International Journal on Emerging Mathematics Education (IJEME)
Vol. 6, No. 1, March 2022, pp. 15-28
P-ISSN: 2549-4996, E-ISSN: 2548-5806, DOI: http://dx.doi.org/10.12928/ijeme.v6i1.21062

Analyzing Students' Problem-Solving Ability Based on Mathematics Disposition During the Covid-19 Pandemic

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Abstract

One of the psychological factors that affect problem solving ability is mathematical disposition. Students need a positive mathematical disposition that will make them persistent in facing problems and developing good habits in learning mathematics. The condition of Covid-19 outbreak emphasizes the importance of positive mathematical disposition and good problem solving skills. This study aims at describing students' mathematical problem-solving skills based on mathematical dispositions during the Covid-19 Pandemic. This research belongs to a qualitative descriptive study that involved 27 students in the fourth semester as the research subject. The research data were collected from questionnaires, test descriptions, and interviews. The questionnaire results were used to categorize students' mathematical dispositions. It was followed by an interview with two students selected from each group of mathematical disposition categories**.** The results of tests and interviews were analyzed based on the category of students' mathematical dispositions. The results of this study showed the three categories of students' mathematical dispositions i.e high, moderate, and low. The students with high mathematical dispositions show good mathematical problem-solving skills because they can perform all indicators of mathematical problem-solving abilities. The students of moderate mathematical disposition were only able to perform the 2-3 indicators. The students of the low mathematical disposition category only fulfilled the 1-2 indicators.

Keywords: Covid-19 pandemic, mathematical disposition, problem-solving ability

How to Cite: Husna, A., & Hanggara, Y. (2022). Analyzing Students' Problem-Solving Ability Based on Mathematics Disposition During the Covid-19 Pandemic. *International Journal on Emerging Mathematics Education, 6*(1), 15-28. http://dx.doi.org/10.12928/ijeme.v6i1.21062

INTRODUCTION

Currently, the required competencies among students are getting higher where students are demanded to master various competencies/skills known as the 4C, i.e. critical thinking, creativity, communication, and collaboration (Fridanianti, Purwati, & Murtianto, 2018). Another crucial aspect is problem-solving skills (Apriadi, Elindra, & Harahap, 2021; Husna, Hanggara & Agustyaningrum, 2020; Yogi, 2015). Problem-solving refers to the process of finding a solution to a problem with prior knowledge (Muniroh & Nursyahidah, 2020). An individual with good problem-solving skills will be able to face the increasingly rapid developments in this 21st century.

Problem-solving skills can be developed through mathematics learning, which trains critical thinking and reasoning skills (Sumartini, 2015). Mathematics focuses on the analytical ability that is needed to solve day-to-day problems, one of which is related to economic things (Marlina & Ruhiat, 2018). In particular, problem-solving for economics include in the mathematical economics courses as an approach or method to solve financial problems using mathematical symbols and logic.

As the crucial role of mathematics, it should be mastered by students. It is in line with the claim (Rosita & Yuliawati, 2016) which states that the ability of mathematical problem solving is important because it can assist to solve problems in everyday life.

Received July 9, 2021; Revised February 24, 2022; Accepted May 21, 2022

The problem-solving skills obtained in a mathematics lesson can generally be transferred in solving other problems (Agustina, 2016). The steps of problem-solving according to Polya (Noriza, Kartono, and Sugianto, 2015) consist of understanding the problem, planning the solution, solving the problem based on the plan, re-checking all the steps that have been taken.

Based on the results of tests conducted by two international studies, namely Trends in International Mathematics and Science Study (TIMSS) and Programming for International Student Assessment (PISA), it is found that the ability to solve mathematical problems in Indonesia is relatively still low. In 2015, the average score obtained by Indonesia was 397 in 44th ranking out of 49 participating countries. At the higher education, students' problem-solving skills are also relatively low. Based on these results, the ability to solve mathematical problems needs serious attention. This condition is also strengthened by the results of the study (Wilujeng, 2018) that students' problem-solving ability is limited influenced by several factors including the learning process that gives a little portion on problem-solving abilities. Similarly, (Fauziah & Sukasno, 2015) state that the learning process is the main culprit for the unsatisfactory student learning outcomes related to their problem-solving skills. In addition, the provided exercises just seem routine and procedural models that is failed to actively involve students in problem-solving activities. This circumstance makes the student's reasoning ability and thinking skills are not effectively trained (Husna, Ikhsan, & Fatimah, 2012).

