JUNIOR HIGH SCHOOL STUDENTS' ERROR: ANALYSIS IN MATHEMATICAL STORY OF CARTESIAN COORDINATES USING POLYA STEPS

Andi Maryanto[1], Hanim Faizah[2]*, Eko Sugandi[3]
Universitas PGRI Adi Buana Surabaya, Indonesia
*E-mail: fhanim@unipasby.ac.id

ABSTRACT

More than a few students are uneasy to solve mathematics word problem. The purpose of this study is to describe the type of error and the factors that cause students to make a mistake in solving mathematics word problem. This study carried out at SMPN 2 Sukodono. The method of data collection of this research is tests and interviews. The method of data analysis in this study id data reduction, test results analysis, display data, and withdrawal or verification. Studies show made that the flaw of subjects 1, subject 2, and subject 3 lie in the understanding of the problem, formulating a plan, carrying out a plan, and examining answer. According to Polya, the three students had problem at the stage of solving mathematics word problem therefore, the three subjects could not continue the work at the next phase of formulalting a plan, carrying out a plan, and examining answer. The cause of the students' mistakes is that the students did not understand the concept of the matter's coordinates. Students didm't understand the problem well, so they didn't understand the proper problem settlement planning.

Keyword : error analysis, mathematical stories, Polya steps, cartesian coordinates

INTRODUCTION

One of area science that plays an important role in daily life especially in school is mathematics. Mathematics is a knowledge that can sharpen logical thinking ability and analysis especially for students as the object of their knowledge [2]. A knowledge is important and also useful to be learned as knowledge and provision for someone's life called mathematics [16]. Mathematics is an important knowledge for a person to learn [9]. Because it became the basic for someone life's work in the age of globalization. Wherever a student is, math will always have a connection with their life. Therefore, mathematics will certainly learned by students at all the stages of education [11]. The purpose of learning math is to give students emphasis on formulating reason, forming an attitude, math application skills on daily life in order to learn other knowledges [12]. But in a real condition, the process of learning mathematics is not always successful. Different levels of student ability can also affect process learning of mathematics. If the student ability is low, it will affect the mathematics learning process in a negative way and so on. An error on the question with certain materials can causing student difficulty. Students who having trouble also make mistakes at a certain step. The majority of learning that is carried out during online learning is more teacher-centered learning [4].

The definition of error is a deviation rather than a predetermined procedure of truth [3]. As for other ide, an error is a form of deviation from a proper and expected procedure

---

[1] Student of Mathematics Education Study Program, PGRI Adi Buana University.
[2,3] Lecturer of Mathematics Education Study Program, PGRI Adi Buana University.

[18]. In solving math problem, many students who are inadequate and make mistake especially on mathematical stories. Therefore, to be able to understand the subject matter of mathematics, it is better to teach the concepts in the material that is taught sequentially [13].

The story presented with a verbal language that has a connection between routinize of human life is called mathematical stories [1]. Completing math story is an example of a problem breaker that useful in student life, but in reality, many students have made a mistake on that [17]. Another definition is that mathematical stories can be solved using numbers, relations, and numeral operations $(+, \times, -, \div)$ [14]. Students in solving math stories, of course, can't escape from mistakes. With students making mistakes when solving a problem, it can be made as a measure of how to know the student's level of understanding a material. This statement is similar to the statement that if you want to improve students' mastery of material, you can find a solution through student mistakes [10]. Therefore, it needs to be identified the kind of faults and variables that encourage the student to do so and then look for solutions.

Student mistakes in solving math word problems is a fact, where students make mistakes in changing problems into mathematical models [6]. Student mistakes in solving word problems is one of the indicators to find out how far students know the basic concepts of mathematics. These errors do not only occur by chance, but often the same errors occur continuously from the basic level to the higher levels. Students' mistakes when solving story problems need to be identified, so that the same mistakes are not repeated. Related to student errors, the results of other studies on Cartesian coordinate material according to Kastolan's theory, show that conceptual errors are the most frequent errors students make [7]. The subject had difficulty determining the formula and theorems, so that the results of student work are not correct. The result of other research found that there were not a few students who went through the stages of understanding the problem, transformation of the problem, the skill of the process, and the writing of the final answer [6].

