Mathematics Self-Efficacy of Junior High School Students in Solving the Problem of Equation of Straight Line

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Abstract

Self-efficacy has an important role in student success. Mathematics self-efficacy and sources of student self-efficacy are important determinants of mathematics achievement. The purpose of this study is to find out how the mathematics self-efficacy of junior high school students in solving the problem of equation of straight line. This research employed a qualitative research method with a case study research design. This research involved 6 students who had studied equations of straight line. Subjects filled out self-efficacy questionnaires to see the level of mathematics self-efficacy of students (high, medium, low). The subjects worked on questions about the problem of equations of straight line. The results of this study found that students who have high self-efficacy are more confident in their abilities. They completed the problems completely with sequential and clear steps. Meanwhile, students with medium self-efficacy were still not sure what they are doing. The answers given was still incomplete. Students with low self-efficacy were also still confused and unsure about doing the questions given. This can be seen from the incomplete steps of the solution and some parts that were not written in solving the problems. This study shows that mathematics self-efficacy affects students in solving problems.

Keywords: self-efficacy; solving the problem; equation of straight line

1. Introduction

Mathematics is one of the required subjects taught in schools and has important role in student success. In the cognitive aspect, students are expected to have good mathematical abilities to get good learning outcomes. Apart from the cognitive aspects, students also have psychological aspects that are important role in student success, one of which is self-efficacy. Self-efficacy is individual belief in his or her ability to organize and carry out a series of actions to achieve specified results. Self-efficacy is about how well a person believes they can complete a given task. Self-ability will have various impacts, such as planning the actions to be carried out, the amount of effort made, endurance in facing obstacles and difficulties, resilience to failure, thought patterns, stress and depression, and the level of achievement that is realized (Bandura 1997).

Self-efficacy has become the focus of research in various fields. This is particularly talked in educational research.The researchers reported that, regardless of previous ability achievement, high-ability students worked harder, lasted longer, endured adversity, had greater optimism and lower anxiety, and achieve more than low efficacy

students. They take on difficult tasks as challenges to be mastered and not as threats to be avoided. Students who doubt their abilities avoid difficult assignments, which they see as personal threats. They have the weak commitment and low aspirations for the goals they have chosen to pursue. When students are given difficult tasks, rather than concentrating on how to solve the problem successfully, they think about personal shortcomings and obstacles they will face. They give up quickly in the face of adversity, and slow to restore their sense of efficacy after failure. They lose faith in their abilities very quickly and easily fall victim to stress and depression (Maier & Curtin 2005).

If students do not have the academic performance they expect, it will foster negative attitudes towards the subject matter and their own academic abilities (Oldham 2018). Individuals who doubt their abilities are easily discouraged by struggles and failures, whereas individuals who are more confident persist despite obstacles until they find success ((Wernersbach et al. 2014). In determining one's future attitude, self-efficacy beliefs have a greater influence than past experiences. Even if a student has a negative past experience in mathematics, but they have high self-efficacy, they are tending to show positive attitudes in the subject that replace past experience ((Pajares & Miller 1994).

Self-efficacy includes three dimensions, namely: (a) Magnitude, where students assess their own beliefs and abilities in overcoming various difficulties in completing tasks. Individuals who have a high level of self-efficacy have the belief that they are able to do difficult tasks while individuals who have low self-efficacy have the belief that they are only able to do easy tasks, (b) Generality, means that individuals assess self-confidence in certain activities. Generalization has different dimensions that vary, including: degree of similarity of activity; ability capital shown through attitude, cognitive, and affective; describe the real situation; shows the characteristics of individual behavior. In the context of this generality, it is students' feelings about their own ability to complete various kinds of task situations or different task contexts from the teacher, (c) Strength, this dimension is the resilience and tenacity of individuals/students in fulfilling their duties. Students who have strong confidence and stability in their ability to complete a task will continue to survive despite many difficulties and challenges. So, it can be concluded that self-efficacy in mathematics is a student's or individual's belief in his or her ability to organize and carry out mathematics learning activities to achieve certain goals by predicting how much effort is needed to achieve these goals which are contained in the dimensions of magnitude, level, and strength(Bandura 1997).