Besides cognitive factors, there are also psychological factors that affect one's a problem-solving ability called mathematical disposition. Students need a positive mathematical disposition that will make them persistent in facing problems and developing good attitudes in mathematics learning (Rosita & Yuliawati, 2016). Mathematical disposition is an interest and appreciation for mathematics to think and act positively including self-confidence, curiosity, perseverance, learning enthusiasm, persistency, flexibility, social sharing, and reflection activities (Wardani, 2009). Someone with a high productive disposition tends to be able to develop their mathematical skills in terms of conceptual understanding, procedural fluency, strategic competence, and adaptive reasoning. (Widjajanti, 2009).

Several aspects of mathematical disposition (NCTM, 2000) include (1) confidence in solving math problems, communicating ideas, and giving reasons; (2) flexibility in exploring mathematical ideas and trying various alternative methods to solve problems; (3) strong determination to complete mathematical tasks; (4) interest, curiosity, and ability to learn mathematics; (5) tendency to monitor and reflect one's thinking process and performance; (6) assessing the mathematics application in other fields and everyday life; and (7) appreciating the role of mathematics in culture and its value, both as a tool, and a language. Based on the preceding description, the aspects of mathematical disposition in this study comprise 1) confidence in math problems-solving, 2) self-ability, 3) curiosity, 4) perseverance, 5) flexibility, and 6) reflection in mathematical activity.

The current Covid-19 pandemic has a direct effect on educational activities that emphasize the distance learning system (online learning) referring to the circular letter No. 15 of 2020 issued by the Indonesian Ministry of Education and Culture regarding guidelines for organizing learning from home during the Covid-19 emergency. Online learning is an alternative solution that can be done during this outbreak (Basilaia & Kvavadze, 2020; Taha et al., 2020). The application of online learning is practical that can be done anytime and anywhere (Means, 2010; Zyurt, et

al., 2013; Nakamura, et al., 2018). However, the online learning that is currently taking place experiences many obstacles, such as the low learning enthusiasm among students since they only face the laptop screen/ handphone and often turn off the camera. In addition, teachers cannot directly monitor student activities during the learning process (Fathonah & Bukhori, 2021). As many as 85.25% of students find it difficult to understand mathematical material that, surely, affects the ability to mathematical problems-solving (Kharisma, Roesminingsih, & Suhanadji, 2020).

Several studies on mathematical problem solving during the COVID-19 pandemic have been done including (Muniroh & Nursyahidah, 2020) in terms of impulsive cognitive style, (Apriadi, Elindra & Harahap, 2021) before and after the Covid-19 pandemic, and related to students' autonomy (Harisudin, 2021). It appears that very few researchers were reported the analysis of mathematical problem-solving in terms of mathematical disposition on today's condition of the outbreak. This study is done to describe problem-solving abilities in terms of mathematical disposition during the Covid-19 pandemic.

RESEARCH METHOD

This research belongs to qualitative research. The sample was selected using the purposive sampling technique. The subjects of this study involved 27 students of the fourth semester in the academic year of 2020/2021. The research instruments included questionnaires, tests, and interview guidelines. The questionnaires were to categorize students' mathematical dispositions. Based on the questionnaire results, they can be grouped into three categories of mathematical disposition – high, medium and low. The results of this study were in the form of a description of students' mathematical problem-solving skills during the Covid-19 pandemic in completing tests of mathematical disposition. Based on the questionnaire results, 2 students can be categorized as high, 2 students as moderate, and the other 2 students as low category, respectively, as shown in Table 1.

The selected research subjects were then asked to take a written test to measure their mathematical problem-solving skills. After the test was completed, it was followed with interviews on each subject. The results of the written test and interviews session proceeded for data analysis. The results were explored based on the indicators of mathematical problem-solving skills including understanding the problem, planning the solution, solving the problem, re-checking all the steps that had been taken. Furthermore, the data were analyzed based on the category of the subject's mathematical disposition and problem-solving skills.