In the actual conditions in the field, researcher have obtained the fact that in the junior high school 2 Sukodono, many students have difficulty in the material cartesian coordinates. Based on student's mathematics scores, the student's level of understanding is low. Based on the results obtained, it is important to analyze the types of errors and also the factors that make students make mistakes, especially in Cartesian coordinates [10]. In addition, other studies show results that the most frequent errors for each number lie in technical errors in calculations with an average of 59%, an average of 39.6% data usage errors, an average of 33% conceptual errors, an average error in language interpretation is 19.8%, and the average error in drawing conclusions is 46.2% [8]. Another study conducted on students in Central Banjarmasin showed that students made four types of errors in solving social arithmetic word problems based on Polya's steps [15]. Errors with a low category are errors in understanding the problem. Meanwhile, errors with a pretty high category are planning errors, planning completion errors, and re-checking errors.

Due to errors in student problem solving then the analysis of errors in problem solving can be used the Polya steps. Math problems can be grouped into two kind of (1) problem to find (2) problem to prove. "Problem to find" is to determine, seek out, or acquire a certain value that unknown by certain terms of calculation. While "problem to prove" is a step for determine true or false statement (Polya, 1973: 154 - 157). Polya, in (Polya, 1973: 5 – 19) also has an opinion that mathematical solutions consist of four steps

(1) understanding problem, (2) formulating a plan, (3) carrying out a plan, and (4) examining answer.

Previous studies have been conducted error analysis using Newman and Kastolan theories, but there is no research has used Polya's theory to analyze errors. For this reason, Polya theory is used to analyze errors in cartesian coordinates. This research has purpose to describe the type of error and the factors that cause students to make a mistake in solving mathematics word problem especially cartesian coordinates with Polya steps.

METHODS

The type of research applied is a qualitative study because it has purpose to describe the type of errors and the factors that cause of VIII-A SMPN 2 Sukodono students make mistakes in mathematical stories of cartesian coordinates based on Polya's theory.

In collecting data, the methods employed are written tests and interviews. Writing tests are required to get the student's answer results then being analyze with Polya steps. Interviews are needed to gain more depth information about student's errors. The study take place at junior high school 2 Sukodono. The source of data obtained from junior high school 2 Sukodono student's 2021/2022. This class is also being recommended by teacher as a research source because it is a class with the most student errors viewed from the teacher's portfolio data on the results of previous student studies. From the 17 students of VIII-A, A group, 3 students have taken with high percentage of the test results and they will be the source in the interview. The research subjects obtained through the first test, determined by the students who made the most mistakes.

There are 2 questions presented regarding the material of cartesian coordinates in the form of descriptions. The interview technique that researchers applied to was semi-structured. The technique is using in order to know more deeply why the students make mistakes. The question index was printed as a guideline for interviews that contained an outline of questions for a research subject or interview source.

The analysis of the test results used is the qualitative data analysis test results according to Miles and Huberman. The data that has been collected being analyze using data reduction, test results analysis, display data, and withdrawal or verification. The student's error studied was an error in solving the problem with the Polya's steps. The following data analysis techniques are used:

Table 1. An Error Analysis Indicator Based on Polya Steps

Math Problem	Error Type	Indicator
Problem to Find	Understanding the problem	a. Error when determining what being known. b. Error when determining what being ask
	Formulating a plan	a. Mathematical modelling errors. b. Error determines the steps to solve the problem.
Problem to Prove	Carrying out a plan	a. Error calculation completion of the math model that used. b. Error marks completion of the math model that has been made. c. An error determines the conclusion to problem solving.
	Examining answer	a. Error in the sequence of completion steps in examining the obtained solutions. b. Error math calculation in examining solution that has been obtainable. c. Error get the final answer.

RESULTS AND DISCUSSION

A.   Results

In this research, the test is presented in the form of descriptions and in needed to find the types of errors made by students. The interview session was used to trigger the subject to make a mistake. After analyzing and grouping the subject's errors, researcher present the results on a chart. Here's the subject's error analysis:

Table 2. Subject's Errors

Math Problem	Error Type	Percentage of students made mistakes	Students Error	Subject's Error point		
Problem to Find	Understanding problem	35%	√			
	Formulating a plan	47%	√	Subject 1	Subject 2	Subject 3
Problem to Prove	Carrying out a plan	59%	√			
	Examining answer	71%	√			