As stated by Aşkar & Umay, Bandura's view of self-efficacy, influencing one's choice of activities, persistence against challenges, level of effort and appearance, is the subject of various studies. Research shows that people with high self-efficacy beliefs show great effort to complete their tasks, do not give up easily when dealing with negative things. They are patient and persistent with that. So, we can see that self-efficacy is one of the characteristics that must be considered in education. A study found that self-efficacy and mathematics achievement of students participating in this study are in line. The high mathematics self-efficacy of students resulted in high mathematics achievement, while the mathematics self-efficacy of students with low mathematics achievement was found to be low. The analysis of the findings of the study shows that high mathematics self-efficacy increases the effort made to complete math tasks, while low mathematics self-

efficacy creates a feeling of pessimism when completing the task to be done. This study shows that mathematical self-efficacy and sources of student self-efficacy are important determinants of mathematics achievement (Wernersbach et al. 2014).

A study on Chinese students found that the difference between high and low self-efficacy was clear. Five of the students who have high self-efficacy have the same viewpoint about the influence of sources of self-efficacy. Whereas students with low self-efficacy seemed to have more diverse viewpoints, four of them expressed relatively different points of view about the influence of each of their sources of self-efficacy. Several studies have shown that participants with high self-efficacy tend to be active in competition, whereas almost all participants with low self-efficacy appear to be deliberately avoiding competition (Gao 2020). Meanwhile, from a study in Indonesia found that level of self-efficacy on average for grade 10 high school students is moderate. This means that most of them have not fully believed in their abilities. Many students have great potential but lack confidence so that this potential is not optimally channeled in learning. Inadequate student self-efficacy in high school is caused by several factors such as students' cognitive levels, social disparities, teacher assessments of previous learning, and student character. Thus, it does not mean that students with high cognitive levels have high self-efficacy, and vice versa (Putri & Prabawanto 2019).

Based on studies above, it shows that some of the mathematics self-efficacy that students have is different. Students have high, medium, and low mathematics self-efficacy. The learning outcomes obtained tend to be in line with the level of mathematical self-efficacy that students have. That is, the differences in mathematics self-efficacy that students have affect their learning outcomes. But the fundamental question is whether the case of differences in mathematics self-efficacy also applies to students in grade 8 in solving the problems, especially about equation of straight line. This is what underlies this research.

2. Research Method

This study employed a qualitative research method using case study design. Case study research is a qualitative approach in which research explores the real life of a case or various cases through detailed and in-depth data collection that involves various sources of information such as observations, interviews, audiovisual materials, and documents from various reports, then reports case descriptions and case themes (Creswell 2015), 2018). Case study aimed to uncover the reasons behind the emergence of a problem and understand the interrelated factors.

The subjects in this study were 6 students of 8 grade in a junior high school in Tanjung Jabung Timur, Jambi who had studied the equation of straight line in their school. This research was conducted on students of the 2020/2021 academic year. In this study, all subjects were given a questionnaire on a mathematics self-efficacy scale and a written test in the form of an essay consisting of a question about the equation of straight line. The questionnaire of the mathematical self-efficacy scale was used to determine the level of mathematical self-efficacy of students (high, medium, low). The self-efficacy indicators used according to (Bandura 1997) include three dimensions, that are magnitude, generality, and strength. While the written test in the form of a question about equation of straight line is used to see how the subjects resolved the problem.

Then, the answer will be analyzed related to the mathematics self-efficacy of the students.

The self-efficacy questionnaire used is based on the three-dimensional indicators of self-efficacy proposed by Bandura, Hoban, Sersland, Raine in Wongsri, Cantwell, Archer which is attached to the following Table 1 (Utari et al. 2017).

Table 1. Indicators of self-efficacy

	Dimensions of self-efficacy	Indicators
1.	Magnitude	The degree of efficacy overcomes learning difficulties.
2.	Strength	Showing how high the students' efficacy in overcoming their learning difficulties.
3.	Generality	Showing self-efficacy will take place in a variety of activities and situations.

In this study, 6 students were asked to do an online self-efficacy questionnaire. To determine the level of students' mathematical self-efficacy, it was obtained through the results of a questionnaire presented on google form. Students are asked to fill out a self-efficacy questionnaire using their smartphone. Then students can read the statements contained in the questionnaire and choose one of the answers. The questionnaire consists of 10 positive statements and 10 negative statements. Likert scale figures compiled present four choices, namely SS (strongly agree), S (agree), TS (disagree), and STS (strongly disagree). Option N (neutral) is not used in order to lead students to take sides. Each choice has a different score. As for the scoring of each statement, it is presented in the following table.