Table 1. list of the research sujects

Name	Subject code	Category
KS	S1	High
PMA	S2	High
YN	S3	Moderate
ABP	S4	Moderate
N	S5	Low
AC	S6	Low

The data analysis technique in this study referring to Miles and Huberman in Sugiyono (2013: 246) of which three stages in analyzing qualitative data, i.e. the reduction stage, the data presentation stage, and data verification.

RESULTS AND DISCUSSION

Description of Student Mathematical Disposition

Based on the results of the mathematical disposition questionnaire, the categories of students based on mathematical dispositions can be presented in Table 2.

Tabel 2. Categories of Student Mathematical Disposition

Subject	Scores	Students		Categories
		Number	Percentage	
HMD	77-86	5	18.52	High
MMD	67-76	14	51.85	Moderate
LMD	57-66	8	29.63	Low

HMD: High Mathematics Disposition
MMD: Moderate Mathematics Disposition
LMD: Low Mathematics Disposition

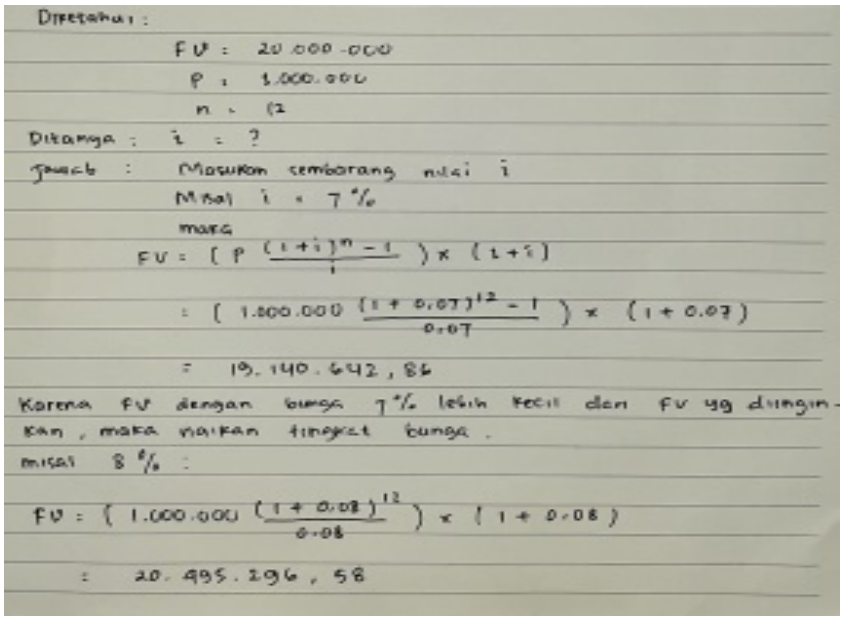
Table 2 above shows the categories of high mathematical disposition with 5 students (18.52%), moderate mathematical disposition with 14 students (51.85%), and low mathematical disposition with 8 students (29.63%), respectively. It indicates that most of the students are in the moderate category of mathematical disposition.

Description of Student Problem Solving Skills in Exercise 1

Exercise 1

By saving IDR 1,000,000 every month, Dina hopes to earn IDR 20,000,000 in a year. How much deposit is required if Dina expects IDR 30,000,000 at the end of the first year?

Figure 1 is the answer from the students with the high mathematical disposition category in Exercise 1.