1.   Subject 1 (S1)

a.   Error Analysis S1 Number One

In question number one, S1 made an error at all stages of understanding problem, formulating a plan, carrying out plan, and examining answer. The following student's solution for number 1:
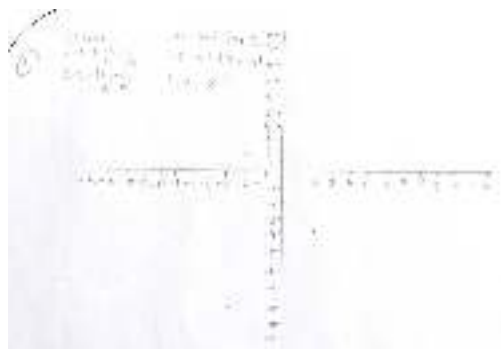
Figure 1. S1 Solution for Number One

In Figure 1, S1 does not write down the point asked and not make a math model that fit for the question. To get the answer, S1 make a cartesian coordinates and then places the known points and do some multiple operations at the points in question. This can be helped by the results of interviews between researcher and subject 1 as follows:

R   : *"Why didn't you write down what was asked on your paper?"*
S1   : *"(Quiet for a moment). Because I didn't think about that,"*
R   : *"Why don't you take the coordinates points of the Arin's house, Bayu's house, and Candra's house for example?"*
S1   : *"Because I don't know how to assume the house."*
R   : *"Can you please explain the process that you are doing?"*
S1   : *"By drawing cartesian coordinates then placing a known point on the coordinates and then multiplying it."*
R   : *"So the coordinates that you got earlier, do you multiply it?"*
S1   : *"Yes."*
R   : *"Why do you have to multiply it?"*

S1   : "Because I think that's the way to answer the question".
R   : "Did you re-check the question number 1?"
S1   : "No."
R   : "Why didn't you re-check it?
S1   : "Because I think my answer is correct."

Based on the solutions and interviews with S1 above, it can be obtained an information that S1 was wrong at 4th steps, understanding question because S1 didn't write what was asked, at the step of formulating a plan because S1 unthinkable to write it down, at the step of carrying out a plan S1 incorrect because only using multiple operations on known points to get the answer, and at the step of examining answer because S1 think it is correct.

Because in the first step S1 made a mistake of understanding problem, then according to Polya, the student has an error at stage "problem to find". By making this mistake, S1 also has an error at the stage of "problem to prove". As a result, S1 is unable for continue her work to the next phase of formulating a plan, carrying out a plan, and examining answer.

b.   Error Analysis S1 Number Two

In question number two, S2's solution was false at 4 steps of understanding problem, formulating a plan, carrying out plan, and examining answer. The following student's solution for number 2:
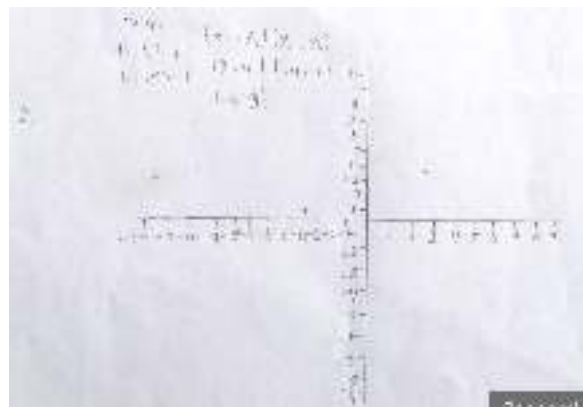
Figure 2. S1 Solution for Number Two

S1 doesn't understand the problem well. It shown at Figure 2, S1 does not write down the asked point and not make a math model that suitable for the question. To get the answer, S1 make a cartesian coordinates and then places the known points and subtracting the points. This can be helped by the results of interviews between researcher and subject 1 as follows:

R   : "Why didn't you write down what was asked on your paper?"
S1   : "So I can answer it faster,"
R   : "Why don't you take the coordinates points of the Radit's house, the crossroad ,and Fira's house for example?"
S1   : "Because I don't know how to assume the points."
R   : "Can you explain the process that you are doing?"
S1   : "By drawing cartesian coordinates then placing a known point on the coordinates and then subtracting it.".
R   : "Did you re-check the question number 1?"
S1   : "No."

R   : "Why didn't you re-check it?
S1   : "Because I think my answer is correct."

