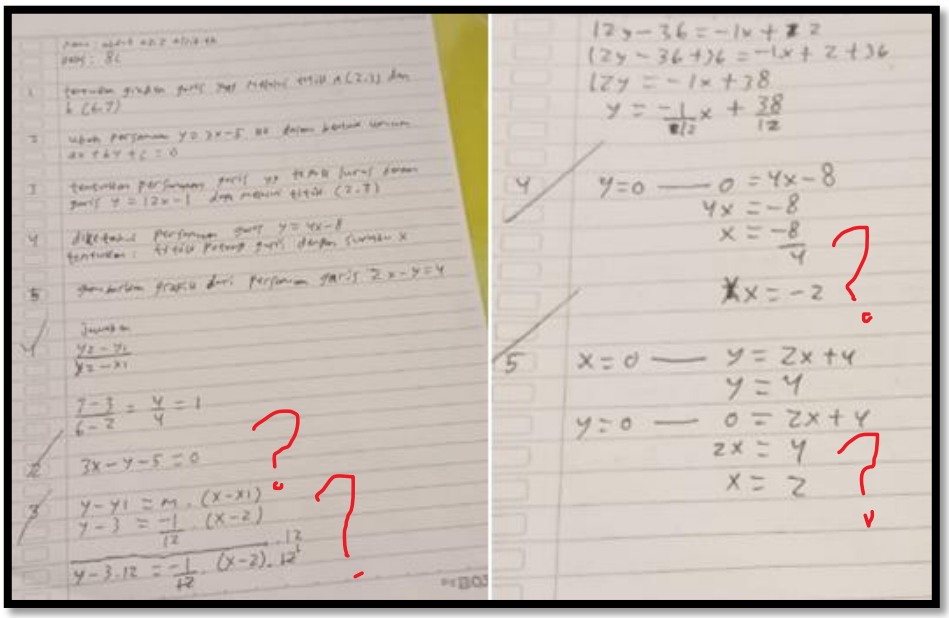

Figure 5. Sample Answers of Students with Low Mathematics Ability (S2)

Figure 5 shows that student (S3) can only solve question number 1. This shows that the level of understanding of students (S3) regarding the basic concepts of linear functions is still very limited. Students (S3) still experience obstacles in understanding the basic information known in the question text, so they are unable to formulate problems, the mathematical operations carried out are incorrect, and they are unable to present and solve mathematical problems.

The results of the analysis above are also supported by the oral statements of students (S3), as in the following transcript.

Researcher : *Can you understand the linear function material well?*
Student (S3) : *I still don't understand how to write the values of x and y into the equation?*
Researcher : *How do you feel while taking the linear function lesson?*
Student (S3) : *I feel dizzy because I don't understand.*
Researcher : *What makes it difficult for you to understand the linear function material?*
Student (S3) : *My difficulty when starting to connect points with equations*
Researcher : *What will you do to improve your understanding of linear functions?*
Student (S3) : *I will study again through the YouTube application.*

The interview results above show that students (S3) still have a limited level of understanding of the concept of linear functions, but can identify information so that question number 1 can be solved. However, the limited understanding of the concept results in other difficulties, namely experiencing obstacles when formulating problems so that they are unable to achieve the indicators of mathematical literacy skills, namely: applying mathematical concepts; using facts to formulate problems, and; presenting and solving mathematical problems. Up to this stage, it can be said that students (S3) have not been able to achieve the literacy ability indicators (I1), (I2), (I3), or indicator (I4).

3.2. Discussion

Based on the results of the analysis of the test answers from 33 students, researchers have shown that grade VIII students have diverse mathematical literacy abilities. The achievement of students' mathematical literacy abilities in the high (S1), medium (S2), and low (S3) mathematical ability groups can be seen in Table 2. Students who achieved indicator (I1), namely being able to understand mathematical problems, were 11 or 64.71%. Students who were able to achieve indicator (I2), namely being able to apply mathematical concepts, were 9 or 52.94%. Students who were able to achieve indicator (I3), namely being able to use facts to formulate mathematical problems, were 9 or 52.94%. Students who were able to achieve indicator (I4), namely being able to present and solve mathematical problems, were only 4 or 23.53%. The student achievements above were further explored through interviews with samples from groups of students who had high (S1), medium (S2), and low (S3) mathematical abilities.