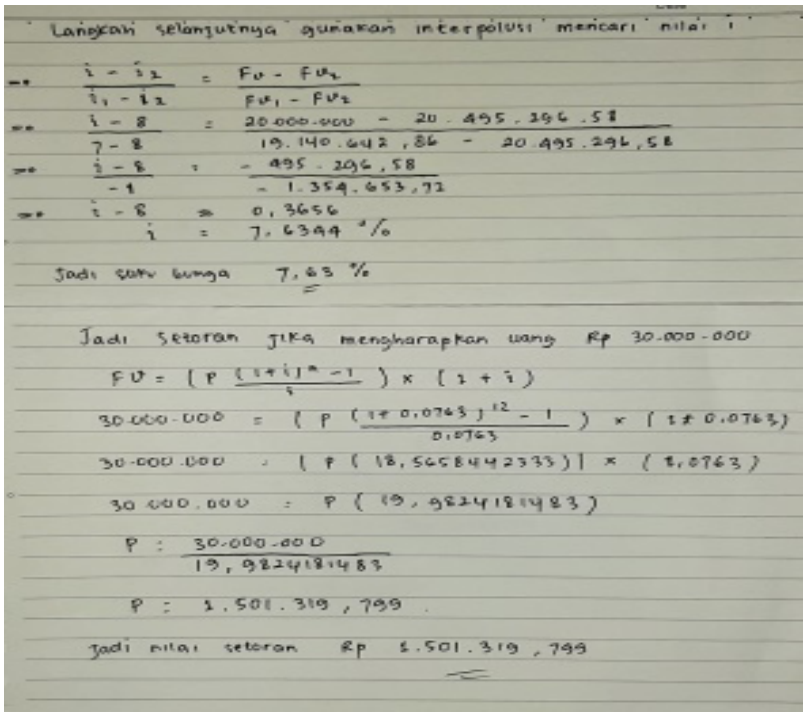


Figure 1. The answer of students with the high mathematical disposition category

KS who had a high mathematical disposition was able to solve problems in the exercise well. KS students wrote the answers completely according to the asked indicators. Starting from the indicator of understanding the problem, KS could understand the problem by writing down what was known and asked in the question. In the indicator of planning problem solving, KS made plans according to the questions. After the indicators of the solution plan, KS met the indicators of the problem-solving based on what had been planned in the previous stage and made correct calculations to present the correct answer. Then, on the last indicator i.e re-checking all the steps that had been done, KS re-examined the results by writing down the results that had been done. KS had shown other ways to solve problems. Based on answers and interviews, KS convinced that the answer was correct by linking the obtained answers with his knowledge on the problem. It is consistent with the interview excerpt below.

P : Do you understand this question?
KS : Yes, I do.
Q : How could you come up with this answer?
KS : Calculating future annuity is same as the current annuity calculation. It means that the interest rate charged for a future annuity can be measured like the current annuity calculation, i.e. (1) finding 2 bigger PV scores and the smaller scores than the desired PV scores. It can be done by entering any value of i into the current value formula of the annuity. If the PV value is greater, the interest rate should be increased to get a lower PV value, and vice versa; (2) After obtaining the interest rate that produces larger and smaller PVs, it will be followed with interpolation.

Figure 2 shows the answer from the students with the moderate mathematical disposition category in Exercise 1.

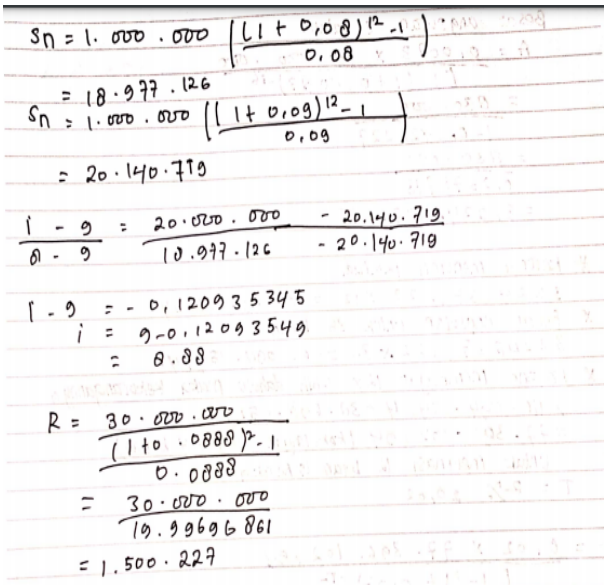


Figure 2. The answer of students with moderate mathematical disposition category

YN who belonged to the moderate mathematical disposition category had not fulfilled the indicators of the problem understanding because he/she did not write down what was known and asked in the problem. In the indicator of planning the solution, YN could do well based on what was known in the problem. In the third indicator of solving the problem, YN was incomplete in solving problems because did not write down the calculation process to get the value of I (interest) by 0.0889. It made the overall results of YN answers were incomplete. In the last indicator of re-checking all the steps that had been taken, YN wrote down the results of the answers. YN had not found yet another way to solve this problem. Based on the answers and interviews, overall, YN was still hesitant to convince that his/her answer was correct. YN had not been able to prove the answer even though the answer was partially correct. It agrees with the interview excerpt below.