Based on the solutions and interviews with S1 before, it can be obtained that S1 was wrong at 4 steps, at the step of understanding question because S1 didn't write what was asked and want to finish it quickly, at the step of formulating a plan because S1 don't know how to assume the points, at the step of carrying out a plan S1 was false because only use subtracting to the known points for get the answer, and at the step of examining answer because S1 think it is correct.

Because S1 had made a mistake of understanding problem, then according to Polya, the student has an error at stage "problem to find". By making this mistake, S1 also has an error at the stage of "problem to prove". As a result, S1 is unable for continue her work to the next phase of formulating a plan, carrying out a plan, and examining answer.

Based on the data obtained by the researcher, the process of learning is done via online using Power Point (PPT), so S1 is lack of a comprehensive knowledge related to the material and lack of an understanding of important points of the material.

2.   Subject 2 (S2)
a.   Error Analysis S2 Number One

In question number one, S2 made a four-step error of understanding question, formulating a plan, carrying out plan, and examining answer. The following of the solution's S2 for number 1:
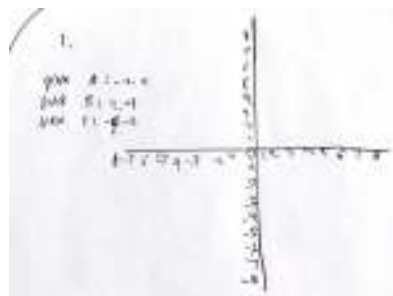

Figure 3. S2 Solution for Number one

According to Figure 3, S2 didn't understand the problem well because S2 not write down what was known and asked also the solution step that used by S2 incorrect. S2 only make cartesian coordinates then exchange point X, coordinates of A (-2, 2) to Y on the answer and point Y, coordinate of B (2, -4) which becomes X in the answer that has already known by student. S2 didn't formulating a plan, carrying out a plan, and examining answer well. It can be known through the solution step and S2's response that incorrect. S2 also not checking back the answer. This can be supported by the result of the researcher's interview with student as follows:

R   : "Why on your answer sheet not writing down what was known and asked?"
S2   : "So it can finish quickly."
R   : "Why don't you take the coordinates points of the Arin's house, Bayu's house, and Candra's house for example as they're known in the question?"
S2   : "So I can finish it quickly."
R   : "what points that you got in there?"
S2   : "Point A(-2,2), point B(2, -4) point C(-4, 2)."
R   : "How did you get the answer (-4, -2)?"
S2   : "By making -2 as y and -4 as x."
*R   : "So are you do an operation like a addition or subtraction?"*
S2   : "No."

R   : "So you make coordinates of the answer. By what was known with this point (point A dan point B) then you exchange it?"
S2   : "yes."
R   : "Why you use that strategy?"
S2   : "To make it easier for find the answer."
R   : "Did you re-check the question number 1?"
S2   : "No."
R   : "Why didn't you re-check it?
S2   : "Because I think my answer is correct."

Based on S2's answers and interviews, it can be concluded if S2 wrong at 4 stages of understanding problem because S2 did not writing down what was asked for, S2 unthinkable to write it, at stage of formulating a plan because S2 don't know how to assume it, at stage of carrying out a plan was false because only use multiple operations on known points to get the answer, and at stage of examining answer because S2 felt it was correct.

Because S2 had made a mistake in the first stage of understanding problem, then according to Polya, the student has an error at stage "problem to find". By S2 make a mistake, then S2 has an error at the stage of "problem to prove". As a result, S2 is unable for continue her work to the next phase of formulating a plan, carrying out a plan, and examining answer.

b.   Error Analysis S1 Number Two

The answer of S2 in question number 2 still looks like he made a four-step errors in Polya. He misunderstood the problem, devised a plan, carried out a plan, and checked the answer. The following student's solution for number 2:
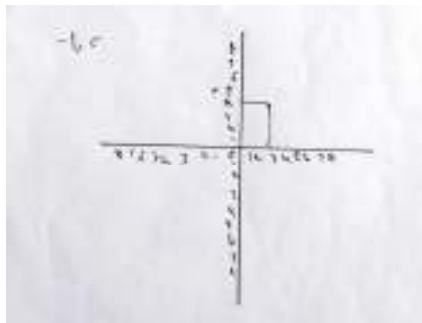
Figure 4. S2's Solution for Number Two