Table 2. Score of student self-efficacy level

Options	Scores of positive statement	Scores of negative statement
SS	4	1
S	3	2
TS	2	3
STS	1	4

To categorize the level of student self-efficacy adapted from (Sadewi et al. 2012) and adjusted to the self-efficacy grid according to (Utari et al. 2017) which is presented in the following table.

Table 3. Category of the level of student self-efficacy

Interval	Category of self-efficacy
61-80	High
41-60	Medium
20-40	Low

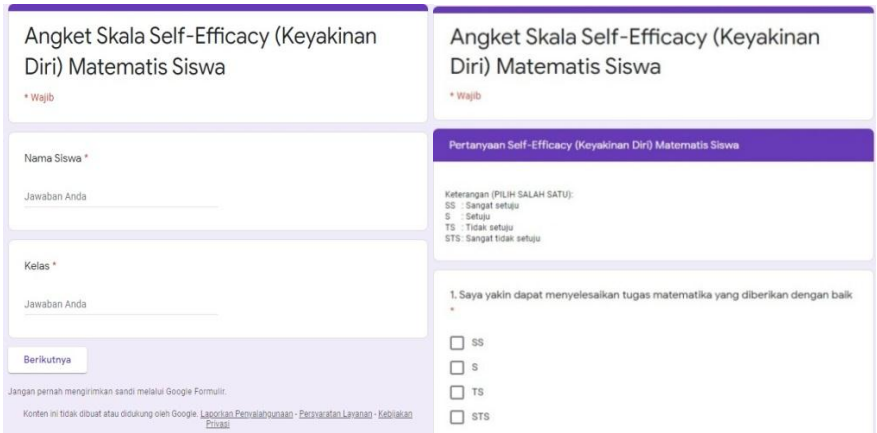

Fig. 1. Student self-efficacy questionnaire on google form

After the students finished filling out the questionnaire, then the six students were asked to work on the equation of straight line problem, that is:

The Problem of Equation of Straight Line

Given the line g through point C (0, b) and point D (4,7). Find the value of b if line g is perpendicular to line k whose equation $3y = -4x-6$. Then determine the equation for the line g.

3. Result and Discussion

From the results of the student self-efficacy questionnaire analysis, it was found that 2 students had a high level of self-efficacy, 2 students had a medium level of self-efficacy, and 2 students had a low level of self-efficacy. ST1 and ST2 are students who have a high level of self-efficacy, SS1 and SS2 are students who have a medium level of self-efficacy, and SR1 and SR2 are students who have a low level of self-efficacy.

Table 4. The Results of student's self-Efficacy level

	Students	Student's total self-efficacy score	self-efficacy level
1	ST1	67	High
2	ST2	64	High
3	SS1	57	Medium
4	SS2	57	Medium
5	SR1	40	Low
6	SR2	39	Low

After the students finished filling out the questionnaire, then the six students solved the equation of straight line problem from the questions given.

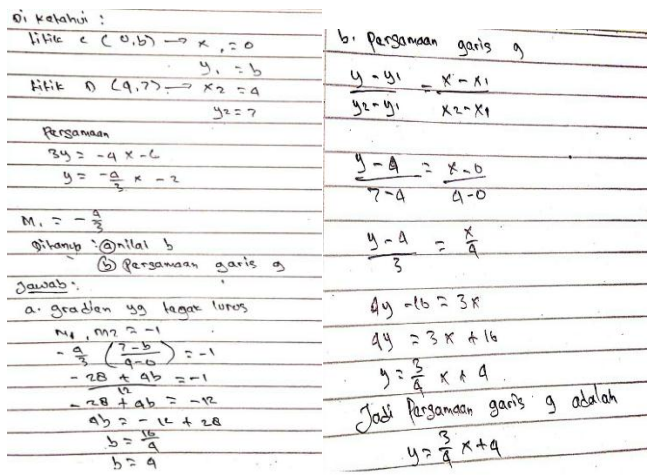

Fig. 2. ST1 answer sheet

ST1 already understand the meaning of the questions given. He wrote down the steps in detail describing what was known and asked. Before finding the value of *b*, ST1 first looks for the slope of the line *k* obtained from the equation 3*y* = -4*x*-6 and converted into $y = \frac{-4}{3}x - 2$. So, he got the slope of the line *k* (m_1) is $-\frac{4}{3}$. After that, ST1 looks for the value of *b* by taking into account the information that line *g* is perpendicular to line *k*. Thus, he wrote $m_1.m_2 = -1$ and the slope of the line *g* (m_2) is obtained from the point traversed, namely point *C* (0, *b*) and point *D* (4,7). From this equation, then ST1 got the value *b* = 4. Next, ST1 would determine the equation for the line *g*. Since the line *g* passed through point *C* (0, *b*) and point *D* (4,7), ST1 used the equation for the line $\frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x-x_1}$. After substituting the *x* and *y* values for this equation, the equation for the line *g* is $y = \frac{3}{4}x + 4$. From this it can be seen that ST1 has understand the problem well and understands the purpose of the question. This can also be seen from the

answers he wrote in sequential and clear steps, resulting in the answers requested. This shows that ST1 is confident and capable of working on the questions given.