Q : What did you consider to answer like this?
YN : The information given on the questions has already been discussed.
Q : How could you come up with this answer?
YN : The savings case is a future annuity application, so I use the future annuity formula by finding the interest rate first.
Q : Did you find it hard to finish it?
YN : I answered based on my understanding, though there seems to be something wrong.

Figure 3 presents the answer from the students with the low mathematical disposition category in Exercise 1. In answering question number 1, N tended to be failed to solve the problem in the test item, because N had not correctly and completely written down what was known and asked about the question. In the indicator of planning problem-solving, N made plans to solve the problem by writing the formula for finding the the-n term in the arithmetic series and the written plan was not in accordance with the problem because the written formula should be related to the concept of the annuity. In the indicator of solving the problem according to the plan, N was able to work on the solution correctly even though it was not in line with the annuity concept since it appeared that the answers from N student were still incorrect due to errors in using the formula. In the indicator to re-checking all the

steps that had been taken, N student made conclusions from the answers that had been done. N, actually, found another way to solve this problem, but it was not in the right way.

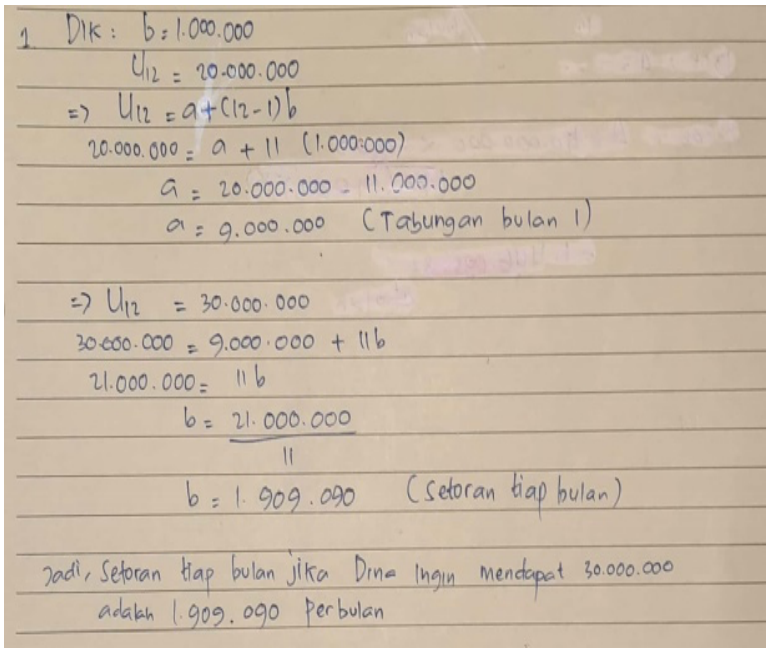


Figure 3. The answer of the students with the low mathematical disposition category

Based on the interview, N was not been able to prove whether the answer was wrong or right. . It is supported with the interview excerpt below.

Q : What did you do to solve this problem?
N : I try to understand the problem, but it is difficult.
Q : What did you imagine or think so you could present to an idea like this?
N : I try to remember what has been taught.
Q : Are you sure with your answer?
YN : No, I'm not sure.

Description of Student Problem Solving Skills in Exercise 2

Exercise 2

Ani is willing to pay her debt of IDR. 100,000,000 in installments at the end of every month for 3 years with an interest of 10% p.a, if after 12 installments. Ani plans to accelerate the repayment from 3 years to 2 years, how much installment should be paid for 12 years if the lender increases the interest by 2% in the following month?

Figure 4 shows the answer from the students with the high mathematical disposition category in Exercise 2.

In the indicators of understanding the problem, PMA who held a high mathematical disposition category did not write down what was known and asked in the exercise. In the indicator of planning problem-solving, PMA made plans based on what was asked in the question. After the indicators of planning the solution, PMA was able to fulfill the indicators of solving the problem based on what had been planned in the previous stage and performed correct calculations to make sure the correct answer.