For the question number 2, S2 did the question but his answer was wrong. According to four Polya's step understanding problem, formulating a plan, carrying out a plan, and examining answer, S2 didn't understand the question so well. It can be seen from S2's result, the step solution that student used was not correct. S2 just move Radit's point toward the crossroad, it is (3, 4), 4 to the left and 1 up according with Fira's coordinate toward Radit's house (-4, 1). S2 didn't formulating and carrying a plan properly. That can be seen through the step solution and result of S2 who was not correct. S2 didn't examining his answer, so the result and step solution that made by him was wrong. To support the researcher statement, the results of the interview with S2 are presented as follows:

R   : "what was known and asked from the question number 2?"
S2   : "Radit's house is located at a position (3, 4) to the crossroad. Fira's house is located at a position (-4, 1) toward Radit's house. Determine the position of Fira's house to the crossroad."
R   : "Why didn't you write down what was asked on your paper?"

> S2   : "So it will finish quickly."
> R   : "So how do you get the point (-1, 5)?"
> S2   : "From radit's house toward the crossroad, move left 4 steps and up 1 step."
> R   : "Is it according to what was known, Fira's house toward Radit's house, isn't it?"
> S2   : "ya."
> R   : "why use this strategy?"
> S2   : "To finish faster."
> R   : "Did you re-check the question number 2?"
> S2   : "Nope."
> R   : "Why didn't you re-check it?
> S2   : "Because I think my answer is correct."

According to answers and interviews of S2 above, it can be known if S2 actually know the point what was asked from question number 2. S2 didn't write it on the paper because he went to finish the question quickly. S2 is not able to do the question well. It can be seen in the interview script that S2 just make cartesian coordinates and move radit's point toward the crossroad (3, 4), as far to the left 4 and up 1 step appropriate with Fira's coordinate toward Radit's house (-4, 1). The student used this strategy because he thinks his strategy was correct. The student also not examining the answer toward step solutions and result that he gained because he felt that the answer was correct.

Because S2 had made an error in the first step, understanding problem, then according to Polya, the student had a problem Based on the solutions and interviews with S2 before, it can be obtained that S2 was wrong at 4 steps, at the step of understanding question because S2 didn't write what was asked and want to finish it quickly, at the step of formulating a plan because S2 don't know how to assume the points, at the step of carrying out a plan S2 was false because only use subtracting to the known points for get the answer, and at the step of examining answer because S2 think it is correct.

Because S2 had made a mistake of understanding problem, then according to Polya, the student has an error at stage "problem to find". By making this mistake, S2 also has an error at the stage of "problem to prove". As a result, S2 is unable for continue his work to the next phase of formulating a plan, carrying out a plan, and examining answer.

S2 had made an error in the first step of understanding problem, then the researcher can conclude that S2 is lack of a understand the matter. Based on the data obtained by the researcher, the process of learning is done via online using Power Point (PPT), so S1 is lack of a comprehensive knowledge related to the material and lack of an understanding of important points of the material.

3.   Subject 3 (S3)
a.   Error Analysis S3 Number One

S3 made a mistake at four of Polya step. The error is understanding problem, formulating a plan, carrying a plan, and examining problem. The following student's solution for number 1:

Figure 5. S3 Solution for Number One

In Figure 5, S3 answer the question but her answer that given was wrong because according of four Polya's step, understanding problem, formulating a plan, carrying a plan, examining answer, S3 didn't understand the problem because through by her final answer, it's not correct. S3 just make a caretesian coordinates and places the point that has been known from the question (coordinate of Arin's house toward Candra's house (-2, 2) and coordinate of Candra's house toward Bayu's house) and then do subtraction operation on those points. S3 didn't formulating a plan and carrying a plan correctly. It can be seen on her sheet answer which doesn't include the points in the question and uses an elimination or substitution to get the answer. Otherwise, S3 just eliminating the points that has been known. S3 also doesn't seem examining her answer. The opinion oof researcher can be supported by the result of interviews with S3 as follows:

> R   : "Why didn't you write down what was asked on your paper?"
> S3 : "So I can finish it quickly."
> R   : "Why don't you take the points that known in the question for an example?"
> S3 : "(Quiet for a moment). Because I directly answer the question and not take it for example."
> R   : "Can you explain the process that you are doing?"
> S3 : "With draw the point, coordinate. I draw coordinates and places known points and then subtract it."
> R   : "why should these point be subtracted?"
> S3 : "Because I think it should be."