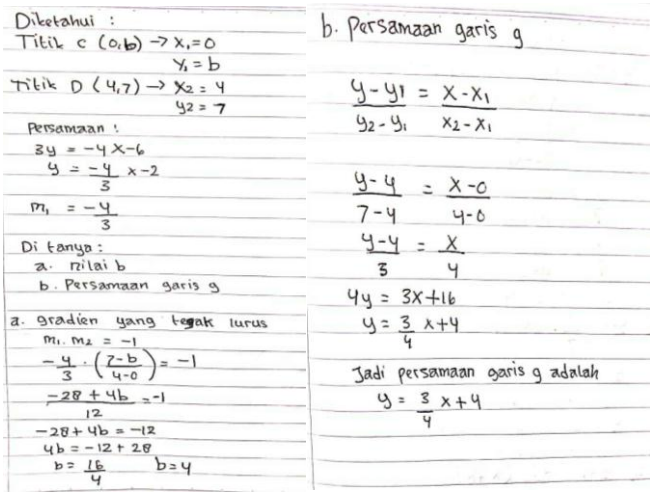

Fig. 3. ST2 answer sheet

ST2 already knew the meaning of the questions given. She wrote down the steps in detail what was known and asked. Before finding the value of *b*, ST2 first looks for the slope of the line k obtained from the equation 3*y* = -4*x*-6 and converted into $y = \frac{-4}{3}x - 2$. So, she got the slope of the line *k* (m_1) is $-\frac{4}{3}$. After that, ST2 looks for the value of *b* based on the information that line *g* is perpendicular to line *k*. Then, she wrote $m_1.m_2 = -1$ and the slope of the line *g* (m_2) is obtained from the point traversed, namely point *C* (0, *b*) and point *D* (4,7). From this equation, then ST2 gets the value *b* = 4. Next, ST2 will determine the equation for the line *g*. Since the line *g* goes through point *C* (0, *b*) and point *D* (4,7), ST2 used the equation of the line formula $\frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x-x_1}$. After substituting the *x* and *y* values for this equation, the equation for the line *g* is $y = \frac{3}{4}x + 4$. From this it can be seen that ST2 understands the problem well and understands the purpose of the question. This can also be seen from the answers she wrote in sequential and clear steps, resulting in the answers requested. This shows that ST2 is confident and capable of working on the questions given.

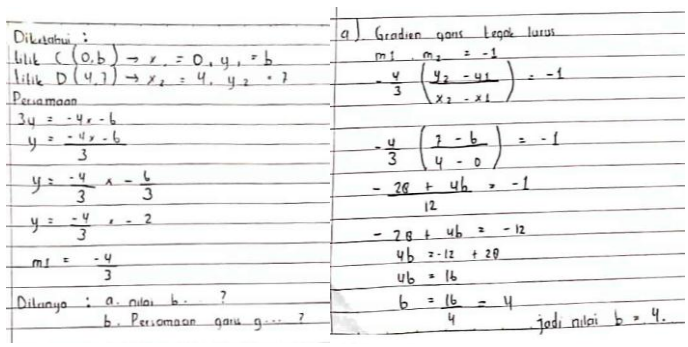

Fig. 4. SS1 answer sheet

SS1 has understand the meaning of the questions given. She wrote down the steps of what was known and asked, although there were some less obvious writings such as writing x_1 and x_2. Before finding the value of b, SS1 first looked for the slope of the line k obtained from the equation 3y = -4x-6 and converted into $y = \frac{-4}{3}x - 2$. So, she got the slope of the line k (m_1) is $-\frac{4}{3}$. After that, SS1 looks for the value of b based on the information that line g is perpendicular to line k. Thus, she wrote $m_1.m_2 = -1$ and the slope of the line g (m_2) is obtained from the point traversed, namely point C (0, b) and point D (4,7). From this equation, then SS1 got the value b = 4. For the next step, SS1 did not solve the next problem about the line equation g. This means that SS1 had difficulty solving the problem, even though she had written it in the 'asked' section. From this, it can be seen that SS1 already understand the problem well and understand the purpose of the question, but she had experience difficulty solving the questions. So, the answer that she had working on is not complete. This shows that SS1 is still not sure about the answer it is working on.