After the interview, students (S1) can be said to be truly able to achieve all the indicators set in this study, namely indicators (I1), (I2), (I3), and (I4). Based on the interview, it can be seen that what drives the achievement of students (S1) is high self-confidence. Regarding students' self-confidence which has a positive impact on mathematics learning outcomes, it has been revealed by previous research results which state that self-confidence in students can foster a spirit of learning which then influences the improvement of their mathematical abilities, in addition, their positive views on mathematics learning will encourage them to carry out tasks given by the teacher competently [17], [18]. Thus, it can be said that one of the factors that influences the achievement of students' mathematical literacy abilities is the self-confidence they have. In addition, students (S1) also expressed

that their self-confidence arose because they felt they had mastered the basic concepts of mathematics well.

Meanwhile, students with moderate mathematical abilities (S2) have not been able to achieve the indicator of presenting and solving mathematical problems or indicator (I3). The difficulties they experience are seen when drawing linear function graphs. The reason given by students (S2) is that there is a feeling of doubt when they are going to place the points (x, y) that they have obtained into Cartesian coordinates. This feeling of doubt is certainly caused by their understanding of Cartesian coordinates which is still limited. However, students (S2) already have a good basic understanding of linear functions as functions that form straight line graphs, as can be seen from the answers to other test numbers that were successfully completed correctly. Students with low mathematical abilities (S3) can be said to have not been able to achieve the indicator of understanding mathematical concepts or (I1), even though they can answer question number 1 correctly. Based on the oral statement they gave, it was identified regarding their inability to connect the concepts needed to solve linear function problems. In addition, students (S3) also admitted that they felt dizzy when they had difficulty understanding linear function material, which could be caused by mathematical anxiety in students. The difficulties experienced by students (S3) in understanding the concepts of linear functions have been revealed by previous research which stated that among the causes were that students had not mastered the substitution method and had not fully mastered how to perform algebraic operations in the form of addition and subtraction involving the variables x and y [19]. These difficulties can arise because students do not know the meaning of the variables used [20].

The findings of this study are in line with previous studies which state that the profile of students' mathematical literacy abilities will be influenced or depend on the level of mathematical ability that students have [21]. In addition, these findings are also in line with previous studies which concluded that students with strong self-efficacy have superior mathematical literacy abilities compared to other students who have medium and low self-efficacy categories. Likewise, students whose self-efficacy is in the medium category will have better mathematical literacy abilities than students with low self-efficacy [22]. Based on the description above, it can be recommended to teachers who will carry out the process of improving students' mathematical literacy abilities, namely by starting by improving the level of self-confidence or self-efficacy of their students. In addition to having an impact on improving mathematical literacy abilities, self-efficacy also affects the growth of a person's creativity, so it is important to build it since school [23]. More specific interventions can be given to students with low mathematical abilities (S3), including providing additional materials through the YouTube application as conveyed by students (S3) when interviewed by researchers. In addition, the use of learning methods that can minimize students' mathematical anxiety also needs to be tried, such as the realistic mathematics education method [24] and the Eliciting Activities Model [25].

4. Conclusion and Suggestions

Based on the indicators set in this study, it can be concluded that the mathematical literacy skills of students with high mathematical ability (S1) can achieve all indicators, namely: understanding mathematical problems (I1); applying mathematical concepts (I2); using facts to formulate mathematical problems (I3), and; presenting and solving mathematical problems (I4). Students with moderate mathematical ability (S2) cannot achieve the indicators: presenting and solving mathematical problems (I4), while students with low mathematical ability (S3) cannot achieve all the indicators set. Another finding in this study is the existence of self-confidence or self-efficacy of students that affects their

mathematical literacy skills. Therefore, it can be recommended to teachers who are concerned with improving students' mathematical literacy skills to start by improving students' self-efficacy in learning mathematics, or they can also start by trying to reduce students' mathematical anxiety levels first.

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