Based from the answers and interviews above, it can be known S3 didn't write what was known and asked, so she can finish the question quickly. S3 unable to do the problem correctly. Attached in the result of interviews above, S3 is proving do subtract operation for find the answer. This plan that has been used by student was wrong. S3 uses that plan because she thought it right. S3 doesn't assume the known points in the problem, so that her step solution and result was false. When the work has done, S3 didn't check again with the problem step solutions also the result that has been gained because she though the result and step solution that has been taken is correct.

Based on Polya's step, whih is the first step is understanding problem, S3 has made an error. Therefore, S3 has problem at stage "problem to find" so that the student also has problem at the stage of "problem to prove". As a result, S3 is unable for continue her work to the next phase.

b.   Error Analysis S3 Number Two

For the question number two, S3 made a mistake at four stages. S3 error is understanding problem, formulating a plan, carrying out plan, and examining answer. The following student's solution for number 3:
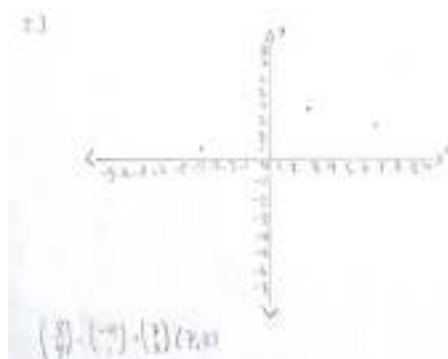

Figure 6. S3 Solution for Number Two

In question number 2, S3 looks like do the question but her answer was incorrect. The student didn't carry out the 4 steps that must be passed so that the answer s obtained by the subject is correct. S3 was wrong at several steps of understanding problem, formulating a plan, carrying a plan, and examining answer. According with Polya's step of understanding problem, S3 doesn't understand the problem carefully yet. S3 doesn't write what was known and asked on the answer sheet. S3 also didn't formulating a plan and carrying a plan correctly. S3 doesn't make a fit example and do substitution or elimination steps to obtain the result. S3 only had a reduction of known points (coordinate of Radit's house toward crossroad (3, 4) and coordinate of Fira's house toward Radit's house (-4, 1)). S3 also seems not examining the formulation plan and the result that obtained well so her answer not correct. To strengthen that statement, the researcher's interviews with the subject are presented as follows:

R : *"What was known and asked from question number 2?"*
S3 : *"Fira's house is located at position (-4, 1). Radit's house is located at (3, 4) toward the crossroad. Determine position of Fira's house toward the crossroad."*
R : *"Why don't you write down the points that known and asked in question number 2?"*
S3 : *"So I can finish it faster."*
R : *"Why don't you take the coordinate of Radit's house, the crossroad, and coordinate of Fira's house for an example?"*
S3 : *"I'm not doing it because I... I'm using the way I work."*
R : *"And what is it?"*
S3 : *"Reduced (chuckling)."*
R : *"Can you explain the process that you are doing?"*
S3 : *"By drawing the coordinate and placing a known point and subtracting it."*
R : *"Did you examining your answer?"*
S3 : *"No."*
R : *"Why didn't you?"*
S3 : *"Because I think my answer is correct."*

From the results and interviews with S3 above, it is known if student not write what was known and asked with quibble to quickly solve the problem. S3 is not able to answer correctly. It can be seen on the researcher's interviews above, S3 doesn't take the coordinates that known because want to use the step solution that has been think before. It's using subtraction to the points that known for get the answer from question number 2. The correct solution strategy for the problem should be take the point has been known then use elimination or substitution strategy. Student do not use that strategy because she feels the way she used is correct. Student not examining her steps and results that has been obtained because she feels that they are correct.

From the previous explanation, it can be concluded that S3's error in the steps of understanding problem, formulating a plan, carrying a plan, and examining answer. Acoording to Polya, S3 still has a mistake in the first step of understanding problem. So, S3 has an error at stage "problem to find". S3 also had an error at stage of "problem to prove", then as a result, S3 is unable to continue her work to the next phase of formulating a plan, carrying a plan, and examining answer.

Based on the researcher result above, the researcher can conclude if S3 lack in understanding the material. According to the information that obtained by the researcher, the process of learning is done via online using Power Point (PPT), so S3 is lack of a comprehensive knowledge related to the material and lack of an understanding of important points of the material.