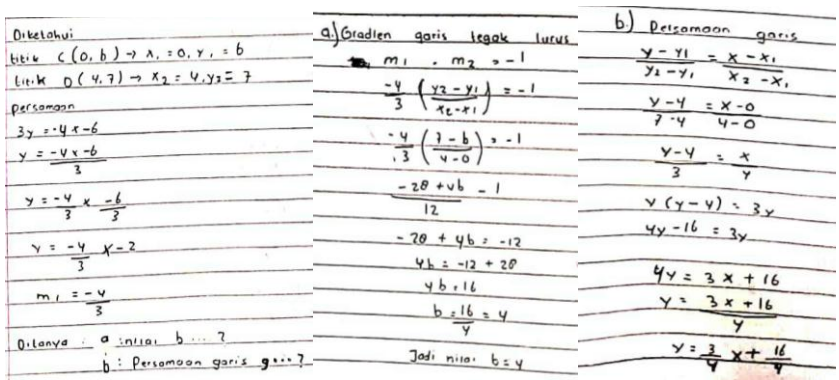

Fig. 5. SS2 answer sheet

SS2 has understand the meaning of the questions given. She wrote down the steps of what was known and asked, although there were some less obvious writings such as writing x_1, x_2, y_1, and y_2. Before finding the value of *b*, SS2 first looks for the slope of the line *k* which is obtained from the equation 3*y* = -4*x*-6 and converted into $y = \frac{-4}{3}x - 2$. So, she got the slope of the line *k* (m_1) is $-\frac{4}{3}$. After that, SS2 looks for the value of *b* based on the information that line *g* is perpendicular to line *k*. Then, she wrote $m_1.m_2 = -1$ and the slope of the line *g* (m_2) is obtained from the point traversed, namely point *C* (0, *b*) and point *D* (4,7). From this equation, then SS2 got the value *b* = 4. Next, SS2 will determine the equation for the line *g*. Since the line *g* goes through point *C* (0, b) and point *D* (4,7), SS2 used the equation of the line formula $\frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x-x_1}$. After substituting the *x* and *y* values for this equation, the equation for the line *g* is $y = \frac{3}{4}x + \frac{16}{4}$. The answer written by SS2 could be simplified even further to $y = \frac{3}{4}x + 4$. In addition, SS2 also did not write the conclusion about the equation of the line *g*. From this, it can be seen that SS2 already understand the problem and understand the purpose of the question, but the answer from the question is still incomplete. This is possible because SS2 is in a hurry to do the problems.

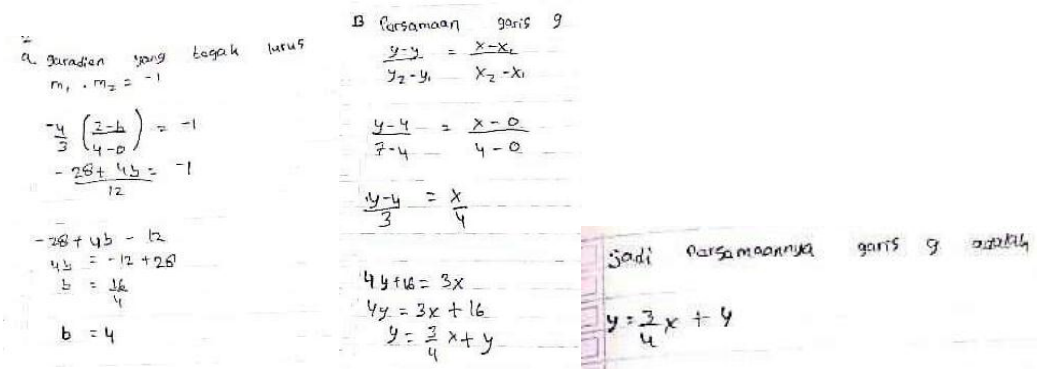

Fig. 6. SR1 answer sheet

SR1 already understands the meaning of the questions given. But she did not write down the complete steps because there was no explanation of what was known and asked. Also, to find the value of *b*, SR1 should first find the slope of the line *k* obtained from the equation 3*y* = -4*x*-6 and convert it to $y = \frac{-4}{3}x - 2$. So that the slope of the line *k* (m_1) is $-\frac{4}{3}$. From this, it appears that SR1 is not too sure about the answer she wrote. Then, SR1 looks for the value of *b* based on the information that line *g* is perpendicular to line *k*. Thus, she wrote $m_1.m_2 = -1$ and the slope of the line *g* (m_2) is obtained from the point traversed, namely point *C* (0, *b*) and point *D* (4,7). From this equation,