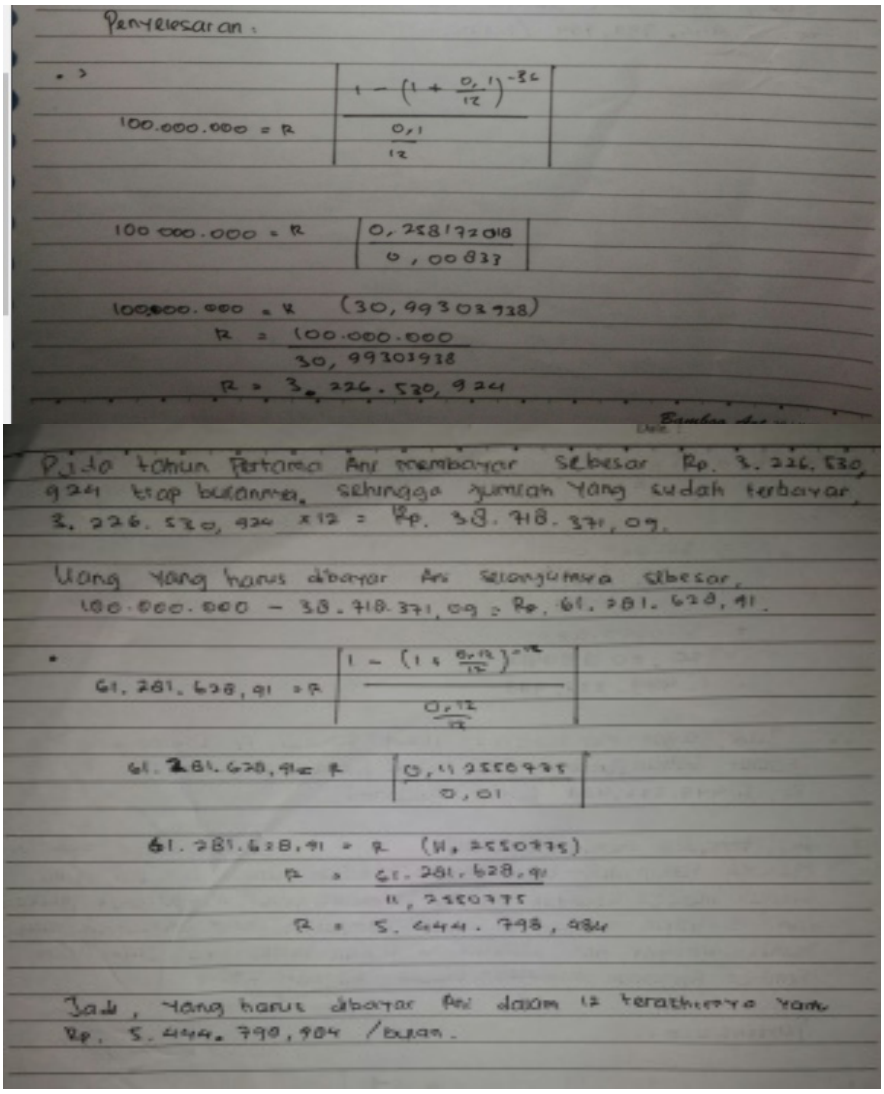


Figure 4. The answer of the students with the high mathematical disposition category

In the last indicator of re-checking all the steps that had been done, PMA students re-examined his/her answers by writing down the results of what had been done. Based on the answers and the interviews results, PMA showed his/her ability to prove the answer was correct, and the reason why PMA students did not write down what was known and asked in the questions because she/he was in a hurry and worried about the limited time. PMA was able to completely and correctly explain what was known and asked in the questions.

Figure 5 below shows the answer from the students with the moderate mathematical disposition category in Exercise 2.

ABP students who belonged to moderate mathematical disposition category had fulfilled the indicators of understanding the problem because he/she was able to write down what was known and asked in the exercise. In the indicator of planning the solution, ABP could make plans based on what was known in the problem. In the third indicator, i.e solving the problem, ABP student was failed to calculate the 2% interest

increase from the initial 10% interest into 12% but ABP calculated only 2% according to the interest increase, so overall the results of ABP answers were partially correct.