B.   Discussion

Based on the discussion results of the three subjects above, it can conclude that the three subjects had an error of understanding problems, formulating a plan, carrying a plan, and examining answers. This is coincides with the results of the study that the most errors of the subject have four stages [6]. It's stage of reading, understanding problems, problem transformations, and writing the final answer. As with previous studies, errors from the three subjects appeared in this research [5]. The following diagram shows the percentage of the subject's error stage.
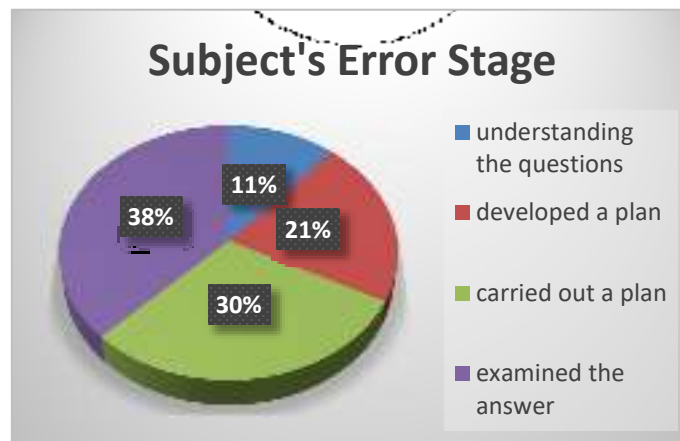

Figure 7. Diagram of Subject's Errors Stage

The errors of the three subjects in understanding the problem were also seen in the results of other studies. The results of this study indicate that the most frequent errors made by students are conceptual errors [7]. Conceptual errors were a mistake in determining a formula, theorem or definition. Subjects with high, medium, and low mathematical abilities, incorrectly determine formulas, theorem or definitions. The errors were obtained from the subject's answer who was wrong in writing the coordinates, determining the value of x and y at the coordinate point, and the error in using the concept of reference point. The results of this study are similar to the results of research which states that students' mistakes in solving a problem can be a benchmark between students' understanding of the material being taught [10]. Therefore, a detailed analysis of errors of the student is needed so that error and factors can be known and find the solutions. Researchers offer a solution for teachers, during pandemic teacher need to vary a model of student teaching or learning style. A learning model should be directed to online learning by making a video or the other so it makes students easier to capture the material that given.

CONCLUSION

Based on the results of data analysis from the research that has been done, it can be concluded that the three subjects experienced errors in 4 steps, namely understanding the problem, making plans, implementing plans, and checking answers. Because the three subjects made mistakes in the first step of understanding the problem, according to Polya, they all had problems in the "problem to find" step and then they also had problems in the "problem to prove" step. As a result, they all cannot continue their work to the next stage, namely making plans, carrying out plans, and checking answers. The cause of these three errors is that the subject cannot understand the concept or material properly because the learning process is carried out online using Power Point (PPT), so students lack

comprehensive knowledge regarding the material. The material and the lack of understanding of the important points of the Cartesian Coordinates material. the inability of students to understand this concept is also experienced by most students in the class which results in low student scores in the class. so that teachers need to innovate learning to overcome learning in Cartesian material.

For the benefit of further research, it is hoped that more in-depth research can be developed on the analysis of student errors in Polya's step math story using different materials and also at different levels of this research. For example, subjects for grades IX, X, XI, and XII to add insight to readers.

REFERENCE

[1] Amir, M. F. (2015). Proses Berpikir Kritis Siswa Sekolah Dasar Dalam Memecahkan Masalah Berbentuk Soal Cerita Matematika Berdasarkan Gaya Belajar. *Jurnal Math Educator Nusantara*, 1(2), 159–170.

[2] Andriani, T., Suastika, I. K., & Sesanti, N. R. (2017). Analisis Kesalahan Konsep Matematika Siswa dalam Menyelesaikan Soal Trigonometri Kelas X TKJ SMKN 1 Gempol Tahun Pelajaran 2016/2017. *Pi: Mathematics Education Journal*, 1(1), 34–39. https://doi.org/10.21067/pmej.v1i1.1998

[3] Anshori, M. T. (2018). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita Materi Perbandingan di Kelas VII SMP. *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa*, 7(1), 1–10.