then SR1 got the value of b = 4. Next, SR1 will determine the equation for the line g. Since the line g goes through point C (0, b) and point D (4,7), SR1 used the equation of the line formula $\frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x-x_1}$. After substituting the x and y values for this equation, the equation for the line g is $y = \frac{3}{4}x + 4$. In addition, SR1 also has written its conclusions about the equation of the line g. From this, it can be seen that SR1 already understands the problem and understands the purpose of the question, but the steps are still incomplete, this could be because SR1 is working in a hurry.

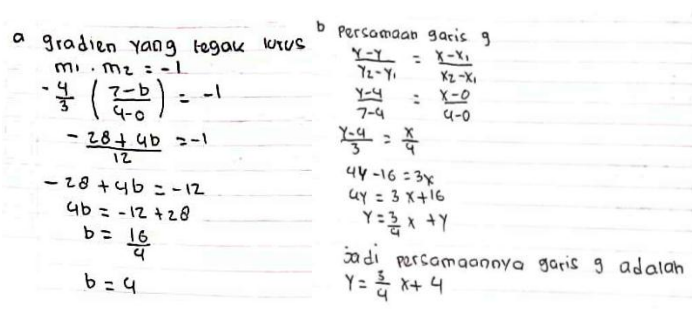

Fig. 7. SR2 answer sheet

SR2 already understands the meaning of the questions given. But he did not write down the complete steps because there was no explanation of what was known and asked. Also, to find the value of b, SR1 should first find the slope of the line k obtained from the equation 3y = -4x-6 and convert it to $y = \frac{-4}{3}x - 2$. So that, the slope of the line k (m_1) is $-\frac{4}{3}$. Then, SR2 looks for the value of b based on the information that line g is perpendicular to line k. Thus, he writes $m_1.m_2 = -1$ and the slope of the line g (m_2) is obtained from the point traversed, namely point C (0, b) and point D (4,7). From this equation, then SR2 got the value of b = 4. Next, SR2 will determine the equation for the line g. Since the line g goes through point C (0, b) and point D (4,7), SR1 used the equation of the line formula $\frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x-x_1}$. After substituting the x and y values for this equation, the equation for the line g is $y = \frac{3}{4}x + 4$. In addition, SR2 has also written its conclusions about the equation of the line g. From this it can be seen that SR2 already understands the problem and understands the purpose of the question, but the steps are still incomplete, this could be because SR2 is working in a hurry.

4. Conclusion

Based on the results of the self-efficacy questionnaire filled out by students, it is found that 2 students had high self-efficacy, 2 students had medium self-efficacy, and 2

students had low self-efficacy. Then, each student solved the problem of equation of straight line. From the students' problem solving, it can be seen that students with high self-efficacy understand the questions well and understand the intent and purpose of the questions given. So that, they solve the problem completely, the steps are sequential and clear. This means that they are confident in their abilities. Students with medium self-efficacy maybe already understand the questions given, but the answers given are still incomplete. This could be because the student is still not sure what they are doing. While students with low self-efficacy can also understand the questions given, but have problems in solving the questions. This can be seen from the incomplete steps of the solution and some parts that were not written in solving the problems. This may be because the student is still confused and unsure about doing the questions given. It can be concluded that students with high self-efficacy are better at solving problems.

It was also found in previous research that students with low self-efficacy in writing questions given were still incomplete and the answers given did not use mathematical symbols. Students with medium self-efficacy were in writing the information provided in full, in detail and using mathematical symbols but they still made mistakes. While students with high self-efficacy in writing the information provided are complete and use appropriate mathematical symbols (Sayekti et al. 2020).

This study shows that mathematics self-efficacy affects students in solving problems, especially in the problem of equation of straight line. Good self-efficacy will help and encourage students' confidence in solving mathematics problems optimally and produce satisfactory results. In addition, students can improve attitudes and behavior to be better than before so that the ideals and hopes for the future in life will also increase and form positive suggestions in themselves.

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