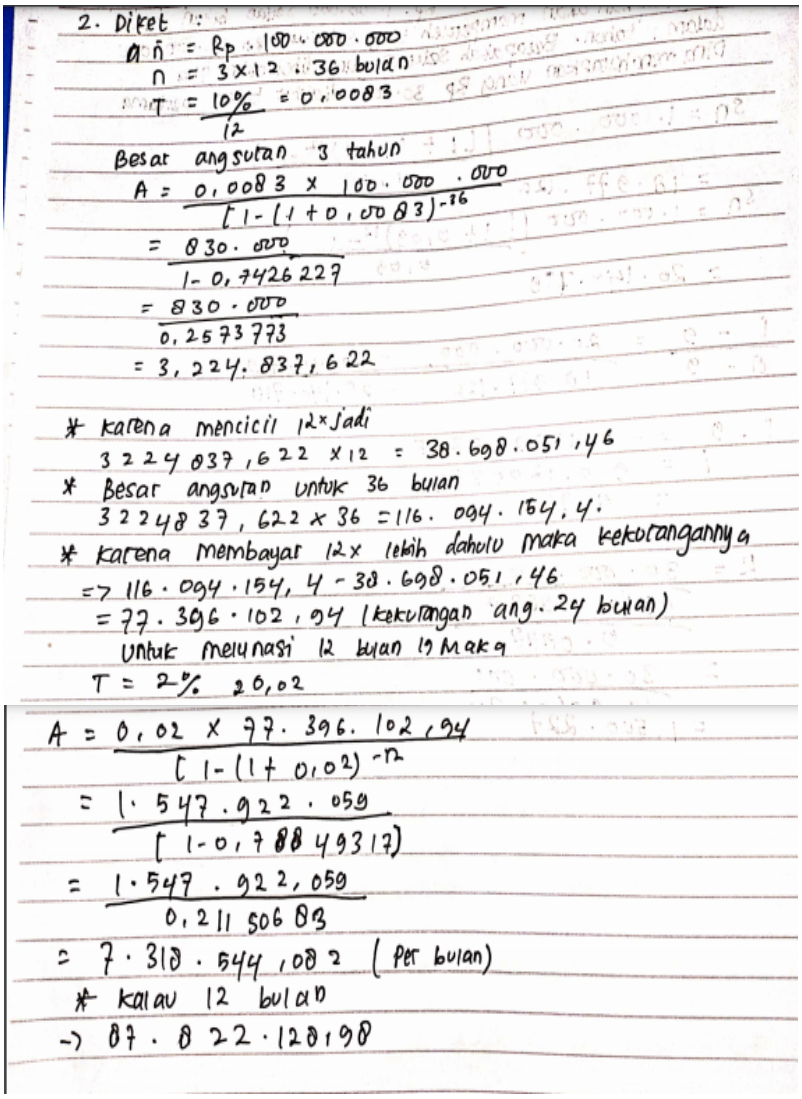


Figure 5. The answer of students with moderate mathematical disposition category

In the last indicator of re-checking all the steps that had been done, ABP rewrote the results of the answers. Based on the answers and the interviews session, ABP could only explain the answers partially and was not sure whether the answer was correct or incorrect.

Figure 6 below presents the answer from the students with the low mathematical disposition category in Exercise 2.

In answering the exercise number 2, AC students tended to be failed to solve problems in questions because she/he did not write down what was known and asked in the test item. In the indicator of planning problem solving, AC students made plans to solve problems based on the questions. In the indicator of solving the problem according to the plan, AC students had not been able to correctly work on the solution because of the inappropriate formula in calculating the amount of interest after experiencing an increase of 2% from the initial interest of 10%. It made the overall

problem-solving results were wrong. In the indicator of re-checking all the steps that have been done, AC made conclusions from his/her answers. Based on the answers and interviews session, AC admitted that she/he was still confused and unsure in explaining the solution to the questions item.