[4] Faizah, H., & Sugandi, E. (2022). Analisis Kemampuan Komunikasi Matematis Tulis Siswa SMP Pada Soal Cerita Bentuk Aljabar Dalam Pembelajaran Daring. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 11(1), 291–304.

[5] Fauziyah, R. S., & Pujiastuti, D. H. (2020). Analisis Kesalahan Siswa dalam Menyelesaikan Soal Cerita Program Linear Berdasarkan Prosedur Polya. *UNION: Jurnal Pendidikan Matematika*, 8(2), 253–264.

[6] Fitriatien, S. R. (2019). Analisis Kesalahan Dalam Menyelesaikan Soal Cerita Matematika Berdasarkan Newman. *JIPMat*, 4(1). https://doi.org/10.26877/jipmat.v4i1.3550

[7] Fitriyah, I. M., Pristiwati, L. E., Sa'adah, R. Q., Nikmarocha, N., & Yanti, A. W. (2020). Analisis Kesalahan Siswa dalam Menyelesaikan Soal Cerita Koordinat Cartesius Menurut Teori Kastolan. *Al-Khwarizmi: Jurnal Pendidikan Matematika Dan Ilmu Pengetahuan Alam*, 8(2), 109–122. https://doi.org/10.24256/jpmipa.v8i2.1002

[8] Jana, P. (2018). Analisis Kesalahan Mahasiswa Dalam Menyelesaikan Soal Matematika Pada Pokok Bahasan Vektor. *Jurnal Mercumatika : Jurnal Penelitian Matematika Dan Pendidikan Matematika*, 2(2), 8. https://doi.org/10.26486/jm.v2i2.398

[9] Jannah, U. (2013). Teori dienes dalam pembelajaran matematika. *Interaksi*, 8(2), 126–131.

[10] Katon, K. S. & Arigiyati, T. A. (2018). *Analisis kesalahan siswa menurut polya materi persamaan dan pertidaksamaan linear satu variabel.* Paper presented at the

Seminar Nasional Pendidikan Matematika Etnomatnesia, 576–580.

[11] Lusiana, R. (2017). Analisis Kesalahan Mahasiswa Dalam Memecahkan Masalah Pada Materi Himpunan Ditinjau Dari Gaya Kognitif. *Jurnal Penelitian Dan Pembelajaran Matematika*, *10*(1), 24–29. https://doi.org/10.30870/jppm.v10i1.1290

[12] Noor, A. J. (2014). Kemampuan Pemecahan Masalah Matematika Siswa Dalam Pembelajaran Matematika Menggunakan Model Cooperative Script. *EDU-MAT Pendidikan Matematika*, *2*, 250–259.

[13] Faizah, H. (2019). Pemahaman mahasiswa tentang konsep grup pada mata kuliah struktur aljabar. *MUST: Journal of Mathematics Education, Science and Technology*, 4(1), 23-34.

[14] Rahmania, L., & Rahmawati, A. (2016). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita Persamaan Linier Satu Variabel. *Jurnal Matematika Dan Pendidikan Matematika*, *1*(2), 165–174.

[15] Rofi'ah, N., Ansori, H., & Mawaddah, S. (2019). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita Matematika Berdasarkan Langkah Penyelesaian Polya. *EDU-MAT: Jurnal Pendidikan Matematika*, *7*(2), 120. https://doi.org/10.20527/edumat.v7i2.7379

[16] Sholiha, S. Z., & Afriansyah, E. A. (2017). Analisis Kesulitan Siswa Dalam Proses Pemecahan Masalah Geometri Berdasarkan Tahapan Berpikir Van Hiele (Penelitian Studi Kasus di Kelas VII SMP Negeri 6 Garut). *Jurnal "Mosharafa," 6*(2), 287–298.

[17] Utari, D. R., Wardana, M. Y. S., & Damayani, A. T. (2019). Analisis Kesulitan Belajar Matematika dalam Menyelesaikan Soal Cerita. *Jurnal Ilmiah Sekolah Dasar*, *3*(4), 545. https://doi.org/10.23887/jisd.v3i4.22311

[18] Sari, I. W. (2018). Analisis Kesalahan Mahasiswa Dalam Menyelesaikan Soal Trigonometri Berdasarkan Kriteria Watson. *Jurnal Widyaloka Ikip Widya Darma 5*(2), 139–146.