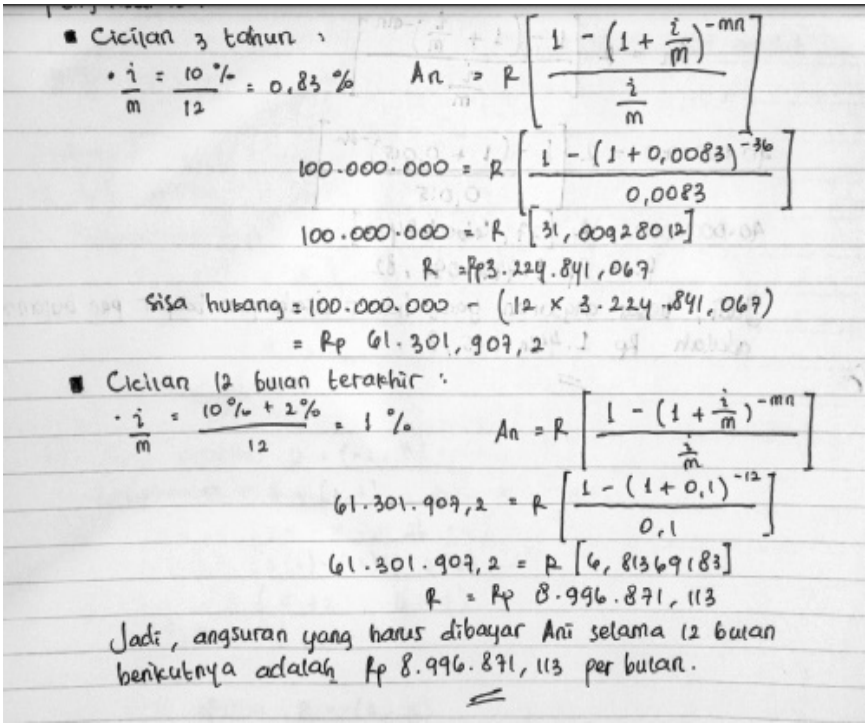


Figure 6. The answer from students with the low mathematical disposition category

Based on the results that have been described, it is obtained that students with high mathematical dispositions can fulfill the four problem-solving indicators and are confident in solving the problems. Students who have a high optimistic mathematical disposition category can overcome difficulties in solving mathematical problems (Muflihatususubriyah, et al, 2021; Hamidah & Prabawati, 2019). If students have a high mathematical disposition, they will own high mathematical problem-solving skills. It is consistent with the claim (Dinia, et al, 2019; Mahmuzah, Ikhsan, & Yusrizal, 2014) that a student who looks more persistent and tenacious in dealing with math problems will be more challenging and more responsible for their learning process and show good attitude in mathematics learning.

Students with moderate mathematical disposition category are only able to fulfill 2 to 3 problem-solving indicators though those are still incomplete. The students in this category show some correct and wrong answers because they only write general answers and misinterpret the questions, but they are still trying to solve the problem which is in line with the findings (Rosita & Yuliawati, 2017; Akbar et al, 2018). Students who have a mathematical disposition are having difficulty in explaining and interpreting the given questions since they are not accustomed to writing down the information contained in the questions and tend to solve problems directly. They think that there is no need to write down the completion steps because it is just wasting time (Akbar, et al, 2018; Karlimah, 2015). In addition, students experience difficulty to

enter the data within the written formulas, and they are also less careful in completing the calculations.

Overall, the students of the low mathematical disposition category are failed to solve the problems in the given questions and they write down the answers as best as they can. It indicates that they are only able to fulfill 1-2 indicators of problem-solving which are still incomplete. It is similar to the previous results (Khoiriyah, 2018; Hajar & Sari, 2018). The students who have a low mathematical disposition feel unsure of their answers because they find it difficult to solve the problems. Moreover, they are inaccurately in reading questions, thinking, analyzing problem analysis, and calculating (Aliah et al, 2020; Wanabuliandari, 2016). The students with low mathematical dispositions can be seen from the lack of persistence in solving problems. The positive attitude among students towards mathematics is one of the success factors in the learning process (Diningrum, Azhar, & Faradillah, 2018).

Therefore, teachers or lecturers need to know the aspects of the mathematical disposition among students or students problem-solving skills in order to know the extent to which students can understand the material, and map the problems faced by students or students to develop learning that is appropriate with their needs during the Covid-19 Pandemic.

CONCLUSION

Based on the research results and discussion, it can be concluded that the students' mathematical dispositions are divided into three categories, high mathematical dispositions with 18.52%, moderate mathematical dispositions with 51.85%, and low mathematical dispositions with 29.63%, respectively. The students who belong to have high mathematical dispositions can meet all indicators of mathematical problem-solving abilities. The students with moderate mathematical disposition fulfill 2-3 indicators of mathematical problem-solving abilities but write it down incompletely. Students with the low mathematical disposition category are only able to meet 1-2 indicators of mathematical problem-solving skills and they write it down incompletely and still experience errors in calculations.

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